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Understanding digital transformation: A review and a research agenda

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ABSTRACT

Extant literature has increased our understanding of specific aspects of digital transformation, however we lack a comprehensive portrait of its nature and implications. Through a review of 282 works, we inductively build a framework of digital transformation articulated across eight building blocks. Our framework foregrounds digital transformation as a process where *digital technologies* create *disruptions* triggering *strategic responses* from organizations that seek to alter their *value creation paths* while managing the *structural changes* and *organizational barriers* that affect the *positive* and *negative* outcomes of this process. Building on this framework, we elaborate a research agenda that proposes [1] examining the role of dynamic capabilities, and [2] accounting for ethical issues as important avenues for future strategic IS research on digital transformation.

Introduction

In recent years, *digital transformation* (DT) has emerged as an important phenomenon in strategic IS research (Bharadwaj et al., 2013; Piccinini et al., 2015a) as well as for practitioners (Fitzgerald et al., 2014; Westerman et al., 2011). At a high level, DT encompasses the profound changes taking place in society and industries through the use of digital technologies (Agarwal et al., 2010; Majchrzak et al., 2016). At the organizational level, it has been argued that firms must find ways to innovate with these technologies by devising "strategies that embrace the implications of digital transformation and drive better operational performance" (Hess et al., 2016:123).

Recent research has contributed to increase our understanding of specific aspects of the DT phenomenon. In line with previous findings on IT-enabled transformation, research has shown that technology itself is only part of the complex puzzle that must be solved for organizations to remain competitive in a digital world. Strategy (Bharadwaj et al., 2013; Matt et al., 2015) as well as changes to an organization, including its structure (Selander and Jarvenpaa, 2016), processes (Carlo et al., 2012), and culture (Karimi and Walter, 2015) are required to yield the capability to generate new paths for value creation (Svahn et al., 2017a). Notwithstanding these contributions, we currently lack a comprehensive understanding of this phenomenon (Gray and Rumpe, 2017; Kane, 2017c; Matt et al., 2015) as well as its implications at multiple levels of analysis. The present work therefore proposes to take stock of current knowledge on the topic by studying the research question: "*What do we know about digital transformation?*"

Consistent with the breadth of our research question, we adopt an inductive approach using techniques borrowed from grounded theory (Wolfswinkel et al., 2013) and review 282 works on DT culled from IS literature. Based on extant definitions, we develop a conceptual definition of DT as "*a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies*". We then present, based on our analysis of the

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literature, an inductive framework describing DT as a process wherein organizations respond to changes taking place in their environment by using digital technologies to alter their value creation processes. For this process to be successful and lead to positive outcomes, organizations must account for a number of factors that can hinder the execution of their transformation.

Based on these findings, we discuss the novelty of DT based on previous literature on IT-enabled transformation. We argue that the scale, the scope, as well as the speed associated with the DT phenomenon call for research to consider DT as an *evolution* of the IT-enabled transformation phenomenon. We then propose a research agenda for strategic IS research on DT articulated across two main avenues. The first avenue proposes to study how dynamic capabilities contribute to DT. The second avenue calls for research to study the strategic importance of ethics in the context of DT. Together these two research avenues ask questions that are relevant for strategic IS research as well as practice.

Our work offers two contributions. First, we provide a review that integrates current knowledge on DT. Second, we identify avenues that future research may use as a guide to answer pressing questions on DT while contributing to expand the theoretical foundations we rely on to study IS. In the next sections, we present the methods of our review. We then detail our findings, including our definition of DT and our inductive framework. Finally, we present our agenda for future research on DT, the limitations of our work and provide concluding remarks.

Methods

In line with the breadth of our research question, we selected an inductive approach to reviewing the literature on DT. Our methods are informed by guidelines from Wolfswinkel et al. (2013) and their use of techniques borrowed from grounded theory for "rigorously reviewing literature" (p. 1). These guidelines comprise five steps to (1) define the scope of the review, (2) search the literature, (3) select the final sample, (4) analyze the corpus, and (5) present the findings. We outline the application of the first four steps in the following paragraphs (for a more detailed account, please refer to Appendix A) and present fifth step in the Findings section below.

We initially ran several queries against online databases to gain an initial understanding of the coverage offered by literature in various disciplines. To ensure that the size of our review sample would remain manageable, we decided to focus on peer-reviewed sources (both in research and in practice) pertinent to IS literature using three databases (AIS Library, Business Source Complete, ScienceDirect). Based on the reading of abstracts as well as a few highly cited articles, we designed our final search criteria using combinations of keywords containing the terms "digital" and "transform" or "disrupt". We also opted to exclude works in progress, research outlets not ranked in the Journal Citation Reports index as well as teaching cases from our final sample.

We then proceeded to run our search query against our selected databases. For each database, we adapted our search query and performed several checks to ensure that works identified through our initial search query were included in our search results. For each search result, we downloaded the full paper in PDF format along with its associated references into a bibliographic software. To finalize our sample, we applied our criteria of inclusion and exclusion against our search results. Our initial sample size of 381 works was reduced to 248 works, which was subsequently augmented to 282 works through backward and forward search (226 from research outlets, 56 from practitioner-oriented outlets).

Our analysis consisted of four main steps that were performed iteratively. First, we collected, for each work, a number of data points such as the publication outlet, the type of publication outlet (research journal, conference proceedings, practitioner's journal), the type of paper (empirical, conceptual), the context of application (e.g., healthcare), the theoretical foundation used or developed, the methods, as well as any definitions of DT and other related concepts. Second, we performed open coding by annotating sources based on the arguments and findings relevant to our phenomenon of interest and tracked relationships between variables in each paper, whether those were hypothesized (in a conceptual paper) or validated (in an empirical paper). Third, we performed two rounds of axial coding to refine our coding scheme into a more manageable set of higher-order categories of relationships. Finally, we integrated these relationships using selective coding. We imported all our coding instances into a relational database to contrast and compare our emergent findings using SQL queries which we complemented with visualization techniques (see Fig. A.2). The result of this process is a high level framework that incorporates the findings from our analysis based on the coverage of the main relationships contained within our sample.

