



Digital transformation: a review, synthesis and opportunities for future research

Swen Nadkarni¹ · Reinhard Prügl¹

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Abstract

In the last years, scholarly attention was on a steady rise leading to a significant increase in the number of papers addressing different technological and organizational aspects of digital transformation. In this paper, we consolidate existing findings which mainly stem from the literature of information systems, map the territory by sharing important macro- and micro-level observations, and propose future research opportunities for this pervasive field. The paper systematically reviews 58 peer-reviewed studies published between 2001 and 2019, dealing with different aspects of digital transformation. Emerging from our review, we develop inductive thematic maps which identify technology and actor as the two aggregate dimensions of digital transformation. For each dimension, we derive further units of analysis (nine core themes in total) which help to disentangle the particularities of digital transformation processes and thereby emphasize the most influential and unique antecedents and consequences. In a second step, in order to assist in breaking down disciplinary silos and strengthen the management perspective, we supplement the resulting state-of-the-art of digital transformation by integrating cross-disciplinary contributions from reviewing 28 papers on technological disruption and 32 papers on corporate entrepreneurship. The review reveals that certain aspects, such as the pace of transformation, the culture and work environment, or the middle management perspective are significantly underdeveloped.

Keywords Digital transformation · Digital disruption · Technological disruption · Corporate entrepreneurship · Literature review · Research agenda

JEL Classification M10

✉ Swen Nadkarni
s.nadkarni@zeppelin-university.net
Reinhard Prügl
reinhard.pruegl@zu.de

¹ Chair of Innovation, Technology & Entrepreneurship, Zeppelin University, Am Seemooser Horn 20, 88045 Friedrichshafen, Germany

1 Introduction

Digital transformation, defined as transformation ‘concerned with the changes digital technologies can bring about in a company’s business model, ... products or organizational structures’ (Hess et al. 2016, p. 124), is perhaps the most pervasive managerial challenge for incumbent firms of the last and coming decades. However, digital possibilities need to come together with skilled employees and executives in order to reveal its transformative power. Thus, digital transformation needs both technology and people. In the last years, scholarly attention, particularly in the information systems (IS) literature, was on a steady rise leading to a significant increase in the number of papers addressing different technological and organizational aspects of digital transformation. In the light of this development, we are convinced it is the right time to map the territory and reflect on the current state of knowledge. Therefore, in this paper we aim at providing a descriptive, thematic analysis of the field by critically assessing where, how and by whom research on digital transformation is conducted. Based on this analysis, we identify future research opportunities.

We approach this objective in two steps. First, we adopt an inductive approach and conduct a systematic literature review (following Tranfield et al. 2003; Webster and Watson 2002) of 58 peer-reviewed papers dealing with digital transformation. By applying elements of grounded theory and content analysis (Corley and Gioia 2004; Gioia et al. 1994) we identify important core themes in the literature that are particularly pronounced and/or unique in transformations enabled by digital technologies. In a second step, in order to assist in breaking down disciplinary silos (Jones and Gatrell 2014) and avoiding the building of an ivory tower (Bartunek et al. 2006; Fuetsch and Suess-Reyes 2017), we supplement the pre-dominantly IS-based digital transformation literature with a broader management perspective. Accordingly, we integrate cross-disciplinary contributions from reviewing 28 papers on technological disruption and 32 papers on corporate entrepreneurship.

We find these research fields particularly suitable for informing digital transformation research for two reasons. First, by reviewing the literature on technological disruption we hope to derive implications regarding technology adoption and integration. Burdened with the legacy of old technology, bureaucratic structures and core rigidities (Leonard-Barton 1992), incumbents may face major challenges in this respect during their digital transformation journey. Second, we expect corporate entrepreneurship to add a more holistic perspective on firm-internal aspects during the process of transformation, such as management influence or the impact of knowledge and organizational learning.

Our findings and related contributions are threefold: First, based on a systematic and structured analysis we develop digital transformation maps which inductively categorize and describe the existing body of research. These thematic maps identify technology and actor as the two aggregate dimensions of digital transformation. Within these dimensions, we reveal nine core themes which help to disentangle the particularities of digital transformation processes and thereby

emphasize the most influential and unique antecedents and consequences of this specific type of transformation. Thus, it becomes possible to identify the predominant contextual factors for which research would create the strongest leverage for a better understanding of the challenges inherent in digital transformation. Second, we contribute to the advancement of this field by elaborating opportunities for future research on digital transformation which integrate the three perspectives mentioned above. In particular, informed by corporate entrepreneurship, we find that the important middle management perspective on digital transformation has thus far been largely neglected by researchers. Also, emerging from our review we call for more studies on the various options for integrating digital transformation within organizational architectures and existing processes. Third, in reviewing the adjacent literature on technological disruption and corporate entrepreneurship, we strengthen the valuable management perspective within the primarily IS-based discussion on digital transformation. This way we avoid the reinvention of the wheel while at the same time enable the identification of cross-disciplinary research opportunities. We hope to stimulate discussion between these different but strongly related disciplines and enable mutual learning and a fruitful exchange of ideas.

2 Conceptual foundations

Technology as a major determinant of organizational form and structure has been well acknowledged by academics for a long time (Thompson and Bates 1957; Woodward 1965; Scott 1992). Following a significant decline of interest in this relationship until the mid-1990s (Zammuto et al. 2007), innovations in information technologies (IT) and the rise of pre-internet technologies have revitalized its relevance in the context of organizational transformation. Thus, the literature on IT-enabled organizational transformation, a concept which originates from the field of information systems (IS) that has caught considerable academic attention starting back in the early 1990s (Ranganathan et al. 2004; Besson and Rowe 2012), may be seen as one of the scholarly roots of digital transformation research. In his seminal book, Morton (1991) argued that companies must experience fundamental transformations for effective IT implementation. In the course of the years a shift of attention occurred from technological to managerial and organizational issues (Markus and Benjamin 1997; Doherty and King 2005). Non-technological aspects such as leadership, culture, and employee training were found to be equally important for successful IT-enabled transformation (Markus 2004). This is supported by Orlikowski (1996) who found empirical evidence from a 2-year case study that organizational transformation was in fact enabled by technology, but not caused by it.

Today, information technologies have become ‘one of the threads from which the fabric of organization is now woven’ (Zammuto et al. 2007, p. 750). Digital technologies are considered a major asset for leveraging organizational transformation, given their disruptive nature and cross-organizational and systemic effects (Besson and Rowe 2012). In order to achieve successful digital transformation, changes must occur at various levels within the organization, including an adaptation of the core

business (Karimi and Walter 2015), the exchange of resources and capabilities (Cha et al. 2015; Yeow et al. 2018), the reconfiguration of processes and structures (Resca et al. 2013), adjustments in leadership (Hansen and Sia 2015; Singh and Hess 2017), and the implementation of a vivid digital culture (Llopis et al. 2004). Therefore, the scope of our review revolves around digital transformation at the organizational level only (in contrast to implications at the individual level).

In this study, we conceptualize digital transformation at the intercept of the adoption of disruptive digital technologies on the one side and actor-guided organizational transformation of capabilities, structures, processes and business model components on the other side. In other words, and in line with Hess et al. (2016), we define digital transformation as organizational change triggered by digital technologies. Hence, we argue that two perspectives of digital transformation within organizations must be captured: a technology-centric and an actor-centric perspective. To exploit the technology-centric perspective we include the literature on technological disruption (e.g. Tushman and Anderson 1986; Anderson and Tushman 1990) and merge it with research on digital transformation. For the actor-centric perspective, we derive essential implications from the field of corporate entrepreneurship (Guth and Ginsberg 1990), which we believe may add valuable insights regarding actor-driven innovation and renewal processes within firms. In the following, we offer a brief introduction to both concepts and their relationship with digital transformation.

Rice et al. (1998) define disruptive innovations as ‘game changers’ which have the potential ‘(1) for a 5–10 times improvement in performance compared to existing products; (2) to create the basis for a 30–50% reduction in costs; or (3) to have new-to-the world performance features’ (p. 52). Similarly, Utterback (1994) emphasizes this disruptiveness at the firm and industry level and provides a similar ‘game changer’ definition in terms of ‘change that sweeps away much of a firm’s existing investment in technical skills and knowledge, designs, production technique, plant and equipment’ (p. 200). Tushman and Anderson (1986) distinguish between product and process disruptiveness. Product disruptiveness encompasses new product classes, product substitutions, or fundamental product improvements. Process disruptiveness may take the form of process substitutions or process innovations which radically improve industry-specific dimensions of merit. Christensen and Raynor (2003) introduce a further form of disruptive innovations, namely disruptive business model innovations, which represent the implementation of fundamentally different business models in an existing business.

We argue that digital technologies may reflect in all of these definitions of disruptive innovation. They may represent new-to-the-world product innovations, dislocate existing processes, and open up entirely new business models. As resumed in a recent study by Li et al. (2017), e-commerce for instance is defined as a disruptive technology (Johnson 2010) which involves significant changes to an organization’s culture, business processes, capabilities, and markets (Zeng et al. 2008; Cui and Pan 2015).

Corporate entrepreneurship (CE) on the other side is a multi-dimensional concept at the intersection of entrepreneurship and strategic management in existing organizations (Zahra 1996; Hitt et al. 2001; Dess et al. 2003). We adopt the conceptualization proposed by Guth and Ginsberg (1990, p. 5), who argue that corporate

entrepreneurship deals with two phenomena ‘(1) the birth of new businesses within existing organizations, i.e. internal innovation or venturing, and (2) the transformation of organizations through renewal of the key ideas on which they are built, i.e. strategic renewal.’ Particularly the aspect of strategic renewal in corporate entrepreneurship, also labelled as strategic change, revival, transformation (Schendel 1990), reorganization, redefinition (Zahra 1993), or organizational renewal (Stopford and Baden-Fuller 1994), provides a promising interface to digital transformation. As stated by Covin and Miles (1999, p. 50), corporate entrepreneurship ‘revitalizes, reinvigorates and reinvents’—processes also required for digital transformation. Various authors have stated that corporate entrepreneurship is a vehicle to improve competitive positioning and transform corporations (Schollhammer 1982; Miller 1983; Khandwalla 1987; Guth and Ginsberg 1990; Naman and Slevin 1993; Lumpkin and Dess 1996). Considering the disruptive nature of many current digital technologies, we believe that organizations need to fundamentally renew and redefine the key ideas of their business in order to fully exploit the potential of digitization and eventually achieve successful transformation. The literature places particular attention on the role of middle managers as the locus of corporate entrepreneurship (Burgelman 1983, Floyd and Wooldridge 1999). Concluding, we will review the research on corporate entrepreneurship and identify those contributions which we believe may offer valuable knowledge regarding actor-driven internal renewal and change processes in the light of digital transformation.

Our review of the literature on digital transformation, technological disruption and corporate entrepreneurship is conducted in a two-step approach. First, we review, analyze and synthesize existing articles on digital transformation. Then, in a second step we supplement these findings by simultaneously reviewing the literature stream on technological disruption and corporate entrepreneurship. We believe a separate analysis and contrasting of the research streams is appropriate for two reasons: first, it provides the reader with more clarity on the status quo of digital transformation knowledge and prevents the confusion of concepts emerging from different literature fields. Second, white spots and opportunities for future research regarding digital transformation become much more visible in such a structured approach.

3 Research methodology

A systematic review is a type of literature review that applies an explicit algorithm and a multi-stage review strategy in order to collect and critically appraise a body of research studies (Mulrow 1994; Pittaway et al. 2004; Crossan and Apaydin 2010).

This transparent and reproducible process is ideally suited for analyzing and structuring the vast and heterogeneous literature on digital transformation. In conducting our review, we followed the guidelines of Tranfield et al. (2003) and the recommendations of Denyer and Neely (2004, p. 133)¹ as well as Fisch and Block (2018) in order to ensure a high quality of the review.

The nature of our review is both scoping and descriptive (Rowe 2014; Paré et al. 2015) as we aim to provide an initial indication of the potential size and nature of the available literature as well as to summarize and map existing findings from digital transformation research. By developing opportunities for future research, our review further contributes to the advancement of this field and stimulates theory development.

For the purpose of data collection, we exclusively limit our focus on peer-reviewed academic journals as recommended by McWilliams et al. (2005). Thus, we opted to exclude work in progress, conference papers, dissertations, or books. First, based on discussion among the authors and the reading of a few highly-cited papers, we designed our search criteria using combinations of keywords containing ‘digital* AND transform*’, ‘digital* AND disrupt*’, ‘digitalization’, and ‘digitization’. Then, we manually searched each issue of each volume of the leading journals in the management² and IS field (AIS Basket of eight).³ In addition, we run our search query against five different electronic databases: *Business Source Premier (EBSCO)*, *Scopus*, *Science Direct*, *Social Sciences Citation Index (SSCI)*, and *Google Scholar*. We used all years available and only included articles referring to business, management, or economics in order to exclude irrelevant publications. We abstained from including *digital innovation* in our search (the only exception in our sample is a recent literature review by Kohli and Melville (2019), in order to capture consolidated insights). Although we realize that it is a hot topic in IS research at the moment (e.g. Fichman et al. 2014; Nambisan et al. 2017; Yoo et al. 2010, 2012), we aim to concentrate our focus on papers dealing with digital transformation on a broader level (firm and industry), rather than with transitions within innovation management.

Our first search query was conducted mid 2017 and yielded an initial sample of 1722 publications. This very large sample was mainly due to the broad ambiguity of the terms ‘digital’ and ‘disrupt’. Given these broad search parameters, we anticipated that only a small fraction of this very large sample would prove to be of substantive relevance to us. To select these relevant articles for our final sample, we performed

¹ The development of clear and precise aims and objectives; pre-planned methods; a comprehensive search of all potentially relevant articles; the use of explicit, reproducible criteria in the selection of articles; an appraisal of the quality of the research and the strength of the findings; a synthesis of individual studies using an explicit analytic framework; and a balanced, impartial and comprehensible presentation of the results.

² The search included *Academy of Management Journal*, *Administrative Science Quarterly*, *Entrepreneurship Theory and Practice*, *Journal of Management Studies*, *Strategic Management Journal*.

³ The search included *European Journal of Information Systems*, *Information Systems Journal*, *Information Systems Research*, *Journal of the Association for Information Systems*, *Journal of Information Technology*, *Journal of Management Information Systems*, *Journal of Strategic Information Systems*, *MIS Quarterly*, *MISQ Executive*.

a predefined and structured multi-step selection process (similar to the approach of Siebels and Knyphausen-Aufseß 2012; Vom Brocke et al. 2015) and defined specific criteria for inclusion (Templier and Paré 2015). The filters during our selection process included (1) scanning the titles, (2) reading abstracts, (3) removing duplicates, (4) full reading and in-depth analysis of the remaining papers, and finally (5) cross-referencing and backward searching by looking through the bibliographies of the most important articles to find additional relevant work. The initial pool was split in half between two panelists who separately performed the scanning of titles, analysis of abstracts and removal of duplicates. After these early steps, the sample could be narrowed down to 155 articles. As we arrived at step 4 “full reading and in-depth analysis of the remaining papers”, both panelists read and independently classified each of the remaining 155 studies. During this process, papers qualified for the final sample if they satisfied three requirements: (1) articles were required to have their primary focus and contribution within digital transformation research or digitally-induced organizational transformation (e.g. a vast number of papers inadequately captured the topic of digital transformation as they primarily focused on business model innovation), (2) articles needed to be based on a sound theoretical foundation and therefore not primarily practitioner oriented (such as articles that offer popular recommendations to business leaders on how to *survive* digital transformation), (3) papers that were not addressing digital transformation at an organizational level (e.g. the rise of home-based online businesses by entrepreneurs) were dismissed. Whenever disagreements emerged regarding the inclusion or classification of an article, we engaged in discussion and tried to resolve the issue together to make our selection rules more reliable. We updated the review in the autumn of 2018 for any articles that had appeared between then. Following this approach, 58 studies passed all five selection steps and were included in our final sample.

Within this sample, conceptual articles (27) and case studies (20) are dominant. Roughly 60% of the articles stem from the IS literature, while 40% cover a broader management perspective of digital transformation. While the reviewed papers span a time frame from 2001 to 2018, approximately eighty-percent of articles were published within the past 5 years, indicating the relative novelty of digital transformation as a research discipline. The distribution of our sample according to journals is provided in Table 4 of “Appendix”.

Upon the recommendation of Webster and Watson (2002), our categorization and analysis of the literature was concept-centric. First, to facilitate analysis and build a basis for our initial coding, each selected paper was reviewed to determine the following database information.