Findings

Defining digital transformation

The first step of our analysis consisted in studying extant definitions of DT. Within our sample, we found 28 sources offering 23 unique definitions (see Table 1). Although encouraging, this relatively small proportion (about 10%) reflects an overall enthusiasm toward the phenomenon of DT at the expense of its conceptual clarity. Studying these definitions, we make three observations. First, DT as it is defined in the reviewed studies, primarily relates to organizations. Second, important differences exist across definitions with regards to the types of technologies (Horlacher et al., 2016; Westerman et al., 2011) involved as well as the nature of the *transformation* taking place (Andriole, 2017; Piccinini et al., 2015b). Third, in spite of differences, similarities exist across definitions, e.g., using common terms such as "digital technologies" (Matt et al., 2015; Singh and Hess, 2017).

We then proceeded to analyze extant definitions based on recommendations for the creation of conceptual definitions. In particular, we referred to the rules offered by Wacker (2004) as well as guidelines from Suddaby (2010) (see Table 2) and evaluated existing definitions against these recommendations (see the third column of Table 1). Our analysis reveals that circularity, unclear

Table 1
Extant definitions of DT.

Definition	Source(s)	Conceptual clarity challenge(s)
The use of technology to radically improve performance or reach of enterprises.	Westerman et al. (2011)Westerman et al. (2014)Karagiannaki et al. (2017)	Conflation between the concept and its impacts.
The use of new digital technologies (social media, mobile, analytics or embedded devices) to enable *major business improvements* (such as enhancing customer experience, streamlining operations or creating new business models). [emphasis original]	Fitzgerald et al. (2014)Liere-Netheler et al. (2018)	Unclear term: "digital technologies" defined using examples. Conflation between the concept and its impacts.
Digital transformation strategy is a blueprint that supports companies in governing the transformations that arise owing to the integration of digital technologies, as well as in their operations after a transformation.	Matt et al. (2015)	Unclear term: "digital technologies". Circularity ("transformation").
Digital transformation involves leveraging digital technologies to enable major business improvements, such as enhancing customer experience or creating new business models.	Piccinini et al. (2015b)	Unclear term: "digital technologies". Conflation between the concept and its impacts.
Use of digital technologies to radically improve the company's performance.	Bekkhus (2016)	Unclear term: "digital technologies". Conflation between the concept and its impacts.
Digital transformation encompasses both process digitization with a focus on efficiency, and digital innovation with a focus on enhancing existing physical products with digital capabilities.	Berghaus and Back (2016)	Unclear terms: "digitalization", "digital capabilities".
Digital transformation is the profound and accelerating transformation of business activities, processes, competencies, and models to fully leverage the changes and opportunities brought by digital technologies and their impact across society in a strategic and prioritized way.	Demirkan et al. (2016)	Unclear term: "digital technologies". Circularity ("transformation"). Conflation between the concept and its impacts.
Digital transformation encompasses the digitization of sales and communication channels, which provide novel ways to interact and engage with customers, and the digitization of a firm's offerings (products and services), which replace or augment physical offerings. Digital transformation also describes the triggering of tactical or strategic business moves by data-driven insights and the launch of digital business models that allow new ways to capture value.	Haffke et al. (2016)	Unclear term: "digitalization". Conflation between the concept and its impacts. Lack of parsimony.
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. These changes can be observed in the rising demand for Internet-based media, which has led to changes of entire business models (for example in the music industry).	Hess et al. (2016)	Unclear term: "digital technologies". Conflation between the concept and its impacts. Lack of parsimony.
Use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models.	Horlacher et al. (2016)Singh and Hess (2017)	Unclear term: "digital technologies" defined using examples. Conflation between the concept and its impacts.
Changes and transformations that are driven and built on a foundation of digital technologies. Within an enterprise, digital transformation is defined as an organizational shift to big data, analytics, cloud, mobile and social media platform. Whereas organizations are constantly transforming and evolving in response to changing business landscape, digital transformation are the changes built on the foundation of digital technologies, ushering unique changes in business operations, business processes and value creation.	Nwankpa and Roumani (2016)	Unclear term: "digital technologies" defined using examples. Circularity ("transformation"). Lack of parsimony.
Digital transformation is not a software upgrade or a supply chain improvement project. It's a planned digital shock to what may be a reasonably functioning system.	Andriole (2017)	Unclear term: "digital shock".
Extended use of advanced IT, such as analytics, mobile computing, social media, or smart embedded devices, and the improved use of traditional technologies, such as enterprise resource planning (ERP), to enable major business improvements.	Chanias (2017)	Unclear term: "advanced IT" defined using examples. Conflation between the concept and its impacts.
The changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or automation of processes.	Clohessy et al. (2017)	Unclear term: "digital technologies". Conflation between the concept and its impacts.
Distinguishes itself from previous IT-enabled business transformations in terms of velocity and its holistic nature.	Hartl and Hess (2017)	Circularity ("transformation"). Comparative definition ("previous IT-enabled business transformations")
Transformations in organizations that are driven by new enabling IT/IS solutions and trends.	Heilig et al. (2017)	Circularity ("transformation").

(*continued on next page*)

Table 1 (*continued*)

Definition	Source(s)	Conceptual clarity challenge(s)
Digital transformation as encompassing the digitization of sales and communication channels and the digitization of a firm's offerings (products and services), which replace or augment physical offerings. Furthermore, digital transformation entails tactical and strategic business moves that are triggered by data-driven insights and the launch of digital business models that allow new ways of capturing value.	Horlach et al. (2017)	Unclear term: "digitalization". Conflation between the concept and its impacts. Lack of parsimony.
The best understanding of digital transformation is adopting business processes and practices to help the organization compete effectively in an increasingly digital world.	Kane (2017c)Kane et al. (2017)	Conflation between the concept and its impacts.
Digital transformation describes the changes imposed by information technologies (IT) as a means to (partly) automatize tasks.	Legner et al. (2017)	Conflation between the concept and its impacts.
Digital transformation highlights the impact of IT on organizational structure, routines, information flow, and organizational capabilities to accommodate and adapt to IT. In this sense, digital transformation emphasizes more the technological root of IT and the alignment between IT and businesses.	Li et al. (2017)	Conflation between the concept and its impacts. Lack of parsimony.
An evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value.	Morakanyane et al. (2017)	Unclear term: "digital capabilities". Conflation between the concept and its impacts.
The use of new digital technologies, in order to enable major business improvements in operations and markets such as enhancing customer experience, streamlining operations or creating new business models.	Paavola et al. (2017)	Unclear term: "digital technologies". Conflation between the concept and its impacts.
Fundamental alterations in existing and the creation of new business models […] in response to the diffusion of digital technologies such as cloud computing, mobile Internet, social media, and big data.	Remane et al. (2017)	Unclear term: "digital technologies" defined using examples.

Note: Definitions are sorted chronologically and alphabetically.

Table 2
Guidelines for conceptual definitions.

Rules for conceptual definitions (adapted from Wacker, 2004:384)
Rule 1: "Definitions should be formally defined using primitives and derived terms."
Rule 2: "Each concept should be uniquely defined."
Rule 3: "Definitions should include only unambiguous and clear terms."
Rule 4: "Definitions should have as few as possible terms."
Rule 5: "Definitions should be consistent within [their] field."
Rule 6: "Definitions should not make any term broader."
Rule 7: "New hypotheses cannot be introduced in the definitions."
Rule 8: "Statistical test for content validity must be performed after the terms are formally defined"
Guidelines for conceptual clarity (adapted from Suddaby, 2010:347)
"Offer definitions of key terms and constructs."
"The definition should capture the essential properties and characteristics of the concept or phenomenon under consideration."
"A good definition should avoid tautology or circularity."
"A good definition should be parsimonious."

terminology, and the conflation of the concept and its impacts, among other challenges, hinder the conceptual clarity of DT.

Based on these findings, we used semantic analysis to build a working definition of DT from extant definitions. We used *semantic decomposition* (Akmajian et al., 2017) to systematically decompose extant definitions into series of constituting primitives and compared those primitives across definitions to identify essential properties of DT (a detailed account of the semantic decomposition process is available in Appendix B). We identified four such properties: (1) *target entity*, i.e., the unit of analysis affected by DT; (2) *scope*, i.e., the extent of the changes taking place within the target entity's properties; (3) *means*, i.e., the technologies involved in creating the change within the target entity; and (4) *expected outcome*, i.e., the outcome of DT. Using these properties, we constructed a conceptual definition of DT as "*a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies*".

Our definition warrants three important observations. First, it is not organization-centric. Although in most extant definitions the target entity primitive refers to an organization, two definitions refer to other forms of entities (society, industry) that exist in many studies where definitions of DT are absent (e.g., Agarwal et al., 2010; Hanelt et al., 2015b; Pagani, 2013). Our definition is therefore consistent with the related concept of *digitalization*, which includes the "broader individual, organizational, and societal contexts." (Legner et al., 2017:301) Second, our definition acknowledges *improvement* as an expected outcome of DT without guaranteeing its realization (see Wacker, 2004:393). Finally, we purposefully do not define the means primitive using the term *digital technologies*.

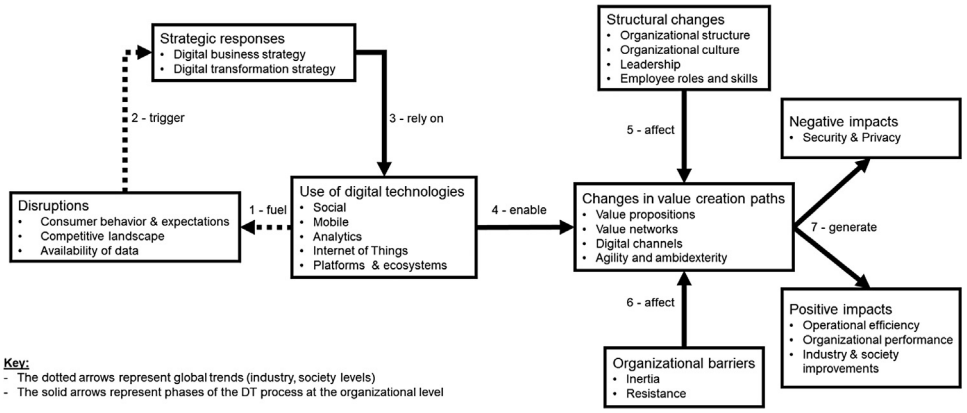

Fig. 1. Building blocks of the DT process. Note: The arrows do not represent a statistical relationship or a causality found in variance models. Rather, they detail an overarching sequence of relationships described by the literature on DT.

Rather, we use the definition of digital technologies provided by Bharadwaj et al. (2013) to reinforce the conceptual clarity of our definition as well as its applicability over time as technology changes.

Digital transformation: an inductive framework

We present in Fig. 1 and in the sections below our inductive framework summarizing current knowledge on DT. This framework builds upon relationships that emerged through our analysis across eight overarching building blocks describing DT as a process where *digital technologies* play a central role in the creation as well as the reinforcement of *disruptions* taking place at the society and industry levels. These disruptions trigger *strategic responses* from the part of organizations, which occupy a central place in DT literature. Organizations use digital technologies to alter the *value creation paths* they have previously relied upon to remain competitive. To that end, they must implement *structural changes* and overcome *barriers* that hinder their transformation effort. These changes lead to *positive impacts* for organizations as well as, in some instances, for individuals and society, although they can also be associated with *undesirable outcomes*. Descriptive statistics as well as a complete list of the works reviewed are available in Appendices C and D.

The nature of digital technologies

Most of the digital technologies mentioned within our sample fit with the popular SMACIT acronym (Sebastian et al., 2017), referring to technologies related to *social* (Li et al., 2017; Oestreicher-Singer and Zalmanson, 2012), *mobile* (Hanelt et al., 2015a; Pousttchi et al., 2015), *analytics* (Duerr et al., 2017; Günther et al., 2017), *cloud* (Clohessy et al., 2017; Du et al., 2016), and the *internet of things* – IoT (Petrikina et al., 2017; Richter et al., 2017). We also found *platforms* as an important category, especially in research articles (Tan et al., 2015a; Tiwana et al., 2010) while other forms of digital technologies, including the internet (Lyytinen and Rose, 2003b), software (e.g., Karimi et al., 2009; Setia et al., 2013), and blockchain (Glaser, 2017) were seldom present. In line with Bharadwaj et al.'s definition of digital technologies, we observe that *combinations* of technologies are particularly relevant in the context of DT (Gray et al., 2013; Günther et al., 2017; Newell and Marabelli, 2015; Westerman and Bonnet, 2015). For example, the ability to implement algorithmic decision-making may be contingent upon a firm's ability to perform analytics on big data collected through individuals' use of social media on their mobile phones (Newell and Marabelli, 2015).