(1) Article title, (2) outlet, (3) research methodology, (4) sample, (5) region, and (6) key findings (see full database in Table 5 of “Appendix”). Next, we started coding our sample, adopting elements of the approach introduced by Corley and Gioia (2004). We began by identifying initial concepts in the data and grouping them into provisional categories and first order concepts (open coding). Then, we engaged in axial coding (Locke 2001) and searched for relationships and common patterns between and among these provisional categories, which allowed us to assemble them into second order themes. Finally, we assigned these second order themes to aggregate dimensions, representing the highest level of abstraction in our coding. In

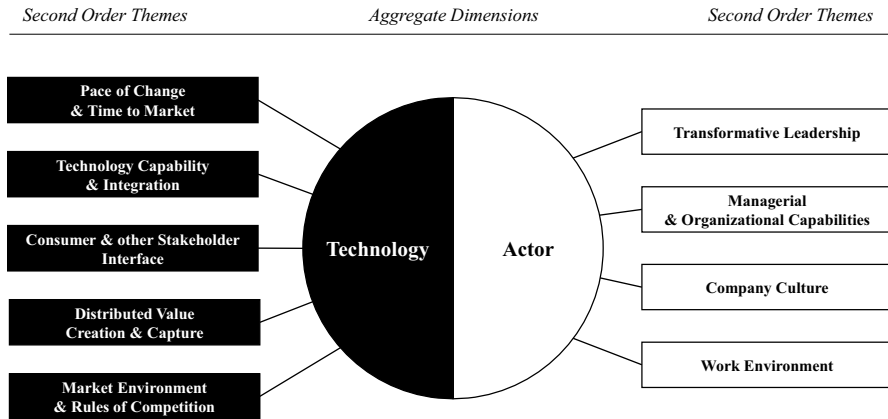


Fig. 1 Digital transformation high-level thematic map emerging from the analysis of the literature

sum, reviewing and analyzing the extant literature, 194 coded insights were generated within the field of digital transformation: 61 first order concepts, nine second order themes, and two aggregate dimensions. The nine second order themes represent core themes across the papers, which finally constitute two aggregate dimensions: technology and actor. In conclusion, we define digital transformation as actor-driven organizational transformation triggered by the adoption of technology-driven digital disruptions. The result of the coding process is a high-level inductive map of the core themes in digital transformation research (Fig. 1).

4 Results

The reviewed studies from our sample provide a rich body of knowledge regarding the specific contextual factors of digital transformation. This may be beneficial to both researchers and practitioners enabling a more comprehensive understanding of the peculiarities of digital transformation (in comparison to previous technology-driven transformations).

4.1 Macro-level findings

On a macro level, the central observation emerging from our review is that both technology- and actor-centric aspects take center stage within this debate. This is also reflected in various definitions of digital transformation provided in the sample. For example, Lanzolla and Anderson (2008) represent the technology-centric side and emphasize the diffusion of digital technologies as an enabler for transformation. Such digital technologies may include big data, mobile, cloud computing or search-based applications (White 2012). Similarly, Hess et al. (2016) note that digital transformation is ‘concerned with the changes digital technologies can bring about in a company’s business model, which result in changed products or organizational structures or in the

automation of processes' (p. 124). However, Hess et al. (2016) also highlight the role of actors (e.g. managers) in promoting transformation processes, while facing the challenge of simultaneously balancing the exploration and exploitation of resources. Leaders must have trust in the value and benefits of new IT technologies and support their implementation (Chatterjee et al. 2002).

In total, we find an almost even distribution of papers studying the two dimensions of technology and actor: 33% are technology-centric, 34% are actor-centric, and 33% of papers cover both technology and actor. However, within these two dimensions we observe a rather uneven distribution of articles by second order themes. On the technology-centric side, we find that understanding the implications of digital technologies on the *consumer interface* and *market environment* are highly active research streams. In comparison, understanding the *pace of change* in times of digital transformation and its direct impact on incumbents is so far comparably understudied. On the actor-centric side, our review reveals a very dominant focus on *leadership* and *capabilities* in a digital context, while in contrast *company culture* and *work environment* thus far received less recognition. We also find that the status-quo of digital transformation literature is rather diverse, in a sense that papers discuss topics across various categories of our thematic map and are therefore not restricted nor focused to a specific unit of analysis. The vast majority of articles is related to adjacent topics of digital transformation underpinning its nature as a diverse and broad field of research while again indicating its emerging nature.

In addition, we observe some degree of diversity in the theoretical foundations drawn upon. Different theories are applied by several authors to capture the context of digital transformation, e.g. alignment view, configuration theory, resource-based view, dynamic capabilities, organizational learning theory, network view or business process reengineering. It would be interesting to use other theoretical angles, for example from the literature on corporate entrepreneurship and technological disruption, in order to increase theoretical diversity. Such an exchange with different fields of research would broaden the scope of the field and help bridging an *ivory divide*. Finally, from a methodological perspective, we observe that actor-centric papers primarily use case studies while technology-centric studies at this point are pre-eminently conceptual. In general, the literature is scarce regarding quantitative empirical evidence. We see this as a strong indicator for the early stage of digital transformation research.

4.2 Micro-level findings: the technology-centric side of the equation

In the following, we present and discuss the most important findings of the second order themes within the technology-centric dimension. In Fig. 2 we provide a thematic map for this dimension and in Table 1 a brief summary including illustrative quotes.

4.2.1 Pace of change and time to market

In times of digital transformation, the speed of technological change is disproportionately accelerating with new digital capabilities being rolled out every year. The technological capability of applications such as the Internet of Things (IoT), big

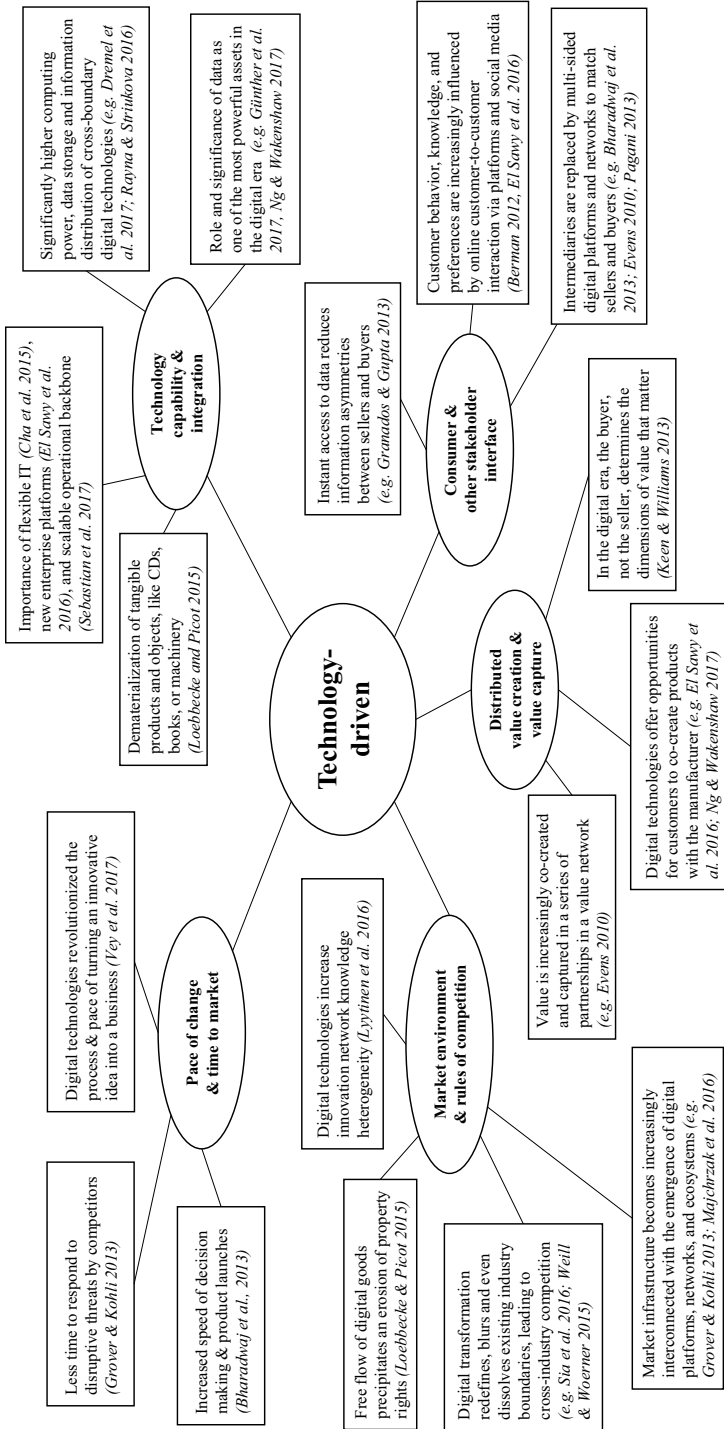


Fig. 2 Thematic map for technology-driven themes in digital transformation literature

Table 1 Summary of emergent themes from the digital transformation literature: the technology-driven side

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
<i>Technology-driven</i>	Pace of change and time to market	Increased speed of decision making, product launches, convenience of new business formation, time-to-market	"Technology has allowed firms to speed up decisions that otherwise might be slowed due to information flows up and down the hierarchy" (Bharadwaj et al. 2013, p. 476)	Grover and Kohli (2013) and Moreau (2013)
	Technology capability and integration	Exponential advancements in the price/performance capability, dematerialization of tangible products, agile and scalable digital infrastructure for seamless technology integration	"The cloud and all sorts of platforms have revolutionized how to set up and run a business. Innovative ideas can be realized in days, and the corresponding business set up almost "overnight" (Vey et al. 2017, p. 23)	Cha et al. (2015), Dremel et al. (2017), Evens (2010), Günther et al. (2017), Hess et al. (2016), Kohli and Johnson (2011), Kohli and Melville (2019), Lyytinen et al. (2016), Rayna and Striukova (2016), Resca et al. (2013), Sebastian et al. (2017) and Sia et al. (2016)
			"Digital products and services emerge as substitutes for established offerings. They offer superior performance and higher benefits to consumers and businesses than their physical/analog counterparts" (Loebbecke and Picot 2015, p. 153)	
			"Data storage capabilities and computing speed have enabled data collection at an unprecedented scale" (Ng and Wakenshaw 2017, p. 13)	

Table 1 (continued)

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
			<p>'Intensive interactive digital connectivity to the outside requires integration between the outside and inside of the enterprise that goes beyond the traditional ERP and supply chain management integration paradigm' (El Sawy et al. 2016), p. 142</p>	
	Consumer and other stakeholder interfaces	Co-creation of products and services with customers, consumer behavior, consumer knowledge, consumer analysis, multi-sided digital platforms eliminate intermediating function, information ubiquity raises exposure of leaders to stakeholders	<p>'IoT applications will be mostly focused on co-creation and communities... For instance, Philips indicated the use of co-creation as type of customer relationship for their IoT product 'Hue', since customers can design their own light recipes' (Dijkman et al. 2015, p. 677)</p>	<p>Bharadwaj et al. (2013), El Sawy et al. (2016), Evens (2010), Granados and Gupta (2013), Hagberg et al. (2016), Ives et al. (2016), Leong et al. (2017), Llopis et al. (2004), Loebbecke and Picot (2015), Majchrzak et al. (2016), Ng and Wakenshaw (2017), Pagami (2013), Sebastian et al. (2017), Setia et al. (2013), Sia et al. (2016), Vey et al. (2017), and Weill and Woerner (2015)</p>
			<p>'In the new digital marketplace, consumers are using mobile, interactive tools to become instant experts on product and service offerings' (Berman 2012, p. 16)</p>	

Table 1 (continued)

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
<i>Technology-driven</i>	Distributed value creation and capture	Value creation and capture are driven and co-created in networks with multiple partners, value is always shifting and a moving target	<p>'If a leader at any level does not understand how to use the digital world and its accompanying instrumentation, and if they do not understand the power that it has on their relationships with their stakeholders... then they will be seriously left behind' (Bennis 2013, p. 635)</p> <p>'As more products and services become digital and connected, network effects become the key differentiator and driver of value creation' (Bharadwaj et al. 2013, p. 475)</p> <p>'In multi-sided platform markets, value is not created in the transformation of goods, but in the mediation of these goods between different kinds of users, who pay for access to the network... in value networks, value is co-created and revenues are shared amongst all participants' (Evens 2010, p. 53)</p>	Berman (2012), El Sawy et al. (2016), Loebbecke and Picot (2015), Matt et al. (2015), Ng and Wakenshaw (2017), Pagani (2013), Rayna and Striukova (2016) and Sebastian et al. (2017)

Table 1 (continued)

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
			<p data-bbox="250 481 371 769">'Digital business will be driven in its next phases by value architectures rather than business models' (Keen and Williams 2013, p. 646)</p>	
	<p data-bbox="385 1125 430 1407">Market environment and rules of competition</p>	<p data-bbox="385 816 579 1095">Dynamics of business environment, inter-connected business infrastructures, emergence of innovation networks, cross-industry competition, erosion of property rights, knowledge heterogeneity, demand harmonization</p>	<p data-bbox="385 481 579 769">'The simultaneous increase in environmental turbulence, the requisite speed of organizational change, and the intensified ubiquity of digital technologies are spawning a phenomenon that is messy, complex, and chaotic' (El Sawy et al. 2010, p. 835)</p>	<p data-bbox="385 164 659 469">Bharadwaj et al. (2013), Dremel et al. (2017), Evens (2010), Grover and Kohli (2013), Kohli and Johnson (2011), Leong et al. (2017), Loebbecke and Picot (2015), Lytinen et al. (2016), Majchrzak et al. (2016), Markus and Loebbecke (2013), Mazzei and Noble (2017), Mithas et al. (2013), Rayna and Striukova (2016) and Sia et al. (2016)</p>
			<p data-bbox="673 481 899 769">'As digital interconnectivity becomes virtually ubiquitous, it overcomes physical barriers and enables the possibility of reaching more people and of building a network based on interests rather than on geographical location' (Lanzolla and Anderson 2008, p. 76)</p>	

Table 1 (continued)

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
			<p>“The new kid on the block can come “out of the blue”, from anywhere—it does not have to be a well-known competitor in your industry’ (Vey et al. 2017, p. 23)</p> <p>‘Two-thirds of respondents said they were experiencing a high level of threat ... from enterprises in other industries that have existing relationships with their customers’ (Weill and Woerner 2015, p. 32)</p>	

data, cloud computing, and mobile technologies significantly increases the overall pace of change. For example, entire industries, like the newspaper business, have been transformed and digitized within a very short period of time (Karimi and Walter 2015). Further, the cloud and online platforms have revolutionized the process and pace of turning an innovative idea into a business (Vey et al. 2017). Today, innovative ideas can be realized within days and companies set-up literally ‘overnight’. In this sense, in the digital world striving for a ‘first-mover advantage’ due to a ‘winner takes it all’ environment has become more important for incumbent firms (Grover and Kohli 2013) as they have much less time to respond to such threats and should not give away first-mover advantages too easily.

Moreover, pure digital companies like Facebook, Google or Amazon have substantially raised the overall time to market and speed of product launches (Bharadwaj et al. 2013). With continuous improvements in hardware, software and connectivity, these companies set the pace for a tightly timed series of product launches. Thus, firms in the hybrid world (digital and physical) are being put under enormous pressure to also accelerate their product introductions. In a digitally transformed market, the control of speed of product development and launches is increasingly transferred to an ‘ecosystem of innovation’ in the sense of a network of actors with complementary products and services (Bharadwaj et al. 2013).

4.2.2 Technology capability and integration

The technological capability and power of digital transformation applications, such as for example the Internet of Things (IoT), big data, cloud computing, and mobile technologies, is in terms of computing power, data storage and information distribution in many cases significantly higher than in previous technology-driven transformations. Earlier business transformations were mostly concerned about introducing *internal* management information systems such as enterprise resource planning (ERP) or customer relationship management (CRM). These transformations were usually limited to improvements to business processes *within firm boundaries* (see Ash and Burn 2003; Kauffman and Walden 2001 *in*: Li et al. 2017). But today, cross-boundary digital technologies such as IoT devices (Ng and Wakenshaw 2017), 3D printing (Rayna and Striukova 2016), and big data analytics (Dremel et al. 2017), drive transformations that go far beyond internal process optimizations as they potentially induce drastic changes to business models (Rayna and Striukova 2016), organizational strategy (Bharadwaj et al. 2013), corporate culture (El Sawy et al. 2016; Dremel et al. 2017; Sia et al. 2016), and entire industry structures (Kohli and Johnson 2011).