Digital technologies as sources of disruption

The literature describes digital technologies as inherently disruptive (Karimi and Walter, 2015). In this section, we report on the three types of disruptions revealed by our analysis (see Table 3): consumer behavior and expectations, competitive landscape, and the availability of data.

Altering consumer behavior & expectations

Digital technologies have a profound impact on the behavior (Chanias, 2017; Hong and Lee, 2017) of consumers who have ubiquitous (Yoo et al., 2010a) access to information and communication capabilities (e.g., using social media on a mobile device). Using these technologies, they become active participants in a dialogue that takes place between an organization and its stakeholders (e.g., Kane, 2014; Yeow et al., 2017). An important implication of these changes is that customers no longer see themselves as captives of the firms with which they transact (Lucas Jr. et al., 2013; Sia et al., 2016) and their expectations with regards to the services that should be provided to them are increasing. This is illustrated in the case study of DBS Bank (Sia et al., 2016) where Asian consumers expect to perform most of their banking operations using mobile digital banking solutions. In this case these expectations

Table 3
Digital technologies as sources of disruption.

Altering consumer behavior and expectations (n = 86)	
Source type	Sources
Research paper – empirical (n = 50)	Agarwal et al. (2011), Bassano et al. (2017), Berghaus and Back (2017), Chanias and Hess (2016), Delmond et al. (2017), Duerr et al. (2018), Duerr et al. (2017), Fehér and Varga (2017), Felgenhauer et al. (2017), Gimpel (2015), Gimpel et al. (2018), Haffke et al. (2016), Hanelt et al. (2015a), Hanelt et al. (2015b), Henfridsson and Lind (2014), Hildebrandt et al. (2015), Hjalmarsson et al. (2014), Hong and Lee (2017), Karimi and Walter (2015), Lee and Lee (2013), Liere-Netheler et al. (2018), Mueller and Renken (2017), Oestreicher-Singer and Zalmanson (2012), Petrikina et al. (2017), Piccinini et al. (2015b), Ramasubbu et al. (2014), Rauch et al. (2016), Reinhold and Alt (2009), Richter et al. (2017), Roecker et al. (2017), Ross et al. (2016), Sachse et al. (2012), Saldanha et al. (2017), Schmidt et al. (2017), Selander and Jarvenpaa (2016), Setia et al. (2013), Smith and Webster (2006), Sørensen et al. (2015), Standaert and Jarvenpaa (2017), Tan et al. (2015a), Tan et al. (2017), Tanniru et al. (2016), Tiefenbacher and Olbrich (2016), Töytäri et al. (2017), Utesheva et al. (2012), Weinrich et al. (2016), Winkler et al. (2014), Wörner et al. (2016), Xie et al. (2014), Yeow et al. (2017), Zolnowski and Warg (2018)
Research paper – other (n = 20)	Agarwal et al. (2010), Bichler et al. (2016), Chowdhury and Åkesson (2011), Cziesla (2014), Fischer et al. (2018), Granados et al. (2008), Günther et al. (2017), Loebbecke and Picot (2015), Lucas Jr. et al. (2013), Neumeier et al. (2017), Newell and Marabelli (2014), Newell and Marabelli (2015), Piccinini et al. (2015a), Pillet et al. (2017), Pousttchi et al. (2015), Prifti et al. (2017), Riedl et al. (2017), Seo (2017), Weiß et al. (2018)
Practitioner outlet (n = 16)	Dery et al. (2017), Earley (2014), Fitzgerald et al. (2014), Hansen and Sia (2015), Kane (2014), Kane (2015a), Kane (2016b), Kane et al. (2017), Nehme et al. (2015), NetworkWorld Asia (2015), Reinartz and Imschloß (2017), Sebastian et al. (2017), Soava (2015), Westerman and Bonnet (2015), Westerman et al. (2011), Wulf et al. (2017)
Disrupting the competitive landscape (n = 84)	
Source type	Sources
Research paper – empirical (n = 46)	Agarwal et al. (2011), Barua et al. (2004), Berghaus and Back (2017), Chanias and Hess (2016), Delmond et al. (2017), Ebbesson (2015), Elbanna and Newman (2016), Gimpel (2015), Holotiuk and Beimborn (2017), Islam et al. (2017), Kamel (2015), Karagiannaki et al. (2017), Karimi et al. (2009), Karimi and Walter (2015), Kauffman et al. (2010), Klötzer and Pflaum (2017), Lee and Lee (2013), Leonhardt et al. (2017), Li et al. (2017), Li et al. (2016), Liere-Netheler et al. (2018), Mithas et al. (2013), Mohagheghzadeh and Svahn (2016), Nwankpa and Roumani (2016), Oestreicher-Singer and Zalmanson (2012), Oh (2009), Pagani (2013), Piccinini et al. (2015b), Ramasubbu et al. (2014), Reitz et al. (2018), Resca et al. (2013), Scott (2007), Selander et al. (2010), Setia et al. (2013), Staykova and Damsgaard (2015b), Tan et al. (2015a), Tan et al. (2017), Tan et al. (2015b), Tiefenbacher and Olbrich (2016), Wenzel et al. (2015), Woodard et al. (2012), Xie et al. (2014), Yeow et al. (2017), Zhu et al. (2006)
Research paper – other (n = 24)	Barrett et al. (2015), Berghaus (2016), Bharadwaj et al. (2013), de Reuver et al. (2017), Dixon et al. (2017), Fichman et al. (2014), Glaser (2017), Granados et al. (2008), Günther et al. (2017), Heilig et al. (2017), Kahre et al. (2017), Krumeich et al. (2012), Krumeich et al. (2013), Lucas Jr. et al. (2013), Myunsoo and Byungtae (2013), Nambisan et al. (2017), Neumeier et al. (2017), Newell and Marabelli (2014), Nischak et al. (2017), Rai and Sambamurthy (2006), Schmid et al. (2017), Seo (2017), Tanriverdi and Lim (2017), Tiwana et al. (2010), Yoo et al. (2010b)
Practitioner outlet (n = 14)	Du et al. (2016), Earley (2014), Fitzgerald et al. (2014), Hansen and Sia (2015), Henningsson and Hedman (2014), Hess et al. (2016), Kane (2017d), Kane et al. (2017), Kane et al. (2016), Kohli and Johnson (2011), Nehme et al. (2015), Porter and Heppelmann (2014), Sebastian et al. (2017), Sia et al. (2016), Wulf et al. (2017)
Increasing the availability of data (n = 37)	
Source type	Sources
Research paper – empirical (n = 15)	Bravhar and Juric (2017), Chatfield et al. (2015), Constantiou et al. (2017), Ebbesson (2015), Gimpel (2015), Gimpel et al. (2018), Hjalmarsson et al. (2014), Hjalmarsson et al. (2015), Holotiuk and Beimborn (2017), Hong and Lee (2017), Lu and Swatman (2008), Pramanik et al. (2016), Saldanha et al. (2017), Tiefenbacher and Olbrich (2016), Trantopoulos et al. (2017)
Research paper – other (n = 13)	Agarwal et al. (2010), Bhimani (2015), Fichman et al. (2014), Günther et al. (2017), Heilig et al. (2017), Legner et al. (2017), Loebbecke and Picot (2015), Lucas Jr. et al. (2013), Newell and Marabelli (2014), Newell and Marabelli (2015), Pousttchi et al. (2015), Rizk et al. (2018), Yoo et al. (2010b)
Practitioner outlet (n = 9)	Basole (2016), Dremel et al. (2017), Fitzgerald (2016a), Gust et al. (2017), Kane (2014), Kane (2016c), Sebastian et al. (2017), Westerman et al. (2011), Wulf et al. (2017)