Further, the review confirms that the role and significance of data itself is changing profoundly and that personal data has become one of the most powerful assets in the digital era (Ng and Wakenshaw 2017). In fact, we believe the impact of the massive increase in quantity and quality of data generated every day (Bharadwaj et al. 2013) and the game changing power of big data analytics (Günther et al. 2017) are yet to be fully experienced and understood by society, economy and academics.

With regards to the process of dematerialization of tangible products and objects (e.g. CDs, books, machinery etc.), triggered by the transformative

capabilities of digital technologies, the most notable insight is that intriguingly, in many cases the digital substitutes, for example e-books, offer superior performance and higher customer benefits than their physical counterparts (Loebbecke and Picot 2015). This, for example, is in contrast to the assumptions provided by Christensen (1997) more than 20 years ago, arguing that new disruptive technologies usually provide different values from mainstream technologies and are often initially inferior to mainstream technologies, therefore only serving niche markets in the beginning.

Finally, regarding technology integration, the current state of research emphasizes the importance of flexible IT (Cha et al. 2015), new enterprise platforms (El Sawy et al. 2016), and a strong and scalable operational backbone (Sebastian et al. 2017) as part of an agile digital infrastructure. The old paradigms of technology integration are not effective any more. However, in a second step we need to reach a more comprehensive understanding of ‘how’ and ‘where’ the integration of technology and transformation activities should be embedded within the organizational architectures of incumbent firms.

4.2.3 Consumer and other stakeholder interface

With regards to the customer interface, which is currently receiving the highest levels of attention by scholars, we conclude that there is some solid research particularly on changes in consumer behavior (Berman 2012; El Sawy et al. 2016; Ives et al. 2016; Lanzolla and Anderson 2008), consumer preferences (Vey et al. 2017) and consumer knowledge (Berman 2012; Granados and Gupta 2013). Firstly, our review confirms that in the new digital marketplace, consumers behave differently than before, and traditional marketing techniques may not apply anymore. Today there are myriad choices to easily gather information about products and services far before the actual purchase. For instance, customer buying decisions are increasingly influenced by online customer-to-customer interaction via platforms and social media, where users share products feedbacks, upload home video clips, or publish blog entries (Berman 2012). In this sense, digital technologies are also transforming firms’ customer-side operations (Setia et al. 2013) and customer engagement strategies (Sebastian et al. 2017). For example, reaching out to customers in a digital environment requires digital omnichannel marketing, including e.g. social media, mobile apps, and augmented reality (El Sawy et al. 2016). Secondly, we may note that digital technologies increasingly reduce the information asymmetries between sellers and buyers (Granados and Gupta 2013). In this sense, information ubiquity (Vey et al. 2017) and instant access to data via mobile technologies (Berman 2012) profoundly change the long-established seller–customer relationship. And thirdly, the current literature raises awareness for the emergence of multi-sided business models. While in the ‘old’ world, intermediaries were matching sellers and buyers, in the digital market place, intermediation increasingly takes place through the establishment of multi-sided digital platforms and networks (Bharadwaj et al. 2013; Evens 2010; Pagani 2013).

4.2.4 Distributed value creation and value capture

The review of the literature reveals that the value chain has become far more distributed in times of digital transformation—particularly value creation and value capture. Two major changes can be observed here: (1) digital technologies offer opportunities to customers to co-create products with the manufacturer, e.g. via digital platforms (El Sawy et al. 2016; Ng and Wakenshaw 2017), and (2) on an inter-firm level value is increasingly co-created and captured in a series of partnerships in a value network (Evens 2010). As Bharadwaj et al. (2013) argue, network effects are the key differentiator and driver of value creation and capture in a digital world. The focus of value creation is therefore shifting from value chain to value networks. For this purpose, companies like Google are experimenting with multi-sided business models. In such a multilayered business model, a company gives away certain products or services in one layer to capture value at a different layer (Bharadwaj et al. 2013). Google is giving away its Android operating system for free and captures value via the ability to control advertising on every phone that uses Android.

In more general terms, we may conclude that control of value in the digital world is less and less determined by R&D capabilities, competitors, or industry boundaries. Instead the buyer, not the seller, determines the dimensions of value that matter (Keen and Williams 2013). Therefore, businesses need to engage with their customers at every point in the process of value creation (Berman 2012). Also, the strong impact of digital technologies on incumbent's value chains imply some degree of deviation from the classical and often analog core business. For example, new product-related competencies, platform capabilities or value architectures will be required. And, incumbents must prepare for new forms of monetization in the digitized marketplace.

4.2.5 Market environment and rules of competition

This is a rather broad and diverse categorization in our review, as it comprises technology-driven changes in the market environment. After consumer-centric aspects this research stream received the most attention by scholars in the review (on the technology-centric side). In sum, the current state of literature recognizes three major developments. First, digital transformation redefines, blurs and even dissolves existing industry boundaries which may lead to cross-industry competition (Sia et al. 2016; Weill and Woerner 2015). Dominant industry logics (Sabatier et al. 2012) apparently do not work anymore in times of digital transformation. The 'new kid on the block can come out of the blue' (Vey et al. 2017, p. 23) and even individuals can become competitors as 3D Printing is expected to lead to a sharp increase in competition from SMEs and individual entrepreneurs (Rayna and Striukova 2016). And with the emergence of multi-sided business models also incumbents are starting to disrupt new markets (Weill and Woerner 2015). For instance, Google is disrupting the mobility sector with its self-driving car subsidiary Waymo, while Amazon has introduced AmazonFresh as a grocery delivery service which is seen as a potentially tough competitor to supermarkets. Second, with the emergence of digital platforms, networks, and ecosystems the market infrastructure becomes

increasingly interconnected (Grover and Kohli 2013; Majchrzak et al. 2016; Markus and Loebbecke 2013). In a broader sense, we see a shift from controlling or participating in a linear value chain to operating in an ecosystem or network (Weill and Woerner 2015). As different types of innovation networks with different cognitive and social translations regarding knowledge emerge, novel properties of digital infrastructure in support of each network are required. Digital technologies therefore increase innovation network knowledge heterogeneity (Lyytinen et al. 2016). Third, the free flow of digital goods precipitates an erosion of property rights and higher risks of imitation (Loebbecke and Picot 2015).

4.3 Micro-level findings: the actor-centric side of the equation

In the following, we present and discuss the most important findings of the second order themes within the actor-centric dimension. In Fig. 3 we provide a thematic map for this dimension and in Table 2 a brief summary including illustrative quotes.

4.3.1 Transformative leadership

Understanding the impact of digital transformation on leadership and management behavior is a very active and prioritized research focus. In total, 23 papers in our review explore this aspect. First and foremost, research calls for a shift in the traditional view of IT strategy as being subordinate to business strategy (El Sawy et al. 2016). In the course of the past two decades information technologies have surpassed their subordinate role as administrative ‘back office’ assets and evolved into an essential element of corporate strategy building. Thus, incumbents should align IT and business strategies on equal terms and fuse them into ‘digital business strategy’ (Bharadwaj et al. 2013).

Also, emphasis is placed on the changing nature of leadership itself, caused by digital transformation. Such changes may include rapid optimization of top management decision-making processes enabled by instant access to information and expansive data sets (Mazzei and Noble 2017), new communication principles (Bennis 2013; Granados and Gupta 2013), or changes in leadership education (Sia et al. 2016). Further, there is consensus that senior management requires a new digital mindset in order to captain their company’s digital transformation journey. Therefore, incumbents should also rethink their leadership education practices. In the past, leadership programs have been primarily about leadership and communication skills. But in times of digital transformation, executives must become ‘tech visionaries’ and develop their transformative powers. For example, Sia et al. (2016) have conducted a case study on an Asian bank that uses hackathons to educate their senior managers. Media transparency and exposure are further key challenges of digitization where top managers may require some additional education. Given the ubiquity of information and the speed of online data dissemination (via mobile phones, viral effects of social media etc.), leaders today are significantly more exposed publicly than their analog predecessors. Therefore, according to Bennis (2013) leadership

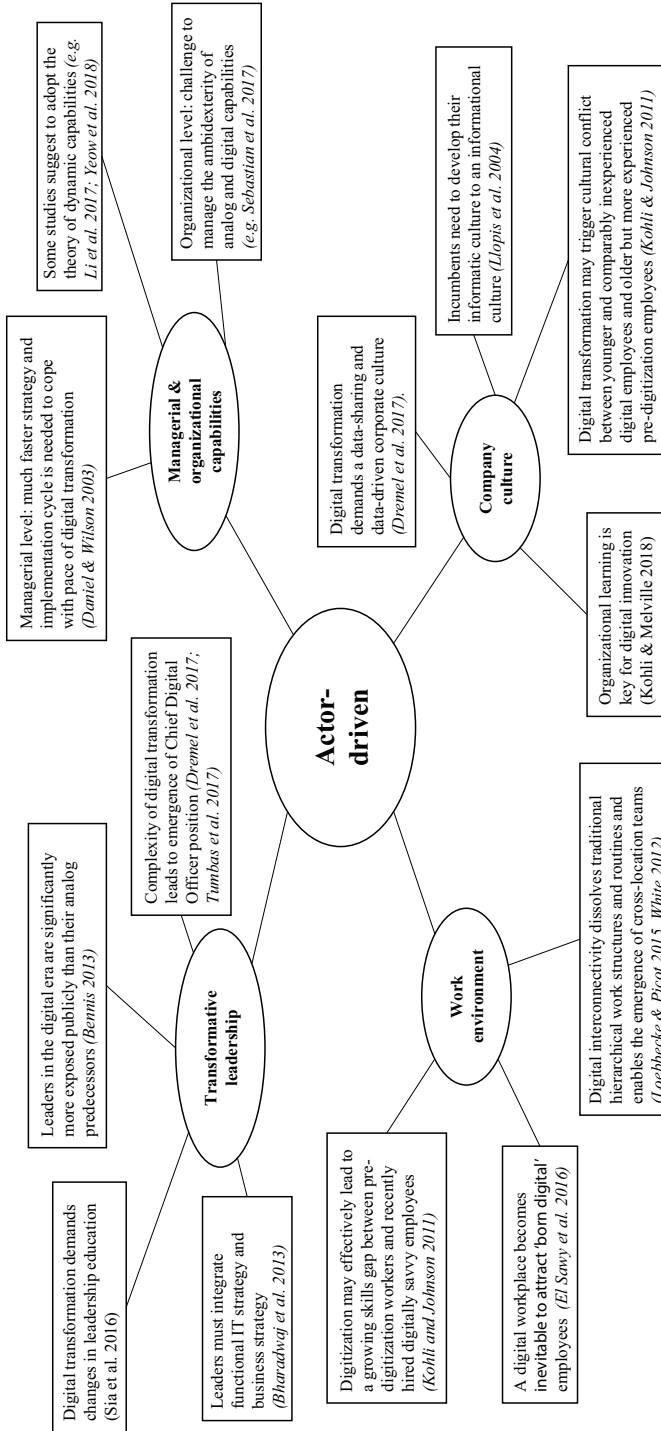


Fig. 3 Thematic map for actor-driven themes in digital transformation literature

Table 2 Summary of emergent themes from the digital transformation literature: the actor-driven side

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
<i>Actor-driven</i>	Transformative leadership	Transformational leadership, fusion between functional IT strategy and business strategy, leadership education, nature of leadership, emergence of Chief Digital Officers	<p>“Transformational leadership is proposed as a significant antecedent of e-business adoption... Transformational leadership first plays a key role in changing characteristics of culture and then facilitates e-business adoption” (Alos-Simo et al. 2017, p. 382)</p> <p>“When implementing a digital transformation project, it is important to have direct policing by top management and solid congruence between a firm’s business goals and its IT development strategy, not just count IT projects as additional jobs for the MIS department” (Liu et al. 2011, p. 1739)</p> <p>“The necessary digital transformation requires new roles, such as a chief digital officer (CDO), and organizational structures to be established” (Dremel et al. 2017, p. 82)</p>	<p>Bennis (2013), Cha et al. (2015), Chat-terjee et al. (2002), El Sawy et al. (2016), Gerth and Peppard (2016), Granados and Gupta (2013), Hu et al. (2016), Kohli and Melville (2019), Llopis et al. (2004), Loebbecke and Picot (2015), Mazzei and Noble (2017), Rigby et al. (2016), Rindova and Kotha (2001), Sia et al. (2016), Singh and Hess (2017) and Yeow et al. (2018)</p>

Table 2 (continued)

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
	Managerial and organizational capabilities	Managerial capabilities, organizational capabilities	<p>‘Organizations can promote digital transformation through building the dynamic managerial capabilities of their top management’ (Li et al. 2017, p. 4)</p> <p>‘It is crucial for firms to use existing resources and capabilities to meet customer demands when implementing digital transformation’ (Liu et al. 2011, p. 1739)</p> <p>‘We argue that information technology investments and capabilities influence firm performance through a nomological network of three significant organizational capabilities (agility, digital options, and entrepreneurial alertness) and strategic processes (capability-building, entrepreneurial action, and coevolutionary adaptation)’ (Sambamurthy et al. 2003, p. 237)</p>	<p>Berman (2012), Daniel and Wilson (2003), El Sawy et al. (2010, 2016), Granados and Gupta (2013), Karimi and Walter (2015), Kohli and Melville (2019), Rindova and Kotha (2001), Sandström (2016), Sebastian et al. (2017), Setia et al. (2013), Singh and Hess (2017), Svahn et al. (2017), Weill and Woerner (2015)</p>

Table 2 (continued)

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
<i>Actor-driven</i>	Company culture	Cultural change, conflict, organizational learning	<p>‘In the past, our leadership program has been all about leadership skills, communication skills. We scrapped all of that and our leadership program now is all about hackathons’ (Sia et al. 2016, p. 109)</p> <p>‘Similarly, a large number of on-site technical contract workers or service providers may cause conflict between two cultures—those who understand technology and those who understand the business’ (Kohli and Johnsons 2011, p. 153)</p> <p>‘Learning is often necessary (although not sufficient) for digital innovation. For example, in the case of externally adopted IS, knowledge drives opportunity sensing, which in turn drives experimentation and subsequent innovation’ (Kohli and Melville 2019, p. 6)</p>	Alos-Simo et al. (2017), Dremel et al. (2017), El Sawy et al. (2016), Llopis et al. (2004), Schuchmann and Seufert (2015), Vey et al. (2017)
	Work environment	Digital workplace, work structures and routine, skills gap	<p>‘Four technologies in particular are rapidly shaping the future of corporate IT and the way that work will be undertaken: Mobile, Big data, Cloud computing, Search-based applications’ (White 2012, p. 210)</p>	Cha et al. (2015), Hansen and Sia (2015), Kohli and Johnson (2011), Schuchmann and Seufert (2015), Seufert and Meier (2016), Vey et al. (2017)

Table 2 (continued)

Aggregate dimension	Second order themes	Examples of first order concepts	Illustrative quotes	Examples of other sources addressing the second-order theme
			<p>'As more 'born digital' younger employees enter the workforce with different values, they will have different expectations of the workplace in terms of flexibility of location and working hours, sophistication of mobile online access, and the extent to which the workplace environment is 'humanized' (El Sawy et al. 2016, p. 143)</p> <p>'With digitization and big data analytics cross-location teams emerge, and traditional hierarchical work structures dissolve and transform into increasingly flexible, in-house and networked structures across locations' (Loebbecke and Picot 2015, p. 151)</p>	

in the digital era needs to be learned through embracing transparency and adaptive capacity (specifically *resilience* as the ability to rebound from problems and crisis).

Finally, the vast extent and complexity of digital transformation leads to the emergence of an additional position at the top management level—the Chief Digital Officer (Dremel et al. 2017; Tumbas et al. 2017). Given the immense challenges of digital transformation and the claim for a new mindset and different skills, CEOs or even CIOs are conceivably not the best match (Singh and Hess 2017). Particularly not if they are expected to drive digital transformation in addition to their original tasks.

4.3.2 Managerial and organizational capabilities

Our analysis suggests that in order to effectively drive digital transformation additional and refined capabilities are required—both managerial and organizational (Li et al. 2017)—in comparison to the analogue world.

At the managerial level, for one thing, a much faster strategy and implementation cycle is needed to cope with the pace of digital transformation (Daniel and Wilson 2003). The turbulent and ever-changing digital environment is forcing managers to make decisions and implement strategies significantly faster than they had been previously required to. In order to study managerial capabilities in the context of digital transformation, some studies have adopted the theory of dynamic capabilities (Daniel and Wilson 2003; Li et al. 2017; Yeow et al. 2018) as introduced by Teece et al. (1997), Teece (2007, 2014). In particular, results indicate that dynamic capabilities may support the refinement of digital strategy and are therefore not separate from alignment, but on the contrary have the potential to enact and guide the process of aligning.

At the organizational level, one of the most intriguing challenges for incumbents will be to manage the ambidexterity of capabilities in terms of analog and digital capabilities. Firms need to incorporate ‘old’ and ‘new’ capabilities into their organizational structure in a complementary and not impeding way. In addition, capabilities in two further areas are of particular importance to many firms. First, capabilities to implement and operate in networks (Bharadwaj et al. 2013), platforms (Li et al. 2017; Sebastian et al. 2017), and ecosystems (El Sawy et al. 2016; Weill and Woerner 2015). Depending on contextual factors like for example their industry or business model, companies must learn to take advantage of network effects in terms of complementary capabilities while also learn how to become more of an ecosystem rather than continue managing value chains. Second, in the digital era it is essential to develop sensing capabilities, such as entrepreneurial alertness and environmental scanning (Kohli and Melville 2019), in order to identify new ideas and critically evaluate, design, modify and eventually deliver new business models (Berman 2012; Daniel and Wilson 2003).

4.3.3 Company culture

Digital transformation is not exclusively a technology-driven challenge but requires deep cultural change. Everyone within the organization must be prepared with an

adaptive skill set and digital know-how. Two major insights can be identified within the existing literature. First, digital transformation demands a data-sharing and data-driven corporate culture (Dremel et al. 2017). Data as such must be recognized much more as a valuable resource and an enabler to become a digital enterprise. This will require higher operational transparency in daily-business and work-routines and a data-sharing mindset among employees. In this sense, incumbents need to develop their informatic culture to an informational culture (Llopis et al. 2004). In comparison to an informatic culture, an informational culture values IT as a core element of strategic and tactical decisions and clearly understands the financial and transformative potential of digital technologies. Second, digital transformation may trigger cultural conflict between younger and comparably inexperienced digital employees and older but more experienced pre-digitization employees (Kohli and Johnson 2011). Management is well advised to prevent that two different cultures arise within the same organization—a group of employees who understand digital technologies and those who have a long-standing track record in the traditional business but are technologically lagging behind. Facilitating a learning friendly culture (Kohli and Melville 2019) and publicly affirming support and trust by the executive level may effectively mitigate such a potential cultural divide.

4.3.4 Work environment

Our review reveals that digital transformation is changing the daily work environment in incumbent firms in terms of work structures (Hansen and Sia 2015; Loebbecke and Picot 2015), job roles, and workplace requirements (White 2012). For example, digital interconnectivity enables the emergence of flexible and networked cross-location teams across the entire geographical company map. In this context, traditional hierarchical work structures dissolve and new opportunities emerge beyond company boundaries, such as the integration of external freelancers (Loebbecke and Picot 2015). Also, the implementation of a digital workplace becomes inevitable. Particularly for ‘born digital’ younger employees a digitally well-equipped workplace may represent a major criterion for their choice of employer (El Sawy et al. 2016). According to White (2012), a digital workplace must be adaptive, compliant, imaginative, predictive, and location-independent.

However, the most notable insight in this perspective is that—in addition to a potential cultural divide—digitization may effectively lead to a growing skills gap between pre-digitization workers and recently hired digitally savvy employees (Kohli and Johnson 2011). In fact, while digital technologies significantly help to optimize and accelerate many work processes and thereby increase productivity, incumbents must be aware that many employees might not keep pace with this digital high-speed train and feel left behind. It is unclear how such a tradeoff is considered and how firms could handle related conflicts.

5 Avoiding an ivory tower: drawing on existing knowledge from adjacent research fields

We assume that pre-existing knowledge on corporate transformation processes in general is partly already available and may provide implications for digital transformation. Therefore, at this point in our review, we aim to stimulate a theoretical discussion by identifying potential *white spots* abstracted from adjacent research fields. For this purpose, we additionally reviewed 28 studies from the literature on technological disruption (to gain technology-centric input) and 32 papers from corporate entrepreneurship (to expand the actor-centric view). By this, we supplement the predominantly IS-based digital transformation literature with a broader management perspective. First, by reviewing the literature on disruptive innovations we hope to derive implications regarding technology adoption and integration. Burdened with the legacy of old technology, bureaucratic structures and core rigidities (Leonard-Barton 1992), incumbents may face major challenges in this respect during their digital transformation journey. Second, we expect corporate entrepreneurship to add a more holistic perspective on firm-internal aspects during the process of transformation, such as management contribution or the impact of knowledge and learning.

We rigorously conducted the same review and analysis process as for our digital transformation sample. A database and concept matrix (Webster and Watson 2002) for the sample on technological disruption and corporate entrepreneurship are provided in Tables 6 and 7 of “Appendix”. The data structures, which summarize the second order themes for both the actor-centric and technology-centric dimension of these additional research fields are illustrated in Figs. 5 and 6 of “Appendix”. Within the main body of this article, we only draw attention toward three key implications (Fig. 4). In the following, we provide a brief synthesis of these implications and their grounding in the respective literature. In a second step, we transfer and apply these implications to the context of digital transformation and integrate them into an agenda for future research opportunities.

5.1 Insights from technological disruption

Existing knowledge from the adoption of disruptive technologies suggests that in order to successfully integrate, commercialize or develop disruptive technologies incumbents need to create organizations that are independent from but interconnected in one way or another with the mainstream business (Bower and Christensen 1995). The reasons for this are manifold. For example, managers are encouraged to protect disruptive technologies from the processes and incentives that are targeted to serve established customers. Rather, disruptive innovations should be placed in separate new organizations that work with future customers for this technology (Bower and Christensen 1995; Gans 2016). Further, separation potentially helps to unravel the discord between viewing disruptive innovations as a threat or an opportunity. Exempted from obligations to a parent company, separate ventures are more likely to perceive a novel technology as an

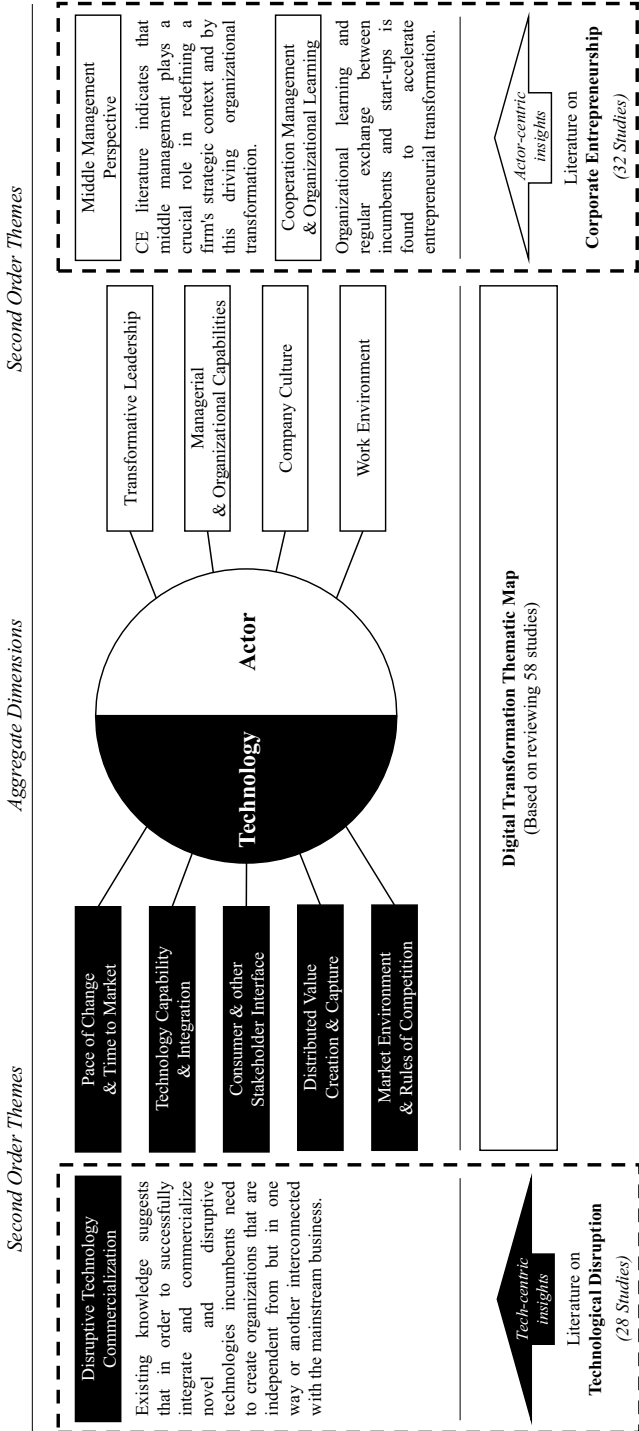


Fig. 4 Expanding the digital transformation high-level thematic map with insights from technological disruption and corporate entrepreneurship

opportunity (Gilbert and Bower 2002). And lastly, a freestanding business also enables local adaptation and increased sensitivity to changes in the environment (Hill and Rothaermel 2003).

5.2 Insights from corporate entrepreneurship

Our review of the corporate entrepreneurship literature identifies two major implications that have not been (adequately) considered in digital transformation research yet.

First, the literature indicates that middle management plays a crucial role in redefining a firm's strategic context and by this driving organizational transformation. A middle management perspective has thus far been completely neglected in digital transformation research. We see this as a major gap, since the middle layers of management are 'where the action is' (Floyd and Wooldridge 1999, p. 124). Top management should control the level and the rate of change and ensure that entrepreneurial activities correspond to their strategic vision (Burgelman 1983), but middle managers at the implementation level are the driving force and key determinant behind organizational transformation. However, on the downside, middle managers may also represent a major barrier to organizational change (Thornberry 2001). Typically, managers have the task to minimize risks, make sure everything is compliant to the rules and perform their functional roles. Thus, middle managers usually have the most to lose from radical changes and are therefore often the least likely to be entrepreneurial or to support transformations (Thornberry 2001). In order to solve middle and operational manager's risk-awareness and unleash their entrepreneurial spirit, research suggests encouraging autonomous behavior (Shimizu 2012). In sum, reviewing the literature on corporate entrepreneurship raises our awareness for the impact of hierarchy and management levels on organizational transformation (Hornsby et al. 2009).

Second, a closer cooperation and regular exchange between incumbents and start-ups in order to accelerate entrepreneurial transformation is proposed (Engel 2011; Kohler 2016). Incumbents should recognize start-up companies as a source of external innovation and develop suitable models for collaboration (e.g. corporate accelerators). In particular, incumbents are advised to implement three common best practices from successful start-ups in order to facilitate transformation: (1) working in small omni-functional teams, (2) goal-driven rapid development instead of bureaucratic processes, and (3) field-level exploration of market potential instead of complex and tedious quantitative models (Engel 2011). In addition, corporate entrepreneurship underlines the importance of organizational learning as a vehicle to drive and shape cultural transformation (Dess et al. 2003; Floyd and Wooldridge 1999; Zahra 2015). We come to understand that learning, and in fact also knowledge management, are intimately tied to the concept of organizational transformation. A culture of learning and knowledge drives experimentation, encourages the development of an adaptive skill set, reshapes competitive positioning, and opens the minds of employees to new realities (Zahra et al. 1999).

6 Opportunities for future research

Based on the cross-disciplinary perspectives from reviewing the literature on digital transformation, technological disruption and corporate entrepreneurship, we propose opportunities for future research on digital transformation. Using our thematic map as a lens to view future research opportunities, we focus on the two dimensions of technology and actor. For the technology-centric dimension we expand on the structural and operational integration of digital technologies and organizational transformation initiatives as well as gaining a deeper understanding of the pace of technological transformation. For the actor-centric dimension we address three topics: we start at the leadership level by emphasizing the relevance of middle management in digital transformation, after that we refer to the potential skills gap and threat of an employee divide in incumbent organizations induced by digital technologies, and finally we move beyond organizational boundaries to turn toward the potential benefits and drawbacks of cooperating with start-ups and pure digital companies to boost transformation. For each area, we propose a set of research questions. Altogether, the agenda is organized around five guiding topics (Table 3).

6.1 Integration of digital transformation within organizational structures and activities in incumbent firms

Our review of the literature on digital transformation reveals a knowledge gap regarding this topic. However, we do gain some interesting cross-disciplinary insights from technological disruption at this point. In fact, as already discussed, studies on technological disruption indicate that in order to successfully integrate, commercialize or develop disruptive technologies incumbents need to create organizations that are completely independent from but interconnected in one way or another with the mainstream business (Bower and Christensen 1995; Gans 2016; Gilbert and Bower 2002; Hill and Rothaermel 2003).

Thus, the question arises as to how incumbents should incorporate their digital transformation activities. Several options and interesting questions arise in this matter that future research may investigate on:

- *Which forms of organizational architecture are most suitable for digital transformation?* Seamless integration of digital technologies requires building an agile and scalable digital infrastructure that enables continuous scalability of new initiatives (Sia et al. 2016). For example, Resca et al. (2013) suggest a platform-based organization. In addition, digital transformation demands a new kind of enterprise platform integration (El Sawy et al. 2016). Given the high intensity of interactive digital connectivity between the outside and inside of a company, traditional enterprise platforms (like ERP) and the 'old' supply chain management integration paradigm are in many cases not the most suitable solution anymore. Therefore, flexible IT is a key transformation

Table 3 Integrative agenda for future research on digital transformation

Research topic	Corresponding second order theme	Source	Exemplary Research Questions
<i>Integration of digital transformation within organizational structures and activities in incumbent firms</i>	Technology Capability and Integration	Review of: DT, TD	<p>'How, when, and why are different forms of organizational architecture most suitable/detrimental for digital transformation?' (e.g. platform-based, flexible IT, open innovation)</p> <p>'When and why is it an advantage/disadvantage to start digital transformation in a new organization which is completely independent from traditional business, as suggested by technological disruption research? Under what circumstances and why do spill-over-effects to the parent organization happen/not happen?'</p> <p>'How, when, and why do incumbents benefit from taking a 'let a hundred flowers bloom' philosophy by starting digital initiatives across all divisions simultaneously and locally to encourage broad experimentation?'</p> <p>'How, when, and why do incumbents benefit from taking a 'launch, learn, pivot' approach by starting with a pilot transformation project in a smaller market or subsidiary?'</p>
<i>Pace of digital transformation</i>	Pace of Change and Time to Market	Review of: DT	'What are the parameters that define the pace of change?'
<i>The role of middle management in digital transformation</i>	Transformative Leadership	Review of: DT, CE	<p>'Why do industries adopt to digital transformation at a different speed? What are the parameters that define whether an industry is more or less transformative?'</p> <p>'It may be assumed that in a 'digitally transformed' company, the role of middle managers transforms in terms of identity and job tasks. What is precisely changing? How and why do middle managers react to these changes?'</p>

Table 3 (continued)

Research topic	Corresponding second order theme	Source	Exemplary Research Questions
<i>The role of middle management in digital transformation</i>	Transformative Leadership	Review of: DT, CE	‘What kind of responsibilities and functions in middle management hierarchy are required to accelerate digital transformation?’ (e.g. business-process management layers or central administration platforms that can be shared across multiple initiatives)
			‘Which mindset and digital literacy do middle managers need to drive digital transformation processes? How, when, and why are middle managers motivated/not motivated to drive digital transformation?’
<i>Growing skills gap and threat of an employee divide</i>	Work Environment	Review of: DT	‘How and why is digital transformation affecting the interface of the top management team and middle managers?’
			‘What is the impact of digital transformation on the overall importance of the middle management layer?’
			‘How, when and why are incumbents able/unable to mitigate a growing skills gap and employee divide in the face of digital transformation? How could different levels of knowledge and experience residing within different employees be integrated in the context of digital transformation?’
			‘How are incumbents able/unable to incorporate <i>old</i> and <i>new</i> capabilities simultaneously within their organization to master the challenge of technological ambidexterity?’

Table 3 (continued)

Research topic	Corresponding second order theme	Source	Exemplary Research Questions
<i>Cooperation with startups and pure tech companies to accelerate digital transformation</i>	Company Culture	Review of: DT, CE	<p>'Who in the company is managing the development and transformation of skills and how, when and why does that impact outcomes of digital transformation?' (e.g. HR, senior leadership, IT division, functional teams, employees etc.)</p> <p>'What are the constituent pillars of a digital culture which for example can be observed in successful start-ups?'</p> <p>'What are the benefits of employee exchange programs with technology companies and start-ups to scale-up digital skills?'</p>

DT digital transformation, *TD* technological disruption, *CE* corporate entrepreneurship

resource in the digital world (Cha et al. 2015). Pursuing an open innovation approach might be another alternative for incumbents.