created pressure for DBS to offer new services to remain competitive as "the digital revolution has put banks under siege" (quote from DBS CEO, p. 107). As a result, *anticipating* rather than responding to changes in customer expectations has become a strategic imperative for firms.

Disrupting the competitive landscape

Digital technologies bring about disruption in the markets where firms operate (Mithas et al., 2013). They facilitate the (re) combination of existing products and services to generate new forms of digital offerings (Yoo et al., 2010b) favoring services over products (Barrett et al., 2015), lowering barriers to entry (Woodard et al., 2012) and hindering the sustainability of the competitive advantage of incumbent players (Kahre et al., 2017). For example, platforms enable the redefinition of existing markets (Tiwana et al., 2010) by facilitating exchanges of digital goods and services. As competition moves from a physical plane to a virtual plane

Table 4
Strategic responses to digital disruption.

Digital business strategy (n = 31)	
Source type	Sources
Research paper – empirical (n = 18)	Berghaus and Back (2017), Fehér et al. (2017), Haffke et al. (2016), Holotiuk and Beimborn (2017), Islam et al. (2017), Karimi and Walter (2015), Leischnig et al. (2017), Li et al. (2016), Mithas et al. (2013), Nwankpa and Roumani (2016), Oestreicher-Singer and Zalmanson (2012), Pagani (2013), Ramasubbu et al. (2014), Richter et al. (2017), Ross et al. (2016), Setia et al. (2013), Woodard et al. (2012), Yeow et al. (2017)
Research paper – other (n = 7)	Bharadwaj et al. (2013), Dixon et al. (2017), Kahre et al. (2017), Matt et al. (2015), Morakanyane et al. (2017), Neumeier et al. (2017), Piccinini et al. (2015a)
Practitioner outlet (n = 6)	Dremel et al. (2017), Hess et al. (2016), Kane et al. (2017), Sebastian et al. (2017), Sia et al. (2016), Weill and Woerner (2018)
Digital transformation strategy (n = 19)	
Source type	Sources
Research paper – empirical (n = 10)	Berghaus and Back (2016), Berghaus and Back (2017), Chanias (2017), Chanias and Hess (2016), Fehér et al. (2017), Gimpel et al. (2018), Haffke et al. (2017), Hartl and Hess (2017), Lucas Jr. and Goh (2009), Riasanow et al. (2017)
Research paper – other (n = 5)	Berghaus (2016), Matt et al. (2015), Morakanyane et al. (2017), Riedl et al. (2017), Weiß et al. (2018)
Practitioner outlet (n = 4)	Hess et al. (2016), Sia et al. (2016), Singh and Hess (2017), Westerman et al. (2011)

where information flows more freely, previous forms of barriers to entry become less significant. For example, in the music industry (Lucas Jr et al., 2013), physical goods sold through intermediaries have been supplanted by music subscription services offered by firms that were not originally part of that industry (e.g., Apple, Spotify). More recently, it has been observed that Blockchain (Friedlmaier et al., 2018; Hayes, 2016; Korpela et al., 2017), as a generic and extensible technology, enables the creation of decentralized, *digital infrastructures* (Tilson et al., 2010). These infrastructures can be applied to a variety of domains (e.g., banking, contract management) and act as complements or substitutes to more traditional, centralized institutions (e.g., to securely exchange funds from peer to peer rather than through authoritative intermediaries).

Increasing the availability of data

Beyond their immediate operational value, digital technologies also foster the generation of data (e.g., digital traces generated through the use of a mobile device). In the context of DT, firms strive to exploit the potential of data for their own benefit, or in some instances, to monetize those data by selling them to third parties (Loebbecke and Picot, 2015). Using analytics, firms can offer services that better answer the needs of their customers or perform processes more efficiently (e.g., using data-driven algorithmic decision-making) for their competitive advantage (Günther et al., 2017). For instance, KLM (Kane, 2014) uses social media such as Twitter and Facebook to perform customer service operations. They then use the data generated through those interactions to maintain and act upon their understanding of customers' sentiments in real time.

Strategic responses to digital disruption

In light of these disruptions, organizations must devise ways to remain competitive as digital technologies provide "both game-changing opportunities for – and existential threats to – companies" (Sebastian et al., 2017:197) (see Table 4). Indeed, although a majority of works within our sample treat DT as an endogenous phenomenon where initiatives are purposefully created to respond to *opportunities* afforded by digital technologies (Tan et al., 2015a), we found 49 sources where it is viewed as an exogenous *threat* for the focal organization (e.g., Li et al., 2016; Lucas Jr. and Goh, 2009; Sia et al., 2016). In the latter, DT is depicted as a higher level phenomenon that disrupts the competitive environment and demands a response from the part of the organization. Although the generic concept of strategy is often invoked to explain these responses (e.g., Yoo et al., 2010b), the literature refers to two novel concepts in the context of DT: digital business strategy and digital transformation strategy.