- *When and why is it an advantage/disadvantage to start digital transformation in a new organization which is completely independent from traditional business, as suggested by technological disruption research? Under what circumstances and why do spill-over-effects to the parent organization happen/not happen??* For example, Ravensburger AG, a German toy and jigsaw puzzle company, founded Ravensburger Digital GmbH as a subsidiary in 2009. The purpose of the subsidiary was to become the firm's digital competence center. In 2017, the digital subsidiary was reincorporated in the parent organization as a digital unit with the goal to apply their digital knowledge to transform the traditional business segments. We call for more qualitative case study research devoted to this question to develop our understanding in this topic.
- *How, when, and why do incumbents benefit from adopting a 'let a hundred flowers bloom' philosophy versus taking a 'launch, learn, pivot' approach?* In the first scenario, a company would start its digital initiatives across all divisions simultaneously and locally to encourage broad experimentation. Such an approach was adopted by AmerisourceBergen Corp., an American drug wholesale company. The company is convinced that digital transformation is a matter of culture that needs to be established across the entire organization. For this purpose, it implemented agile project teams throughout the entire enterprise, of which each focused on different aspects. On the downside, companies following such a broad approach may risk losing focus and at some point, the various initiatives may start competing against each other. Hence, we believe it is crucial to have a big picture in mind and accordingly allocate resources and attention very thoughtfully. Alternatively, incumbents may start with a pilot transformation project in a smaller market or subsidiary. Arguably, a major advantage is the opportunity to assure that customers are happy with the transformation results and everything is working out well before starting the large roll out in other markets. And it provides incumbents time to fine-tune their initiatives. For example, American medical company Alcon premiered their initial transformation efforts in Brazil before ramping up their rollout in 27 further countries.

6.2 Pace of digital transformation

The rapid pace of technological change is perhaps the most defining characteristic of digital transformation in distinction to previous IT-enabled transformations. Yet, as this topic is only addressed by four papers in our sample it is still to be studied in more depth. For example, there is consensus among the studies that the pace of change has accelerated significantly, however the parameters that define the pace of change remain yet to be defined. Further, we are informed that some industries like the newspaper business have been digitally transformed within a very short period of time (Karimi and Walter 2015), while other branches are still under transformation or are yet to be converted. We posit two exemplary research questions regarding the pace of digital transformation:

- *What are the parameters that define the pace of change?* Our review reveals that the speed of product launches (Bharadwaj et al. 2013) and the time it takes to turn an idea into a business (Vey et al. 2017) are two potential indicators, but we certainly need to obtain a more comprehensive conceptualization at this point.
- *Why do industries adopt to digital transformation at a different speed?* For example, consider front-runner industries like the media or publishing versus late-comers such as oil and gas. In this specific case, the easiness to dematerialize and digitize the product portfolio is certainly a main reason. However, other industries are less obvious, and we would like to invite future research to investigate upon these conditions. What are the parameters that define whether an industry is more or less transformative?

6.3 The role of middle management in digital transformation

We have learned from our review of the corporate entrepreneurship literature that middle managers are the locus of organizational transformation in incumbent firms (Floyd and Wooldridge 1999; Hornsby et al. 2002, 2009; Shimizu 2012). While top management controls the level and rate of change, middle managers are in charge of execution (Burgelman 1983). Hence, one may conclude that middle managers are the kingpin of digital transformation. Yet, there is not a single paper in our sample that covers a middle management perspective in digital transformation. We believe that this subject has been highly neglected in research to this point and deserves far more attention in future. Several topics are particularly interesting:

- *How and why is digital transformation affecting the role, tasks and identity of middle managers? How and why do middle managers react to these changes?* Based on our review, we expect a deep change in the nature of middle management's role and influence in a 'digitally transformed' company ranging from administration to leadership aspects. Middle managers require a new attitude as they move from directing and controlling stable processes and people at the middle of hierarchy to managing resources and connecting people in the middle of networks. In addition, middle managers in the digital era must step up to their role of supporting, enabling, and coaching people to use the available digital tools. They are expected to facilitate the organization.
- *What kind of new responsibilities and functions in middle management hierarchy are required to accelerate digital transformation?* The odds are that change fatigue might grow on employees and digital transformation may start faltering. For this purpose, horizontal functions such as business-process management layers or central administration platforms may be implemented (McKinsey & Company 2017). They could be shared across multiple initiatives within the organization and help to accelerate transformation.
- *Which mindset and digital literacy do middle managers need to be the driving force behind digital transformation? How, when, and why are middle managers motivated/not motivated to drive transformation?* Research on corporate entrepreneurship emphasizes that middle managers are often the least likely to sup-

port change as they are inherently risk-averse, hardly entrepreneurial and very attached to their functional routines (Thornberry 2001). In addition, middle managers may easily get stressed about their ‘sandwich’ position in-between senior management and the operational level. So how can we expect middle managers to be the speedboat of digital transformation? Also, incumbents need to carefully evaluate the existing digital skills and literacy of their middle managers. How comfortable do they feel with digital tools, social media, the cloud and similar trends? They may not fulfill their coaching and leadership role if they heavily struggle with technology in the first place.

- *How and why is digital transformation affecting the interface of the top management team (TMT) and middle managers?* The relationship between the TMT and middle managers is a very special and important relationship which significantly affects both strategy formulation and the quality of implementation. Middle managers are the organizational ‘linking pins’ between top and operational level and thus heavily rely on a good exchange with their superiors. To what extent and in which ways does digital transformation affect this special leader–follower relationship? How are digital technologies changing the speed and quality of information exchange? What is the impact on the inter-personal level?
- *What is the impact of digital transformation on the overall importance of the middle management layer?* Since the 1950s, research indicates the decline of middle managers in terms of both numbers and influence (Dopson and Stewart 1993; Leavitt and Whisler 1958; Pinsonneault and Kraemer 1997). The shift in emphasis from planning and controlling to speed and flexibility is severely affecting the assumedly ‘slow’ middle. Are middle managers afraid that digital technologies will replace most of their traditional tasks and functions, e.g. communicating and monitoring strategy? Will digitalization naturally empower lower level operational managers at the bottom and consequently eliminate the middle layer?

6.4 A growing skills gap and threat of an employee divide

Given the complexity and explosive pace of digital technologies, there is a threat of a growing skills gap between pre-digitization workers and recently hired digitally savvy employees (Kohli and Johnsons 2011). A couple of topics are particularly interesting for future research:

- *How, when and why are incumbents able/unable to mitigate a growing skills gap and employee divide in the face of digital transformation?* Given the increased complexity of digital technologies, traditional IT trainings may not be effective anymore. In a similar vein, *how could different levels of knowledge and experience residing within different employees be integrated in the context of digital transformation?* Future research might examine the mechanisms required for facilitating or hindering such an integration.
- *How and when are incumbents able/unable to incorporate ‘old’ and ‘new’ capabilities within their organization?* On the one hand firms need to develop new

capabilities to continuously transform their business, while on the other hand they must leverage their existing knowledge and skills in order to maintain their existing operations. Thus, for the time of transformation incumbents need to develop multiple, often inconsistent competencies simultaneously. In this context, *how do firms ensure not to lose focus while mastering the challenge of ambidexterity in times of digital transformation?*

- *Who in the company is managing the development and transformation of skills (e.g. HR, senior leadership, IT division, functional teams, employees etc.), and how and why does that impact outcomes of digital transformation?* This question is not addressed by current research at all. However, according to a survey (Capgemini Consulting 2013) this lack of alignment with digital strategy is rather worrisome. Responsibilities for skills transformation and development in times of digitization need to be clearly defined and allocated. Empirical academic research in this direction might be helpful to understand the status-quo in incumbent firms regarding this issue.

6.5 Cooperation with startups and pure tech companies to accelerate digital transformation

Corporate entrepreneurship proposes a closer cooperation and regular exchange between incumbents and start-ups in order to accelerate entrepreneurial transformation (Engel 2011; Kohler 2016). In fact, start-ups are often perceived as the forerunners of digital transformation. They are praised for faster innovation capabilities, higher levels of agility, a culture of risk-taking, and supremely digitized processes and workflows. In contrast, incumbents have more experience, access to capital, established brand trust and a huge customer base. Hence, a cooperation between start-ups and incumbents may be beneficial for both parties. In addition, non-tech incumbents may also consider cooperating with pure digital players which are beyond their start-up phase but are important knowledge carriers in digital matters. Two topics are particularly interesting:

- *Assuming that successful start-ups have a good digital culture—what are the constituent pillars of such a digital culture? And how could incumbents incorporate these “best practices” and “lessons learned”?*
- *What are the benefits of employee exchange programs with technology companies or start-ups to scale-up digital skills?* For example, in early 2008 consumer goods giant Procter and Gamble and Google have been swapping two dozen employees in an effort to foster creativity, exchange thoughts on online advertisement and strengthen their mutual relationship. This program worked very well for both sides.

7 Limitations and conclusion

Our review is not without limitations. First, the specific objectives and nature of our filtering process applied during the review naturally come with a certain selection bias. For example, data collection, analysis and interpretation remain

influenced by the subjective assessments of the researchers. Also, despite being the common rule within systematic literature reviews, searching exclusively in peer-reviewed academic journals might have omitted some relevant research contained in books or dissertations. However, by means of a rigorous and transparent search process, an as complete as possible review sample was collected and analyzed subsequently. Second, using a high-level thematic map for such a complex multi-dimensional phenomenon like digital transformation highlights particular connections while it potentially fails to capture others. Specifically, critics may point to the lack of analytical depth within each second order theme. However, we believe that within the limited scope of a review our broad thematic description nevertheless adds value to the advancement of this field and should rather be seen as a holistic starting point for future research to dive deeper into the characteristics of sub-themes of digital transformation. Finally, we are aware that our focus on the organizational level of digital transformation within the private sector does not fully capture the implications of digital transformation for our society, as it also occurs at various other levels, such as the individual level or public sector. As such, future researchers may apply alternative approaches to review and synthesize the existing literature on digital transformation. For example, in contrast to our inductive method to code and analyze our sample, it may also be interesting to apply a more deductive and pre-structured method, in particular when focusing on a deeper understanding of the sub-themes emerging from our analysis. Accordingly, future research could benefit from adopting a phenomenon-based research strategy as proposed by von Krogh et al. (2012).

Concluding, our paper contributes to the extant discussion by consolidating, mapping and analyze the existing research on digital transformation, sharing important macro- and microlevel observations in the literature and proposing corresponding future research directions. Emerging from our review of 58 studies, we develop a thematic map which identifies technology and actor as the two aggregate dimensions of digital transformation and that elaborates on the predominant contextual concepts (second order themes) within these dimensions. From a macrolevel perspective, we observe that the status-quo of digital transformation literature is rather diverse, in a sense that papers discuss topics across various clusters and concepts. Further, we find some degree of diversity in the theoretical foundations drawn upon as well as confirm that the existing literature in general is scarce regarding quantitative empirical evidence. Another important contribution of our paper is bringing different lenses together by integrating knowledge from related disciplinary areas outside IS management, such as technological disruption and corporate entrepreneurship. With our review, we hope to provide a comprehensive and solid foundation for the ongoing discussions on digital transformation and to stimulate future research on this exciting topic.

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Appendix

See Tables 4, 5, 6 and 7 and Figs. 5 and 6.

Table 4 Distribution of sample across journals

Journal	ABS 2015 ranking	Quantity
MIS Quarterly	4*	13
MISQ Executive	2	10
Journal of Strategic Information Systems	4	3
Information Systems Journal	3	3
International Journal of Information Management	–	3
International Journal of Advanced Corporate Learning	–	3
Technological Forecasting and Social Change	3	2
Management Decision	2	2
Business Horizons	2	2
Academy of Management Journal	4*	1
Journal of Management Information Systems	4*	1
Information Systems Research	4*	1
International Journal of Research in Marketing	4	1
Harvard Business Review	3	1
MIT Sloan Management Review	3	1
European Journal of Information Systems	3	1
Industrial Management and Data Systems	2	1
Business and Information Systems Engineering	2	1
Business Strategy Review	1	1
Journal of Theoretical and Applied Electronic Commerce Research	1	1
Strategy and Leadership	–	1
Business Information Review	–	1
Human Systems Management	–	1
International Journal of Arts Management	–	1
International Journal of Retail and Distribution Management	–	1
Journal of Media Business Studies	–	1

Table 5 Database-digital transformation sample (58 Studies, in alphabetical order)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Alos-Simo et al. (2017)	Industrial Management and Data Systems	Quantitative (181 incumbent firms)	Spain	Empirical results provide significant evidence that adaptive culture is the vehicle by which transformational leaders positively influence digital transformation
Bennis (2013)	MIS Quarterly	Conceptual	U.S	Information ubiquity in a digital world raises exposure of leaders to the public. Thus, effective leadership in a digital world needs to be learned through embracing information-driven transparency and adaptive capacity
Berman (2012)	Strategy and Leadership	Conceptual	U.S	The article identifies changing consumer behavior and consumer knowledge about products and service offerings due to digital technologies. In this new marketplace, businesses need to engage with their customers at every point in the process of value creation and furthermore develop capabilities to design and deliver new business models

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Bharadwaj et al. (2013)	MIS Quarterly	Conceptual	U.S	Four key themes are identified to guide the thinking on digital business strategy and help provide a framework to define the next generation of insights. The four themes are (1) the scope of digital business strategy, (2) the scale of digital business strategy, (3) the speed of digital business strategy, and (4) the sources of business value creation and capture in digital business strategy. The authors define digital business strategy as the fusion of IT strategy and business strategy
Cha et al. (2015)	Management Decision	Case study (10 cases—5 firms that reported successful IT-enabled OT and 5 that reported less successful)	Australia	This study develops an integrative model of IT-enabled organizational transformation (OT). Specifically, three important findings are provided. First, flexible IT and policies were found to be key transformation resources. Second, training, teamwork, leadership, and project ownership were identified as key transformation capabilities. Third, strategic outcomes such as responsiveness, customer satisfaction, and business scope were suggested as key transformation outcomes

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Chatterjee et al. (2002)	MIS Quarterly	Quantitative (62 companies from various industries)	U.S	This paper draws upon institutional theory and the conceptual lens of structuring and metastructuring of three factors—top management champions, strategic investment rationale, and extent of coordination—in achieving higher levels of Web assimilation within an organization
Daniel and Wilson (2003)	European Journal of Information Systems	Case study (13 managers from 5 organizations within the domain of e-business transformation)	U.K	This study identifies eight distinct dynamic capabilities associated with e-business transformation. These capabilities fall into two groups. One group is associated with the need for innovation due to the characteristics of the e-business environment, while the second group relates to the need to incorporate or integrate e-business in the existing operations of the business

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Dijkman et al. (2015)	International Journal of Information Management	Mixed methods (11 interviews with IoT informants and an online survey with 103 IoT professionals)	International	IoT applications will support the co-creation of products and services with customers and strengthen customer relationship. Thus, the most important building blocks that constitute an IoT business model are the value proposition, customer relationships and key partnerships
Dremel et al. (2017)	MIS Quarterly Executive	Case study (AUDI AG)	Germany	The authors focus on the topic of big data analytics as an enabler of a transformation that can lead to competitive advantage. The article illustrates how Audi drives digitalization towards harnessing digital opportunities in digital business models and data-driven services in a three-stage journey of increasingly strategic big data analytics. The authors conclude with five learnings with actionable guidance for senior executives on how enterprises can evolve toward digitization through increasingly effective use of data and analytics

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
El Sawy et al. (2016)	MIS Quarterly Executive	Case study (LEGO)	Denmark	This paper describes the decade-long journey of LEGO to transform into a digital leader with products, marketing, and its IT platform. Among others, the authors argue that digital transformation demands a new kind of enterprise platform integration, a new digital workplace, and a different kind of people mindset
El Sawy et al. (2010)	Information Systems Research	Conceptual	U.S	The concept of digital ecodynamics is presented and defined as the holistic confluence among environmental turbulence, dynamic capabilities and IT systems—and their fused dynamic interactions unfolding as an ecosystem
Evens (2010)	Journal of Media Business Studies	Conceptual	Belgium	Digitization blurs boundaries between previously distinct access networks and technologies (in media, telecommunication and computing), and affects industry architectures and business models within the media ecosystem. With the emergence of multi-media platforms, value in the digital broadcasting industry is being gradually more created through the establishment of value networks

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Gerth and Peppard (2016)	Business Horizons	Conceptual	U.S. and Germany	The paper presents five major causes for Chief Information Officer (CIO) derailment: (1) misunderstanding the transition, (2) ambiguity in defining IT success, (3) ambiguity in role expectations, (4) poor relationship management with peers, and (5) pushing change at the wrong pace. CEOs must recognize the value and contribution that a CIO can bring and actively engage with the CIO and with all digital matters to create an environment that enables successful digital transformation

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Granados and Gupta (2013)	MIS Quarterly	Conceptual	U.S	The article addresses market transparency related to the disclosure of information outside the boundaries of the enterprise. The authors contend that there is a greater need for a transparency strategy in a digital environment. They articulate the informational elements of an effective transparency strategy and some of the strategic options around it (disclosing, distorting, biasing, and concealing). Further, it is argued that digital technologies increasingly reduce the information asymmetries between sellers and buyers
Grover and Kohli (2013)	MIS Quarterly	Conceptual	U.S	This article propose that a firm's digital business strategy must balance its system—software, process, and information—visibility with the ability to appropriate value from such systems. Through a visibility-value framework the authors illustrate the tradeoffs involved in making these choices. Further, the high pace of digital transformation increases the overall speed-to-market

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Günther et al. (2017)	Journal of Strategic Information Systems	Systematic literature review (67 papers on big data value realization)	Netherlands	This in-depth systematic review of IS literature on big data identifies six debates central to how organizations realize value from big data, at different levels of analysis. Based on this review, two socio-technical features of big data that influence value realization are identified: portability and interconnectivity. The authors argue, in practice, organizations need to continuously realign work practices, organizational models, and stakeholder interests in order to reap the benefits from big data

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Hagberg et al. (2016)	International Journal of Retail and Distribution Management	Conceptual	Sweden	Digitalization transforms the following four elements of the retailer-consumer interface: (1) retailing exchanges (in a number of ways and in various facets of exchange, including communications, transactions, and distribution), (2) the nature of retail offerings (blurred distinctions between products and services, what constitutes the actual offering and how it is priced), (3) retail settings (where and when retailing takes place), and (4) the actors who participate in retailing (i.e. retailers and consumers, among other parties)
Hansen and Sia (2015)	MIS Quarterly Executive	Case study (Hummel, a Danish/German sports and fashion products company)	Denmark and Germany	Four major lessons learned can be derived regarding digital omnichannel strategies from studying the digital transformation journey of Hummel: (1) embrace channel partners in the omnichannel strategy, (2) recognize that a successful omnichannel strategy requires deep change, (3) leverage the strategic role of the Chief Digital Officer (CDO), and (4) evolve the role of the CIO in enabling an omnichannel strategy

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Hess et al. (2016)	MIS Quarterly Executive	Case study (3 German media companies: ProSiebenSat.1 Media SE; Mittelbayerische Verlag AG; Ravensburger AG)	Germany	The article proposes 11 strategic questions for managers confronted with digital transformation, all grouped along the following four dimensions of digital transformation, as suggested by the authors: use of technologies, changes in value creation, structural changes and financial aspects
Hu, Huang et al. (2016)	International Journal of Information Management	Case study (Red Collar Group, a Chinese suit manufacturer)	China	This case study provides three major lessons learned regarding corporate entrepreneurship in times of digitization: (1) corporate entrepreneurship is evident in different stages during an organization's transformation into a digital ecosystem, (2) the fundamental goal of organizational transformation lies in the construction of a digital ecosystem, and (3) the development of such a digital ecosystem is a process of co-evolution, in terms of the complex interplay between competitive and cooperative business strategies

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Ives et al. (2016)	MIS Quarterly Executive	Conceptual	U.S	IoT technologies enable direct real-time customer relationships. Also, incumbents must be aggressive in pursuing the advantages of digital data streaming via the Internet of Things (IoT), since they have many advantages over startups, such as the ability to leverage their larger scale and scope, give customers greater assurances of security and reliability, and take advantage of the trust and brand loyalty they have already established with customers
Karimi and Walter (2015)	Journal of Management Information Systems	Quantitative (136 responses from senior executives from the newspaper industry through a web survey)	U.S	Empirical results suggest that first-order dynamic capabilities that are created by changing, extending, or adapting a firm's existing resources, processes, and values are positively associated with building digital platform capabilities, and that these capabilities impact the performance of response to digital disruption

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Keen and Williams (2013)	MIS Quarterly	Conceptual	U.S	The article argues that digital business strategy will be driven by value architectures rather than business models. In digital business, the buyer determines value and value is a function of the choice space rather than the product or service. As such, value is always shifting and a moving target
Kohli and Johnson (2011)	MIS Quarterly Executive	Case study (Encana Oil and Gas Inc.: multiple interviews with key IS and business leaders in the period from 2009-2010)	U.S	Two major insights are provided in the article. First, industries with non-physical products may digitize their production and supply chain processes to gain greater visibility Second, from a work environment perspective digitization may lead to a growing skills gap between pre-digitization employees and recently hired digitally savvy employees

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Kohli and Melville (2019)	Information Systems Journal	Systematic literature review (161 articles on digital innovation)	U.S	The authors undertook a systematic review of the digital innovation literature according to a theoretical framework comprising 7 dimensions: initiation; development; implementation; exploitation; the role of the external competitive environment; role of internal organizational environment; and product, service, and process outcomes. From a macro perspective, they identify uneven coverage of research streams, both diversity and diffusiveness, and knowledge and learning as an underlying conceptual pillar. Several areas of future research are proposed
Lanzolla and Anderson (2008)	Business Strategy Review	Conceptual	U.K	The paper researched current transformations in media, telecommunications and technology companies and identifies three specific trends—digital interactions, digital distribution and ubiquitous digital reach

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Leong et al. (2017)	International Journal of Information Management	Case study (16 in-depth semi-structured interviews with executives and employees from FinTech start-up 007fenqi)	China	Digital transformation is disrupting even highly regulated markets such as banking and finance. The development of an ecosystem-based business model that consists of not only lending services, but also the spending and earning channels, may open up new revenue streams while lowering operational risks
Li et al. (2017)	Information Systems Journal	Qualitative (7 Chinese SMEs on the Alibaba digital platform)	China	Based on qualitative research on seven Chinese SMEs, a process model is derived that aims to describe and explain how SME entrepreneurs, with support from a digital platform service provider, drive digital transformation through managerial cognition renewal, managerial social capital development, business team building, and organizational capability building
Liu et al. (2011)	Management Decision	Case study (17 interviews with representative from CBC Bank)	Taiwan	The study demonstrates that managing digital transformation can be challenging, and that awareness of, and preparedness for, analysis of both the resources/capability and external demands through the resource fit perspective are necessary

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Llopis et al. (2004)	Human Systems Management	Case study (Telefonica Group)	Spain	Three lessons learned can be derived from Telefonica's organizational transformation towards a digital culture: (1) leadership has a key role throughout the entire process, (2) it is difficult to adapt the current budget scheme to the financing of internet-related initiatives, and (3) efforts must be concentrated on customers and their training to use technology
Loebbecke and Picot (2015)	Journal of Strategic Information Systems	Conceptual	Germany	The authors expect digitization and big data analytics to hit knowledge-based business models and cognitive workers as hard as non-knowledge business models and manual workers. Also, digitization breaks down traditional hierarchical work structures and transforms them into flexible networked structures across locations

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Lyytinen et al. (2016)	Information Systems Journal	Conceptual	U.S	This article considers how the 'new materiality' afforded by digital technologies affects organizational and inter-organizational knowledge-related capabilities to innovate with products. It proposes a framework of digital product innovation networks and explores some characteristics of digital information infrastructures that can support highly digitized forms of innovation networks. Further, the authors argue that the movement towards anarchic forms of innovation networks is an inevitable journey for organizations that want to embrace the generative capacity of digitally induced product innovation

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Majchrzak et al. (2016)	MIS Quarterly	Conceptual	U.S	In their introductory commentary to a MISQ Special Issue, the authors discuss four major implications for researchers interested in societal and business change in the context of information and communication technologies (ICTs): researchers (1) should expand their definitions of theory to include theories of the problem and theories of the solution, (2) explicitly define the ICT artifact, include affordances and constraints, and explicitly examine the unintended consequences of the ICT artifact, (3) consider emergent digital designing as a replacement for organizations, (4) couple research findings with public policy and regulation recommendations where relevant
Markus and Loebecke (2013)	MIS Quarterly	Conceptual	U.S. and Germany	Markus and Loebecke develop the notion of the larger unit of analysis as a business community to accommodate the possibility of overlapping ecosystems with multiple orchestrators. This brings into play the notion of a community platform that is tailored for use by all members of a community

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Matt et al. Benlian (2015)	Business and Information Systems Engineering	Conceptual	Germany	Digital transformation strategies have a cross-functional character and need to be aligned with other functional and operational strategies. Given the rather recent appearance of DT strategies, further evidence is needed as to how this alignment can be conducted in practice. Further, the article proposes that digital technologies imply significant changes in value creation
Mazzei and Noble (2017)	Business Horizons	Conceptual	U.S	The authors develop a framework which proposes three tiers of value creation due to big data phenomenon: (1) data as a tool to improve problem solving and decision making, (2) data as an industry, with spin-offs and new ventures specialized on big data, and (3) data as a strategy for companies by building data resources to develop innovative business models

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Mithas et al. (2013)	MIS Quarterly	Quantitative (400 firms and 1225 firm-year observations from 1999 to 2006)	U.S	Findings imply that digital business strategy is not solely a matter of optimizing firm operations internally or of responding to one or two focal competitors, but also arises strikingly from awareness and responsiveness to the digital and business competitive environment
Moreau (2013)	International Journal of Arts Management	Conceptual	France	The case study shows that digitization matches the characteristics of disruptive innovation as described in the literature. It explains why established firms initially paid little heed to an innovation leading to a product (digital music files) that is cheaper and lower-quality than their existing product (CDs) and ill-suited to their mainstream consumers
Ng and Wakenshaw (2017)	International Journal of Research in Marketing	Conceptual	U.K	Data storage capabilities and computing speed have enabled data collection at an unprecedented scale. Moreover, digitization and IoT applications are changing the role and significance of data itself (data as a service). Thus, in the digital era, personal data is the most powerful yet contentious aspect of IoT

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Pagani (2013)	MIS Quarterly	Qualitative black-box modelling (45 industry experts from 15 leading companies in Europe and the United States from 2000 to 2008)	International	This study shows that in order to survive in an increasingly uncertain and complex environment, the firm has to transform its organizational intelligence into a new relational intelligence, enacting an open communication process with its stakeholders
Rayna and Striukova (2016)	Technological Forecasting and Social Change	Conceptual	France and U.K	3D printing technologies have the potential to change the way business model innovation is carried out, by enabling adaptive business models and by bringing the 'rapid prototyping' paradigm to business model innovation itself. Further, the authors argue that digitization leads to 'dematerialization' by turning tangible objects into intangible ones

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Resca et al. (2013)	Journal of Theoretical and Applied Electronic Commerce Research	Case study (Midblue project)	Italy	A theoretical framework is proposed that combines three perspectives. First, the importance of digital architectures in the modalities through which firms organize for innovation is stressed. Second, organization as a platform outlines a scenario for generating multiple organizational forms based on recombination of existent resources, routines and transactions. Third, digital platforms are seen as determinant tools for a dematerialization process that consents to recombine the factors of production for achieving a competitive advantage
Rigby et al. (2016)	Harvard Business Review	Conceptual	U.S	Agile methods such as scrum, kanban, and lean development are spreading beyond IT to other functions. In their conceptual paper, the authors argue that the concept of agility may be a useful approach to create a new generation of skilled general managers for the digital era

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Rindova and Kotha (2001)	Academy of Management Journal	Case study (Yahoo! and Excite)	U.S	This study represents an early application of dynamic capabilities in the context of e-business. The findings suggest that digitization demands continuous company-wide transformations (labelled as 'continuous morphing'). Continuous morphing is an important mechanism for renewing competitive advantage in transient environments
Sambamurthy et al. (2003)	MIS Quarterly	Conceptual	U.S	This paper introduces a theoretical perspective which highlights three important dynamic capabilities (digital options, agility, and entrepreneurial alertness) and three strategic processes (capability-building, entrepreneurial action, and coevolutionary adaptation) within the nomological network of influences that mediate between IT investments and capabilities and firm performance

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Sandström (2016)	Technological Forecasting and Social Change	Case study (25 interviews with key individuals who have been in charge of shifting the hearing aid industry towards 3D printing)	International	Transition to 3D printing is partially associated with competence destruction, meaning that firms need to develop new skill sets. While it is important to do so at an early point, first movers faced extensive technological uncertainty. Waiting until the dominant design and reduced uncertainty therefore seems to be an important success factor
Schuchmann and Seufert (2015)	International Journal of Advanced Corporate Learning	Case study (11 banking organizations)	Germany	The paper identifies organizational learning as an enabler for digital transformation. Concludingly, successful digital transformation begins with understanding digital consumer behavior, preferences and choices. It then leads to major consumer-centric changes within the organization that address these needs

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Sebastian et al. (2017)	MIS Quarterly Executive	Case study (25 medium and large companies)	U.S	This article describes findings from a study of 25 companies that were embarking on digital transformation journeys. The authors identify two digital strategies—customer engagement and digitized solutions—that provide direction for a digital transformation. Two technology-enabled assets are essential for executing those strategies: an operational backbone and a digital service platform
Setia et al. (2013)	MIS Quarterly	Quantitative (70 branches of a large Indian bank)	India	The authors show how information quality acts as a key digital resource and a critical antecedent to customer-side dynamic capabilities that enable a rapid sense-and-respond to customer needs. This study provides insights for how local business processes and digital design can influence an enterprise's customer-side response capabilities and digital business strategy

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Seuvert and Meier (2016)	International Journal of Advanced Corporate Learning	Conceptual	Switzerland	Digital transformation requires not only general skills and attitudes. These skills and attitudes have to be applied and used in the specific functions and professional domains that constitute the organization. Digital transformation emerges when usage enables innovation and creativity that then leads to significant change—at the individual or organizational level
Sia et al. (2016)	MIS Quarterly Executive	Case study (12 interviews with executives from a large Asian bank)	Singapore	Digital business strategy demands strong leadership, the continuous navigation of the dynamic and emerging digital landscape, and an agile and scalable “core”. In addition, changes in leadership programs towards the digital context can be observed (e.g. participation in hackathons, e-forums)
Singh and Hess (2017)	MIS Quarterly Executive	Case study (10 interviews with executives and Chief Digital Officers from 6 companies)	Germany	The case shows that digitization leads to the establishment of new roles in the C-suite such as that of the Chief Digital Officer (CDO). The CDO needs a solid blend of digital/IT competences and management skills. However, the authors argue that this position may be a temporary phenomenon

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Swahn et al. (2017)	MIS Quarterly	Case study (Volvo Cars)	Sweden	This case study illustrates digital innovation at Volvo Cars. It specifically shows the paradoxes Volvo experienced while transitioning to the open connected car initiative, which externalizes software development of applications for the vehicle. In general, the case shows that incumbents may face four competing concerns as they embrace digital innovation: innovation capability, innovation focus, innovation collaboration, innovation governance
Tumbas et al. (2017)	MIS Quarterly Executive	Qualitative (35 interviews with Chief Digital Officers from various sectors)	Liechtenstein	Results from this qualitative article suggest three general types of CDOs (digital accelerator, digital marketer and digital harmonizer) which result from different reasons for establishing the role. Further, the authors identify specific domains where successful CDOs build digital capabilities and each of these domains is a focal domain for one of the identified CDO types: digital innovation, data analytics, and customer engagement

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
Vey et al. (2017)	International Journal of Advanced Corporate Learning	Conceptual	Switzerland	Facilitating a learning friendly culture by using different pillars is a way to generate innovation and to secure the existence of organizations in times of digital transformation. For this purpose, new roles and action areas for Learning and Development (L&D) professionals emerge, such as change agents and consultants, or innovation labs
Weill and Woerner (2015)	MIT Sloan Management Review	Conceptual	U.S	The author identifies a shift from controlling or participating in a linear value chain to operating in an ecosystem. Ecosystems offer greater customer choice, enhanced customer value and better customer experience. Incumbents should engage in open ecosystems based on relationships with complementary or even competing services to own the customer relationship

Table 5 (continued)

Authors (year)	Outlet	Methodology (sample)	Region	Key findings
White (2012)	Business Information Review	Conceptual	U.K	Digital transformation requires the introduction of digital workplaces. A digital workplace must be adaptive, compliant, imaginative, predictive, and location-independent. The adoption of digital workplaces needs to be initiated by senior management
Yeow et al. (2018)	Journal of Strategic Information Systems	Case study (Longitudinal case study of sportswear company Hummels)	Denmark	Empirical evidence is provided that as an organization shifts towards a digital strategy, misalignments between the emergent strategy and resources give rise to tension. This case study resulted in the development of an aligning process model that is comprised of three phases (exploratory, building, and extendional) and generalizable organizational aligning actions that form the organization's sensing, seizing, and transforming capacities