Bharadwaj et al. (2013) argue that digital technologies call for researchers to study the *fusion* between organizational strategy and IS strategy (e.g., Kahre et al., 2017) rather than their *alignment*. They observe that competition among firms increasingly rests upon their ability to leverage digital technologies to accomplish their vision (Mithas et al., 2013) and that separating the two concepts may diminish their potential for synergies. To that end, they offer the concept of digital business strategy – DBS, defined as "organizational strategy formulated and executed by leveraging digital resources to create differential value" (p. 472). Since then, the concept of DBS has gained some traction in research and in practice (e.g., Holotiuk and Beimborn, 2017; Leischnig et al., 2017; Mithas et al., 2013; Oestreicher-Singer and Zalmanson, 2012; Sia et al., 2016). In 3 works, we also found evidence of DBS as an emergent concept (Chanias, 2017; Henfridsson and Lind, 2014; Yeow et al., 2017). For example, Yeow et al. (2017) studied a company incorporating a B2C model into its existing B2B model and found that tensions arising from the misalignment between a firm's existing resources and its emergent digital business strategy are continuously addressed via an *aligning* process, consistent with the view that DT is a "journey" (Kane, 2017c) rather than a project (Gray et al., 2013).

Matt et al. (2015) propose the concept of *DT strategy* (DTS) to "focus on the transformation of products, processes and organizational aspects owing to new technologies" (p. 339). The authors argue that contrary to DBS, which focuses on "future states", DTS

"is a blueprint that supports companies in governing the transformations that arise owing to the integration of digital technologies, as well as in their operations after a transformation." (p. 340). They view DTS as separate from "IT strategies and all other organizational and functional strategies" (p. 340) while *structural changes*, defined as "variations in a firm's organizational setup" (p. 341), must be carefully planned to leverage digital technologies for the benefit of the organization without forgoing financial constraints. Based on this concept, Hess et al. (2016) studied the DT of three German media companies and found that the specific financial constraints in place within each company had important implications on their respective ability to use digital technologies. Although less prominent (19 sources), this body of literature emphasizes the transformational process through which a firm leverages digital technologies to redefine its business model.

Leveraging digital technologies to uncover new paths for value creation

Digital technologies alone provide little value to an organization (Kane, 2014). It is their use within a specific context that enables a firm to uncover new ways to create value, consistent with the enduring idea that organizational change is an *emergent* phenomenon (Markus and Robey, 1988). In this section, we outline these new paths to value creation and present elements relevant to unlock the transformative potential of digital technologies (see Tables 5–7).

Transforming the value creation process

The literature emphasizes the alteration as well as the redefinition of *business models* (Osterwalder and Pigneur, 2010) in the context of DT (e.g., Morakanyane et al., 2017; Piccinini et al., 2015b). In this section, we detail four prominent changes related to (1) value propositions, (2) value networks, (3) digital channels, and (4) enabling agility and ambidexterity (see Table 5).

Value propositions. Digital technologies enable the creation of new value propositions that rely increasingly on the provision of *services* (Barrett et al., 2015). Organizations use digital technologies to transition from or augment the sales of physical products with the sales of services as an integral part of their value proposition to satisfy the needs of customers by offering innovative solutions as well as to gather data on their interactions with products and services (Porter and Heppelmann, 2014; Wulf et al., 2017). A prime example of the creation of new value propositions through the use of digital technologies is Netflix, which business model was originally based on the rental of movies stored on physical media. Over the years, Netflix has moved away from this value proposition to become the first large-scale provider of video streaming services. More recently, they have leveraged data collected from the use of their streaming service to better understand the content viewers enjoy as well as *how* content is consumed to help with the production of their own content (Günther et al., 2017). Overall, the literature highlights the potential for digital technologies to generate disruptive innovations that can significantly alter existing value propositions (Huang et al., 2017).

Value networks. Digital technologies also enable the redefinition of value networks (Delmond et al., 2017; Tan et al., 2015a). Andal-Ancion et al. (2003) argue that a firm can use digital technologies to implement one of three main mediation strategies. In a *disintermediation* strategy, digital technologies bypass intermediaries and enable direct exchanges among participants of a value network, e.g., customers (Hansen and Sia, 2015). In a *remediation* strategy, the couplings between participants of a value network are reinforced as digital technologies enable close collaboration and coordination among participants, e.g., by using a platform to coordinate exchanges within a supply chain (Klötzer and Pflaum, 2017). In *network-based* mediation, complex relationships among multiple stakeholders with potentially competing interests are created for the benefit of customers (Tan et al., 2015a). Digital technologies have also granted customers with the ability to become co-creators of value (*prosumers)* within a value network (Lucas Jr. et al., 2013:379). For example, online communities (e.g., Oestreicher-Singer and Zalmanson, 2012) and social media (e.g., Kane, 2014) depend almost exclusively on the active contributions of users who have no obligation to use those technologies. Firms therefore have an imperative to incentivize customer engagement with digital technologies to drive the co-creation of value (Saldanha et al., 2017; Yeow et al., 2017).

Digital channels. In 72 sources, we found evidence that organizations use digital technologies to implement changes to their distribution and sales channels. This can be done in one of two ways. First, organizations can create new customer-facing channels, e.g., using social media, to reach and entertain a dialogue with consumers (Hansen and Sia, 2015). For example, Hansen and Sia (2015) found that an organization can effectively use social media to bridge the gap between the physical and the digital world to support the creation of an omnichannel strategy, which the authors defined as "an integrated multichannel approach to sales and marketing" (p. 51). Second, the emergence of algorithmic decision-making afforded by digital technologies (Günther et al., 2017; Newell and Marabelli, 2015) provides an unprecedented opportunity for organizations to effectively allow software to coordinate activities across organizations. In the manufacturing sector, sensors and other technologies associated with the IoT can improve supply change efficiency (Klötzer and Pflaum, 2017) – e.g., through automated, *smart* procurement (Porter and Heppelmann, 2014). Although IoT developments are still in their infancy when compared to other digital technologies (e.g., social media), we can expect that developments in smart products, digital goods and the emergence of product upgrades "over the air" will drive further interest on this topic.