Table 6 Database—technological disruption and corporate entrepreneurship sample (28 and 32 studies respectively, in alphabetical order)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
<i>Technological disruption (28 studies)</i>				
Anderson and Tushman (1990)	Administrative Science Quarterly	Quantitative (Longitudinal data across three U.S. industries: cement, airplanes, mini-computer)	U.S	This paper empirically explores when and how dominant designs emerge from technological discontinuities and which firms pioneer dominant designs. The authors argue that a breakthrough innovation inaugurates an era of ferment in which competition among variations of the original break-through culminates in the selection of a single dominant configuration of the new technology
Bergek et al. (2013)	Research Policy	Case study (Two sets of comparative industry cases with various companies and experts)	International	Creative accumulation requires firms to handle a triple challenge of simultaneously (1) fine-tuning and evolving existing technologies at a rapid pace, (2) acquiring and developing new technologies and resources and (3) integrating novel and existing knowledge into superior products and solutions

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Berman et al. (2016)	Strategy and Leadership	Conceptual	International	To successfully guide innovations, companies should investigate opportunities to exploit new and emerging technologies or business models, or apply existing technologies in new ways, and look at other industries for ideas. To do so, the authors suggest using predictive and cognitive analytics to investigate new trends, identify new customer segments and make smarter business decisions
Bower and Christensen (1995)	Harvard Business Review	Conceptual	U.S	The paper argues that in order to successfully commercialize and develop disruptive technologies incumbents need to create organizations that are completely independent from the mainstream business. Once a spin off has become commercially viable in a new market, it should not be integrated into the mainstream organization

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Danneels (2004)	Journal of Product Innovation Management	Conceptual	U.S	The author challenges the findings proposed by Christensen (1997), who argues that incumbents tend to falter when faced with disruptive technologies. With reference to other studies, the author argues that incumbents were more likely to survive in the long term. Future research needs to address what the characteristics are of incumbents that do not fail
DaSilva et al. (2013)	Technology Analysis and Strategic Management	Case study (Salesforce, Amazon Inc. and Siebel Systems)	U.S	Findings suggest disruptive technology per se is not the reason for the collapse of large corporations, but rather the failure to adapt or create new business models to incorporate novel technology
Downes and Nunes (2013)	Harvard Business Review	Conceptual	U.S	To survive “big-bang” disruptions such as new digital platforms, incumbents need to develop new tools to detect radical change in the offering, new strategies to slow down disrupters, new ways to leverage existing assets in other markets, and a more diversified approach to investment

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Gans (2016)	MIT Sloan Management Review	Conceptual	Canada	Incumbents may develop three strategies in response to technological disruption within their industry: (1) attack by investing in the new disruptive technology, (2) cooperate with or acquire the market entrant, and (3) having critical assets that entrants lack and thus may buy time for the incumbent firm
Gawer and Cusumano (2014)	Journal of Product Innovation Management	Conceptual	U.K. and U.S	Industry platforms facilitate the generation of a potentially very large number of complementary innovations by tapping into the innovative capabilities of many external actors, and function as a technological foundation at the heart of innovative business ecosystems. In this sense, they guide technological innovation trajectories and stimulate innovation on complements

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Gerstner et al. (2013)	Administrative Science Quarterly	Quantitative (72 CEOs from 33 U.S. pharmaceutical companies)	U.S.	Based on a sample of 72 CEOs from U.S. pharmaceuticals, this study provides evidence that narcissistic CEOs of established firms will be relatively aggressive in their adoption of technological discontinuities. However, the effect of a CEO's narcissism on organizational outcomes will be moderated by audience engagement—the degree to which observers view a phenomenon as noteworthy and provocative. When audience engagement is high, narcissistic CEOs will anticipate widespread admiration for their bold actions and thus will invest especially aggressively in a discontinuous technology
Gilbert and Bower (2002)	Harvard Business Review	Conceptual	U.S.	When incumbents are being threatened by a disruptive innovation, the authors suggest to (1) separate business operations for better performance, (2) invest in stages, (3) cultivate outside perspective, (4) appoint an active integrator, (5) modularize integration, and (6) consider acquisitions

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Günzel and Holm (2013)	International Journal of Innovation Management	Case study (12 in-depth interviews with key informants from three Danish newspapers)	Denmark	There is a need to distinguish between front-end and back-end business model innovation processes, and to recognize the importance of organizational learning when incumbents are faced with disruptive technologies
Habtay and Holmén (2014)	International Journal of Entrepreneurship and Innovation Management	Mixed methods (88 strategic business units)	South Africa	Incumbents on average can succeed with disruptive market-innovation by being market orientated (MO), leveraging prior core competences and integrating the disruptive innovation under the same business unit that is responsible for traditional businesses
Hill and Rothaermel (2003)	Academy of Management Review	Conceptual	U.S	The authors identify a number of factors that help to explain incumbent performance in markets shaken by a radical technological innovation. These include among others investment in basic research to raise awareness of emergent technologies, the legitimization and institutionalization of autonomous action, and the creation of a stand-alone division to commercialize a radical technology

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Holm et al. (2013)	International Journal of Technology Management	Case study (Two Danish media companies: JP/Politikens Hus and Berlingske Media)	Denmark	Findings suggest that a more nuanced view and balanced understanding of the term 'openness' with regards to business models is needed. Yet, this study confirms that the business model is a useful conceptual and analytical device that can be used when studying the interrelations between technological discontinuities and business model adjustments
Johnson et al. (2008)	Harvard Business Review	Conceptual	U.S	This study proposes five strategic circumstances that often require business model innovation (BMD): (1) the opportunity to address through disruptive innovation the needs of large groups, (2) the opportunity to capitalize on a brand-new technology by wrapping a new business model around it (Apple and MP3 players) or the opportunity to leverage a tested technology by bringing it to a whole new market, (3) the opportunity to bring a job-to-be-done focus where one does not yet exist, (4) the need to fend off low-end disrupters, and (5) the need to respond to a shifting basis of competition

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Koen et al. (2010)	Research-Technology Management	Case study (7 case studies: 4 successful and 3 unsuccessful business model innovation projects at ADM, ConocoPhillips, and Newell-Rubbermaid)	U.S	The case studies identify five key dilemmas that companies face in pursuing business model innovation: (1) paradoxical leadership, (2) organizational complexity, (3) innovation management approach, (4) financial uncertainty, and (5) prior knowledge and experiences of team members
Lavie (2006)	Academy of Management Review	Conceptual	U.S	The paper presents a model of capability reconfiguration, integrating the Schumpeterian perspective on technological discontinuities with the dynamic capabilities literature to explain the responses of incumbents to technological change. The author identifies substitution, evolution, and transformation as three mechanisms of capability reconfiguration
Lucas and Goh (2009)	Journal of Strategic Information Systems	Case study (Kodak)	U.S	Kodak's middle managers, culture and rigid, bureaucratic structure hindered a fast response to new technology which lead to a 80% decline in its workforce, loss of market share, a tumbling stock price, and significant internal turmoil

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Obal (2013)	Industrial Marketing Management	Quantitative (134 IT managers)	U.S.	Evidence is given, that pre-existing, interorganizational trust developed by customers with incumbents has a positive influence on the adoption and diffusion of disruptive technology by established firms
von Pechmann et al. (2015)	Industrial and Corporate Change	Qualitative (Renault's ZE Initiative, a program to develop and market EV technology—observation over a 7-year period)	France	The article proposes three management levers for systemic and disruptive innovation scale-up: autonomous spanning units, a portfolio of viable local systems, and concurrent platform management
Roy and Sarkar (2016)	Strategic Management Journal	Quantitative (Database of 141 European, Japanese, and U.S. robot manufacturers from 1978 to 1987)	International	The study explores the relationship between a firm's organization and its ability to face a radical technological change. It is suggested that, during such a change, the presence of both in-house upstream knowledge and downstream market linkages, within a firm's boundary, has its advantages. Evidence is given that technologically pre-adapted incumbents with in-house users are more likely to be able to make a transition to the new technological paradigm even if it is radical in nature

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Sabatier et al. (2012)	Technological Forecasting and Social Change	Case study (22 interviews with experts from the drug industry from 2008 to 2009)	International	In mature industries experiencing strong discontinuities and high technological uncertainty, entrants' business models initially tend to fit into the industry's established dominant logic and its value chains remain unchanged. But as new technologies evolve, and uncertainty decreases, disruptive business models emerge, challenging dominant industry logics and reshaping established value chains
Shaughnessy (2016)	Strategy and Leadership	Conceptual	U.S	In the digital era, many firms have focused on technology as the source of disruptive innovation. However, with the arrival of the platform age the source of disruptive innovation is now the organizational form. The platform is a new way to organize wealth-creating activity

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Tongur and Engwall (2014)	Technovation	Case study (18 in-depth interviews with key participants involved in the "Slide-In Electric Road System" project)	Sweden	To survive during technology shifts, firms need to master the complexity of "double ambidexterity," i.e., not just the ambidexterity to simultaneously foster incremental and radical innovation, but also the ambidexterity to simultaneously advance both technological and business model innovation. Specifically, when developing new technology considered discontinuous, business model aspects need to be brought into the analysis early on
Tushman and Anderson (1986)	Administrative Science Quarterly	Quantitative (Longitudinal data across 3 U.S. industries: cement, airplanes, mini-computer)	U.S	The study empirically demonstrates that technology evolves through periods of incremental change punctuated by technological breakthroughs that either enhance or destroy the competence of firms in an industry. It is further shown that while competence-destroying discontinuities are initiated by new firms and are associated with increased environmental turbulence, competence-enhancing discontinuities are initiated by existing firms and are associated with decreased environmental turbulence

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Vecchiato (2017)	Technological Forecasting and Social Change	Case study (Motorola and Nokia: interviews with internal and external informants)	U.S. and Finland	Results show that a primary reason why incumbents fail to identify new markets in the face of disruptive technologies and therefore lose their leadership is the inability to recognize either the rising 'social' market, where customers use products for fulfilling their need for friendship, or the 'esteem' market, where customers use products for fulfilling their need for achievement
Yu and Hang (2010)	International Journal of Management Reviews	Literature review	Singapore	In this paper, a reflective review of the extant literature on disruptive innovation theory is presented. Seven potential future research directions are identified within this research domain. In addition, potential integrations with other research fields such as open innovation and others, further research on start-up firms and research methodology are discussed

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
<i>Corporate Entrepreneurship (32 Studies)</i>				
Ahuja and Morris Lampert (2001)	Strategic Management Journal	Quantitative (107 firms based on patenting activities between 1980 and 95)	International	Three organizational pathologies inhibit breakthrough inventions in large corporations: (1) the familiarity trap—favoring the familiar, (2) the maturity trap—favoring the mature, and (3) the propinquity trap—favoring search for solutions near to existing solutions
Birkinshaw (1997)	Strategic Management Journal	Mixed methods (39 separate initiatives in 6 subsidiaries of multinational corporations)	Canada	Entrepreneurship at the subsidiary level has the potential to enhance local responsiveness, worldwide learning and global integration
Burgelman (1983)	Management Science	Conceptual	U.S	Burgelman identifies CE with the autonomous strategic behavior loop model. Middle level managers play a crucial role in this through their support for autonomous strategic initiatives early on, by combining these with various capabilities dispersed in the firm's operating system, and by conceptualizing strategies for new areas of business. Top management's critical contribution consists in strategic recognition and support rather than planning

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Chen and Nadkarni (2017)	Administrative Science Quarterly	Quantitative (129 SMEs)	China	Results confirm that CEOs' temporal leadership—how they manage the temporal aspects of top management teams' activities—mediates the relationship between their temporal dispositions and corporate entrepreneurship—firms' innovation, corporate venturing, and strategic renewal activities. Also, CEOs' time urgency is positively related to their temporal leadership, which in turn is positively related to corporate entrepreneurship
Corbett et al. (2013)	Journal of Product Innovation Management	Literature review (8 publications from the CE domain)	U.S	Findings from the reviewed literature indicate that (1) TMT diversity and TMT network size are positively associated with a firm's pursuit of CE, while (2) TMT size has a negative effect on CE, particularly under higher levels of perceived technological uncertainty
Covin and Miles (1999)	Entrepreneurship Theory and Practice	Conceptual	U.S	A typology is presented of the forms in which corporate entrepreneurship is often manifested: sustained regeneration, organizational rejuvenation, strategic renewal, and domain redefinition

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Dess et al. (2003)	Journal of Management	Conceptual	U.S	This article identifies four major issues scholars can pursue to further the understanding about CE: (1) the various forms of CE (following the typology of Covin and Miles 1999), (2) their implications for organizational learning, (3) the role of leadership and social exchange in the CE process, and (4) the internationalization of CE. The authors adopt organizational learning theory as a means of integrating their discussion and highlighting the potential contributions of CE
Dushnitsky and Lenox (2005)	Research Policy	Quantitative (Panel of 2289 U.S. public firms during the period 1969–1999)	U.S	Corporate venture capital (CVC) programs may be instrumental in harvesting innovations from entrepreneurial ventures and thus an important part of a firm's overall innovation strategy
Engel (2011)	Research-Technology Management	Conceptual	U.S	The authors argue that the most disruptive innovations are those that go beyond technical discovery to embrace business model innovations that disrupt supply chains, disintermediate incumbents, and create new markets

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Floyd and Woodbridge (1999)	Entrepreneurship Theory and Practice	Conceptual	U.S	The study integrates concepts from knowledge theory and social network theory into the CE debate and highlights the importance of a mid-level management perspective in the CE process. It further offers an integrative model that explains how organizations overcome inertia in the capability development process
Guth and Ginsberg (1990)	Strategic Management Journal	Conceptual	U.S	The topic of CE encompasses two types of phenomena and the processes surrounding them: (1) the birth of new businesses within existing organizations, i.e. internal innovation or venturing; and (2) the transformation of organizations through renewal of the key ideas on which they are built, i.e. strategic renewal
Hornsby et al. (2002)	Journal of Business Venturing	Quantitative exploratory factor analysis (Interviews with 761 middle managers in 17 organizations)	U.S	This study identifies five internal organizational factors that influence middle managers to foster entrepreneurial activity within established companies: (1) management support, (2) work discretion/autonomy, (3) rewards/reinforcement, (4) time availability, and (5) organizational boundaries

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Hornsby et al. (2009)	Journal of Business Venturing	Quantitative (458 managers from different levels and companies)	U.S	The pos. relationship between managerial support and entrepreneurial action is more positive for senior and middle level managers than it is for lower- (first) level managers. Also, the pos. relationship between work discretion and entrepreneurial action is more positive for senior and middle level managers than it is for first-level managers. These findings suggest that managerial level provides a structural ability to "make more of" organizational factors that support CE
Ireland et al. (2009)	Entrepreneurship Theory and Practice	Conceptual	U.S	The paper outlines a model of the antecedents, elements, and outcomes of CE as an identifiable strategy. To possess such a strategy, firms must significantly display the three foundational elements of an entrepreneurial strategic vision, a pro-entrepreneurship organizational architecture, and entrepreneurial processes and behavior as exhibited throughout the organization. The outcomes of CE strategy include the development of competitive capabilities and strategic repositioning

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Karimi and Walter (2016)	Long Range Planning	Quantitative (148 responses from the newspaper industry through a web survey)	U.S	While autonomy, risk-taking, and proactiveness have positive associations with the extent of adoption of disruptive business model innovation, innovativeness does not. Further, disruptive business model innovation adoption has a non-linear association with business model performance
Kohler (2016)	Business Horizons	Qualitative (40 interviews with managers of corporate accelerators and startup teams)	U.S	To leverage startups' innovation and to make corporate accelerators an effective part of a firm's overall innovation strategy, managers need to systematically and thoughtfully consider the design dimensions of proposition, process, people, and place

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Kuratko et al. (2014)	Business Horizons	Conceptual	U.S	There are four key implementation issues that most corporations are not recognizing or responding to effectively when trying to promote corporate entrepreneurship: (1) understanding what type of innovation is being sought, (2) coordinating managerial roles, (3) effectively using operating controls, and (4) properly training and preparing individuals. Together, these four issues, if understood and appropriately addressed, help create an effective innovative ecosystem within the organization
Lant and Mezias (1990)	Strategic Management Journal	Computer simulation model	U.S	The paper proposes that the concept of CE can be better understood by viewing it through the lens of an organizational learning perspective. This learning framework is used in conceptualizing both the content and level of entrepreneurship. Three types of entrepreneurial strategies are represented by three different patterns of search behavior: fixed, imitative, and adaptive. Firms with adaptive strategies do less well over the long run than firms with imitative strategies, under conditions of high environmental ambiguity

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Ling et al. (2008)	Academy of Management Journal	Quantitative (CEOs and members of their TMTs in 152 SMEs)	U.S	The study provides empirical evidence that transformational CEOs influence TMTs' behavioral integration, risk propensity, decentralization of responsibilities, and long-term compensation and that these TMT characteristics impact corporate entrepreneurship
Marion et al. (2012)	IEEE Transactions on Engineering Management	Mixed methods (Pennsylvania and Massachusetts Small Business Development Centers & Inc. Magazine)	U.S	This study empirically reveals that successful start-ups use certain best practices in unique ways. They innovate with "hyper-agility" and implement (1) small omnifunctional teams with no functional boundaries, (2) goal-driven rapid development of technology rather than process guided methods, and (3) instinctive exploration of market potential rather than quantitative analysis

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Meyer et al. (1990)	Strategic Management Journal	Conceptual	U.S	Based on a historical analysis of the hospital industry, this paper classifies models of organizational change according to the primary mode of change (continuous or discontinuous) and the primary level at which change occurs (organization or industry) to yield four basic types of change: adaptation, metamorphosis, evolution, and revolution. These types influence organizations' adaptive responses, shape industries' competitive structures, and constrain researchers' methods of inquiry
Nason et al. (2015)	Small Business Economics	Literature review (157 articles on CE)	U.S	The literature review identifies how size confers CE competitive advantages via slack resources and resource structuring processes, but disadvantages via bureaucratic structures and resource bundling. Aware of these weaknesses, the authors suggest that small firms are more likely to utilize CE for growth to overcome liabilities of smallness, while large firms are more likely to utilize CE for learning to overcome liabilities of inertia

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Peltola (2012)	Business Horizons	Case study (Interview with the managing director of a Finnish B2B marketing services firm)	Finland	Regarding the implementation of a CE strategy, the following lessons can be drawn from the case study: (1) firms must analyze their history and their current way of doing business, (2) employees must understand what the firms stands for, now and in the future, (3) employee roles should be reorganized and redefined to meet long-term business demands, and (4) in order to expand the entire market, cooperations with competitors might be worth considering
Shimizu (2012)	Organization Science	Conceptual	Japan	Although an increasing degree of autonomy among middle and operational managers has positive effects on CE, too much autonomy is harmful to the success of CE by unexpectedly encouraging opportunistic behaviors and decreasing perceived fairness (increasing perceived unfairness)

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Thornberry (2001)	European Management Journal	Conceptual	U.S	The author proposes various obstacles to a successful implementation of corporate entrepreneurship in established companies, including superficial top leadership commitment, uncertainty about the firm's CE objectives, and low entrepreneurial levels of middle managers
Turner and Pennington (2015)	Small Business Economics	Quantitative (Survey data collected from 200 franchisees of one large U.S. organization)	U.S	Results demonstrate how knowledge sharing and organizational learning are associated with the motivation, opportunity, and ability to act within the corporate entrepreneurial context
Turró et al. (2014)	Technological Forecasting and Social Change	Quantitative (718,758 observations from the Global Entrepreneurship Monitor (GEM) database from 2004–2008)	International (62 different countries)	Findings highlight the impact of the environmental factors on organizational innovation, specifically on CE. Variables such as living in an entrepreneurial culture and media exposure (informal factors), and the number of procedures necessary to create a new business or access to finance (formal factors), appear to be significant for CE. Moreover, informal factors behave as moderators between formal factors and CE

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Urbano and Turró (2013)	International Entrepreneurship and Management Journal	Quantitative (339,071 observations from the Global Entrepreneurship Monitor (GEM) database from the years 2004–2008)	International (9 different European countries)	The results show that internal factors (resources and capabilities) play a more important role than external factors (formal and informal institutions). In other words, education level, knowing other entrepreneurs and being able to identify business opportunities positively affect CE. On the other hand, environmental factors, such as a fear of failure, the effect of the media and the number of days required to start a business, are not significant factors
Zahra (1996)	Academy of Management Journal	Quantitative (127 Fortune 500 companies)	U.S	The study's argument is that executive stock ownership and long-term institutional ownership are positively related to CE, and that the association of ownership and governance with CE is moderated by the level of technological opportunities that exist in the firm's major industry

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Zahra (2015)	Small Business Economics	Conceptual	U.S	Both formal and informal CE activities are always needed to induce innovation, risk taking, and proactiveness into companies' operations. Also, hubs are crucial within the study and practice of CE—both formal and informal. They connect individuals across levels and across organizational boundaries, and they capitalize on the skills and talents of the members of internal and external network
Zahra and Covin (1995)	Journal of Business Venturing	Quantitative (Longitudinal analysis (7-year-period) of 24 medium-sized manufacturing firms, 39 chemical companies, and 45 Fortune 500 industrial firms)	U.S	The results from this empirical study suggest that CE has a positive impact on financial measures of company performance. Specifically, the results indicate that CE appears to be a particularly effective strategic practice among firms operating in hostile business settings

Table 6 (continued)

Authors (Year)	Outlet	Methodology (sample)	Region	Key findings
Zahra et al. (1999)	Entrepreneurship Theory and Practice	Conceptual	U.S	This paper argues that formal and informal CE activities can enrich a company's performance by creating new knowledge that becomes a foundation for building new competencies or revitalizing existing ones. The knowledge-creation process within CE activities and the subsequent strategic use of this knowledge are tightly linked to the firm's learning and unlearning processes

Table 7 Concept matrix: categorization of technological disruption and corporate entrepreneurship sample (28 and 32 studies respectively)

Articles	Methodology	Journal	Technology-centric				Actor-centric				
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformative Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment
<i>Technological Disruption (28 Studies)</i>											
1. Anderson and Tushman (1990)	Quantitative	ASQ			x				x		
2. Bergek et al. (2013)	Case study	RP	x						x		
3. Berman et al. (2016)	Conceptual	S&L			x	x		x			x
4. Bower and Christensen (1995)	Conceptual	HBR		x				x		x	
5. Danneels (2004)	Conceptual	JPIM		x							
6. DaSilva et al. (2013)	Case study	TASM				x		x		x	
7. Downes and Nunes (2013)	Conceptual	HBR	x	x				x			
8. Gans (2016)	Conceptual	MIT SMR	x	x							

Table 7 (continued)

Articles	Methodology	Journal	Technology-centric				Actor-centric					
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformative Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment	
9. Gawer and Cusumano (2014)	Conceptual	JPIM				x						
10. Gerstner et al. (2013)	Quantitative	ASQ							x			
11. Gilbert and Bower (2002)	Conceptual	HBR		x					x			
12. Günzel and Holm (2013)	Case study	IJIM				x		x				x
13. Habtay and Holmén (2014)	Mixed methods	IJEIM		x					x			
14. Hill and Rothaermel (2003)	Conceptual	AMR		x					x			
15. Holm et al. (2013)	Case study	IJTM		x							x	
16. Johnson et al. (2008)	Conceptual	HBR		x								

Table 7 (continued)

Articles	Methodology	Journal	Technology-centric				Actor-centric					
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformative Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment	
17. Koen et al. (2010)	Case study	RTM	x									x
18. Lavie (2006)	Conceptual	AMR							x			
19. Lucas and Goh (2009)	Case study	JSIS								x		x
20. Obal (2013)	Quantitative	IMM			x							
21. von Pechmann et al. (2015)	Qualitative	ICC		x								
22. Roy and Sarkar (2016)	Quantitative	SMJ									x	
23. Sabatier et al. (2012)	Case study	TFSC			x						x	
24. Shaughnessy (2016)	Conceptual	S&L		x							x	x

Table 7 (continued)

Articles	Methodology	Journal	Technology-centric				Actor-centric					
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformational Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment	
25. Tongur and Eng-wall (2014)	Case study	Technov		x						x		
26. Tushman and Anderson (1986)	Quantitative	ASQ	x					x				
27. Vecchiato (2017)	Case study	TFSC		x					x			
28. Yu and Hang (2010)	Review	IJMR		x				x			x	
<i>Corporate entrepreneurship (32 Studies)</i>												
1. Ahuja and Morris Lampert (2001)	Quantitative	SMJ										x
2. Birkinshaw (1997)	Mixed methods	SMJ										
3. Burgelman (1983)	Conceptual	MS							x			x

Table 7 (continued)

Articles	Methodology	Journal	Technology-centric				Actor-centric						
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformative Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment		
4. Chen and Nadkarni (2017)	Quantitative	ASQ							x				
5. Corbett et al. (2013)	Review	JPIM							x				
6. Covin and Miles (1999)	Conceptual	ET&P							x				
7. Dess et al. (2003)	Conceptual	JOM								x			x
8. Dushnitsky and Lenox (2005)	Quantitative	RP							x				
9. Engel (2011)	Conceptual	RTM	x						x				x
10. Floyd and Wooldrige (1999)	Conceptual	ET&P							x				x
11. Guth and Ginsberg (1990)	Conceptual	SMJ										x	

Table 7 (continued)

Articles	Methodology	Journal	Technology-centric				Actor-centric					
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformative Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment	
12. Hornsby et al. (2002)	Quantitative	JBV							x		x	
13. Hornsby et al. (2009)	Quantitative	JBV							x			
14. Ireland, Covin and Kuratko (2009)	Conceptual	ET&P						x				
15. Karimi and Walter (2016)	Quantitative	LRP									x	
16. Kohler (2016)	Qualitative	BH								x		
17. Kuratko et al. (2014)	Conceptual	BH								x		x
18. Lant and Mezias (1990)	Comp. Simul.	SMJ									x	
19. Ling et al. (2008)	Quantitative	AMJ										x

Table 7 (continued)

Articles	Methodology	Journal	Technology-centric				Actor-centric					
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformative Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment	
20. Marion et al. (2012)	Mixed methods	TEM	x						x			x
21. Meyer et al. (1990)	Conceptual	SMJ					x					
22. Nason et al. (2015)	Review	SBE								x		x
23. Peltola (2012)	Case study	BH							x			x
24. Shimizu (2012)	Conceptual	OS							x			
25. Thornberry (2001)	Conceptual	EMJ							x			
26. Turner and Pennington (2015)	Quantitative	SBE										x
27. Turró et al. (2014)	Quantitative	TFSC									x	

Table 7 (continued)

Articles	Methodology	Journal	Technology-centric				Actor-centric					
			Pace of Change and Time to Market	Technology Capability and Integration	Consumer and other Stakeholder Interface	Distributed Value Creation and Capture	Market Environment and Rules of Competition	Transformational Leadership	Managerial and Organizational Capabilities	Company Culture	Work Environment	
28. Urbano and Turró (2013)	Quantitative	IEMJ						x				
29. Zahra (1996)	Quantitative	AMJ							x			
30. Zahra (2015)	Conceptual	SBE							x			
31. Zahra and Covin (1995)	Quantitative	JBV						x				
32. Zahra et al. (1999)	Conceptual	ET&P							x		x	

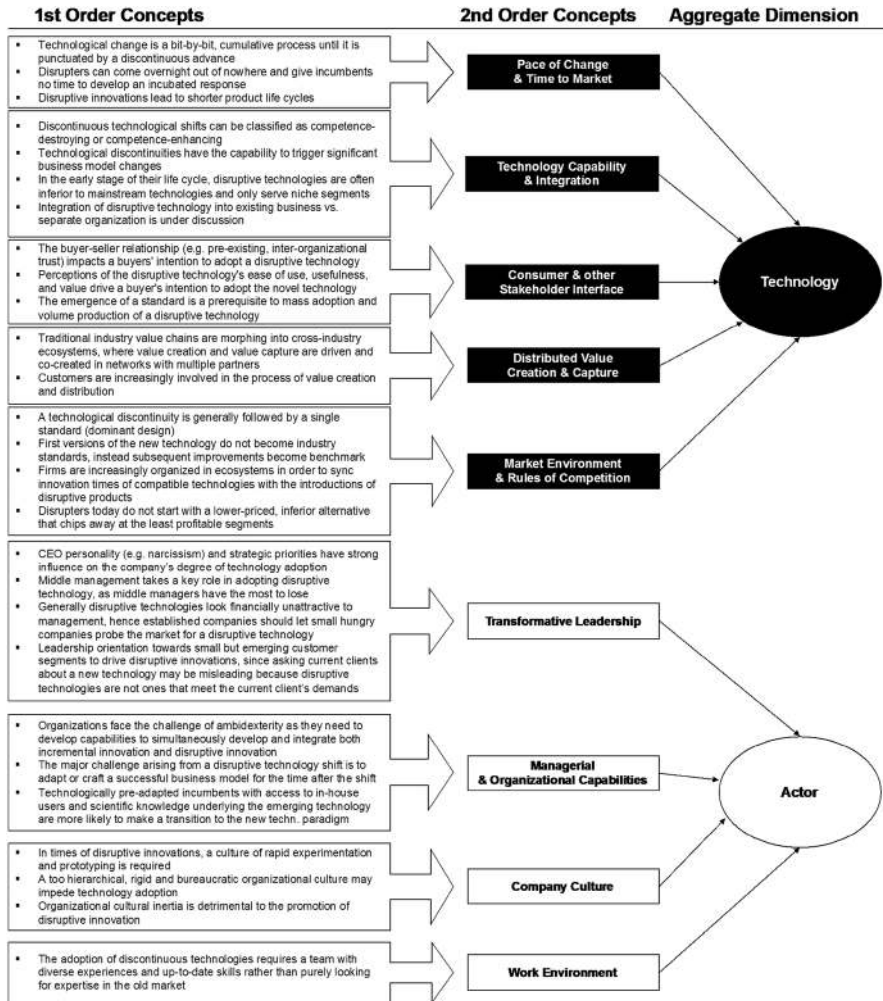


Fig. 5 Data structure for the technology-centric dimension of technological disruption

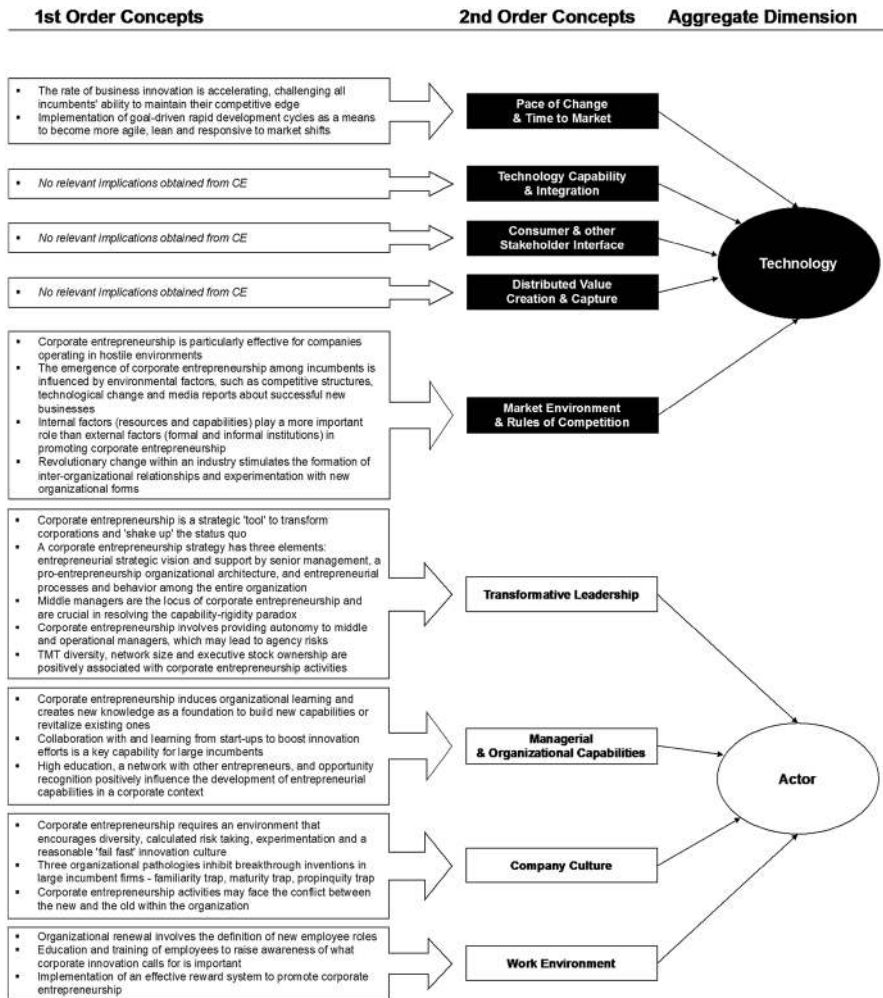


Fig. 6 Data structure for the technology-centric dimension of corporate entrepreneurship

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