Agility and ambidexterity. Digital technologies can help firms rapidly adapt to changes in environmental conditions (Fitzgerald, 2016b; Günther et al., 2017; Hong and Lee, 2017; Huang et al., 2017; Kohli and Johnson, 2011) by contributing to organizational agility, defined as a firm's "ability to detect opportunities for innovation and seize those competitive market opportunities by

Table 5
Transforming value creation and capture processes.

Value propositions (n = 111)	
Source type	Sources
Research paper – empirical (n = 63)	Antonopoulou et al. (2017), Asgarkhani (2005), Becker et al. (2018), Bravhar and Juric (2017), Clohessy et al. (2017), Delmond et al. (2017), Duerr et al. (2017), Fehér and Varga (2017), Friedlmaier et al. (2018), Gimpel (2015), Gimpel et al. (2018), Haas et al. (2014), Hanelt et al. (2015b), Hartl and Hess (2017), Henfridsson et al. (2014), Hildebrandt et al. (2015), Huang et al. (2017), Jha et al. (2016), Karimi et al. (2009), Karimi and Walter (2015), Kauffman et al. (2010), Kazan and Damsgaard (2014), Kleinschmidt and Peters (2017), Lee and Lee (2013), Leischnig et al. (2017), Li et al. (2016), Lucas Jr. and Goh (2009), Lyytinen and Rose (2003b), Nwankpa and Roumani (2016), Oestreicher-Singer and Zalmanson (2012), Osmani et al. (2012), Pagani (2013), Petrikina et al. (2017), Piccinini et al. (2015b), Ramasubbu et al. (2014), Rauch et al. (2016), Remane et al. (2016a), Remane et al. (2016b), Resca et al. (2013), Riasanow et al. (2017), Richter et al. (2017), Roecker et al. (2017), Ross et al. (2016), Schmidt et al. (2017), Scott (2007), Selander et al. (2010), Shivendu and Zhang (2016), Srivastava and Shainesh (2015), Staykova and Damsgaard (2015a), Staykova and Damsgaard (2015b), Svahn et al. (2017a), Tan et al. (2015a), Tan et al. (2017), Tanniru et al. (2016), Terrenghi et al. (2017), Töytäri et al. (2017), Tumbas et al. (2015), Utesheva et al. (2012), Venkatesh et al. (2016), Woodard et al. (2012), Wörner et al. (2016), Yeow et al. (2017), Zolnowski and Warg (2018)
Research paper – other (n = 27)	Agarwal et al. (2010), Barrett et al. (2015), Bhimani (2015), Chowdhury and Åkesson (2011), Cziesla (2014), Fischer et al. (2018), Günther et al. (2017), Heilig et al. (2017), Jöhnk et al. (2017), Kahre et al. (2017), Krumeich et al. (2012), Krumeich et al. (2013), Lucas Jr. et al. (2013), Lyytinen and Rose (2003a), Nambisan et al. (2017), Neumeier et al. (2017), Nischak et al. (2017), Pousttchi et al. (2015), Püschel et al. (2016), Rai and Sambamurthy (2006), Rizk et al. (2018), Seo (2017), Sørensen (2016), Tanriverdi and Lim (2017), Weissenfeld et al. (2017), Yoo (2013), Yoo et al. (2010b)
Practitioner outlet (n = 21)	Andal-Ancion et al. (2003), Basole (2016), Demirkan et al. (2016), Dremel et al. (2017), Earley (2014), Fitzgerald et al. (2014), Gray et al. (2013), Gust et al. (2017), Hansen and Sia (2015), Hess et al. (2016), Kane (2015a), Kane (2015b), Kane (2016b), Nehme et al. (2015), Porter and Heppelmann (2014), Reinartz and Imschloß (2017), Sebastian et al. (2017), Sia et al. (2016), Svahn et al. (2017b), Westerman et al. (2011), Wulf et al. (2017)
Value networks (n = 92)	
Source type	Sources
Research paper – empirical (n = 54)	Asgarkhani (2005), Barua et al. (2004), Bazarhanova et al. (2018), Chanias (2017), Clohessy et al. (2017), Delmond et al. (2017), Dillon et al. (2015), Duerr et al. (2018), Duerr et al. (2017), Elbanna and Newman (2016), Friedlmaier et al. (2018), Gimpel (2015), Gimpel et al. (2018), Haffke et al. (2016), Hildebrandt et al. (2015), Hjalmarsson et al. (2015), Holotiuk and Beimborn (2017), Horlach et al. (2017), Huhtamäki et al. (2017), Islam et al. (2017), Karagiannaki et al. (2017), Karimi et al. (2009), Karimi and Walter (2015), Kiefer (2000), Korpela et al. (2017), Leonardi et al. (2016), Li et al. (2016), Medaglia et al. (2017), Mohagheghzadeh and Svahn (2016), Omar and Elhaddadeh (2016), Pagani (2013), Piccinini et al. (2015b), Ramasubbu et al. (2014), Reinhold and Alt (2009), Riasanow et al. (2017), Sachse et al. (2012), Saldanha et al. (2017), Schmidt et al. (2017), Selander et al. (2010), Setia et al. (2013), Smith and Webster (2006), Srivastava and Shainesh (2015), Standaert and Jarvenpaa (2017), Svahn et al. (2017a), Tan et al. (2015a), Terrenghi et al. (2017), Töytäri et al. (2017), Utesheva et al. (2012), Winkler et al. (2014), Wörner et al. (2016), Xie et al. (2014), Yeow et al. (2017), Zhu et al. (2006), Zolnowski and Warg (2018)
Research paper – other (n = 17)	Barrett et al. (2015), Bharadwaj et al. (2013), Bhimani (2015), de Reuver et al. (2017), Fischer et al. (2018), Granados et al. (2008), Han et al. (2015), Hayes (2016), Legner et al. (2017), Lucas Jr. et al. (2013), Nischak et al. (2017), Pousttchi et al. (2015), Prifti et al. (2017), Rizk et al. (2018), Seo (2017), Yoo (2013), Yoo et al. (2010b)
Practitioner outlet (n = 21)	Andal-Ancion et al. (2003), Basole (2016), Dremel et al. (2017), Fitzgerald (2014a), Gray et al. (2013), Hansen et al. (2011), Hansen and Sia (2015), Hess et al. (2016), Kane (2015a), Kane (2017b), Kane (2017d), Kane et al. (2016), Kohli and Johnson (2011), Nehme et al. (2015), NetworkWorld Asia (2015), Porter and Heppelmann (2014), Sia et al. (2016), Svahn et al. (2017b), Westerman and Bonnet (2015), Westerman et al. (2011), Wulf et al. (2017)
Digital channels (n = 72)	
Source type	Sources
Research paper – empirical (n = 44)	Andrade and Doolin (2016), Barua et al. (2004), Berghaus and Back (2016), Berghaus and Back (2017), Bolton et al. (2017), Chanias (2017), Chanias and Hess (2016), Chatfield et al. (2015), Delmond et al. (2017), Duerr et al. (2017), Ebbesson and Bergquist (2016), Fehér and Varga (2017), Gimpel (2015), Gimpel et al. (2018), Haffke et al. (2017), Haffke et al. (2016), Holotiuk and Beimborn (2017), Horlacher et al. (2016), Karimi and Walter (2015), Kiefer (2000), Lee and Lee (2013), Li et al. (2017), Li et al. (2016), Oestreicher-Singer and Zalmanson (2012), Pagani (2013), Petrikina et al. (2017), Ramasubbu et al. (2014), Reinhold and Alt (2009), Ross et al. (2016), Sachse et al. (2012), Schmidt et al. (2017), Scott (2007), Selander et al. (2010), Shahlaei et al. (2017), Smith and Webster (2006), Standaert and Jarvenpaa (2017), Tan et al. (2015b), Terrenghi et al. (2017), Tiefenbacher and Olbrich (2016), Utesheva et al. (2012), Wenzel et al. (2015), Xie et al. (2014), Yeow et al. (2017), Zhu et al. (2006)
Research paper – other (n = 12)	Cziesla (2014), Fischer et al. (2018), Granados et al. (2008), Heilig et al. (2017), Krumeich et al. (2012), Krumeich et al. (2013), Legner et al. (2017), Lucas Jr. et al. (2013), Morakanyane et al. (2017), Piccinini et al. (2015a), Rai and Sambamurthy (2006), Weissenfeld et al. (2017)
Practitioner outlet (n = 16)	Fitzgerald (2013), Gray et al. (2013), Hansen and Sia (2015), Hess et al. (2016), Johnson (2002), Kane (2014), Kane (2015a), Kane (2017d), Kane et al. (2016), Porter and Heppelmann (2014), Sebastian et al. (2017), Sia et al. (2016), Soava (2015), Westerman and Bonnet (2015), Westerman et al. (2011), Wulf et al. (2017)
Agility and ambidexterity (n = 79)	

(*continued on next page*)

Table 5 (*continued*)

Value propositions (n = 111)	
Source type	Sources
Source type	Sources
Research paper – empirical (n = 39)	Becker et al. (2018), Berghaus and Back (2017), Clohessy et al. (2017), Delmond et al. (2017), Duerr et al. (2017), Freitas Junior et al. (2017), Gimpel et al. (2018), Haffke et al. (2017), Haffke et al. (2016), Hartl and Hess (2017), Henfridsson and Lind (2014), Henfridsson et al. (2014), Holotiuk and Beimborn (2017), Horlach et al. (2017), Karagiannaki et al. (2017), Karimi et al. (2009), Karimi and Walter (2015), Leonhardt et al. (2017), Li et al. (2017), Li et al. (2016), Nwankpa and Datta (2017), Oh (2009), Osmani et al. (2012), Piccinini et al. (2015b), Ramasubbu et al. (2014), Reitz et al. (2018), Ross et al. (2016), Scott (2007), Shahlaei et al. (2017), Standaert and Jarvenpaa (2017), Svahn et al. (2017a), Tan et al. (2015a), Tanniru et al. (2016), Terrenghi et al. (2017), Tumbas et al. (2015), Woodard et al. (2012), Xie et al. (2014), Yeow et al. (2017), Zolnowski and Warg (2018)
Research paper – other (n = 18)	Bharadwaj et al. (2013), Dixon et al. (2017), Fichman et al. (2014), Fischer et al. (2018), Gerster (2017), Günther et al. (2017), Heilig et al. (2017), Jöhnk et al. (2017), Kahre et al. (2017), Le Dinh et al. (2016), Legner et al. (2017), Neumeier et al. (2017), Nischak et al. (2017), Piccinini et al. (2015a), Rai and Sambamurthy (2006), Schmid et al. (2017), Weiß et al. (2018), Yoo et al. (2010b)
Practitioner outlet (n = 22)	Demirkan et al. (2016), Dery et al. (2017), Dremel et al. (2017), Earley (2014), Fitzgerald (2014b), Gust et al. (2017), Hansen et al. (2011), Hansen and Sia (2015), Hess et al. (2016), Kane (2015b), Kane (2016b), Kane et al. (2017), Kane et al. (2016), Kohli and Johnson (2011), Maedche (2016), NetworkWorld Asia (2015), Sebastian et al. (2017), Sia et al. (2016), Weill and Woerner (2018), Westerman and Bonnet (2015), Woon (2016), Wulf et al. (2017)

assembling requisite assets, knowledge, and relationships with speed and surprise" (Sambamurthy et al., 2003:245). Analytics and the IoT can be exploited to optimize existing business processes and reduce slack resources (Du et al., 2016). In other instances, these technologies can be implemented to provide insight into untapped market opportunities or to increase customer proximity (Hansen and Sia, 2015; Setia et al., 2013). For example, a firm can offer innovative maintenance services based on the analysis of data generated by sensors embedded within its products (Porter and Heppelmann, 2014). The literature also reports on the ability for firms to use of digital technologies to achieve ambidexterity – also referred to as bimodality in the practitioner literature (Haffke et al., 2017) and successfully combine the *exploration* of digital innovation with the *exploitation* of existing resources (Li et al., 2017; Svahn et al., 2017a). For example, in their study of 25 companies, Sebastian et al. (2017) found that ambidexterity is founded upon a firm's ability to maintain both an *operational backbone* as well as a *digital services platform*.

Structural changes required for changing the value creation process

Like any other initiative that has the potential to profoundly alter the fabric of an organization, DT is associated with a number of important structural changes (see Table 6).

Organizational structure. Consistent with the idea that agility and ambidexterity are necessary capabilities to compete in a digital world, the literature highlights cross-functional collaboration as an important element of DT (Earley, 2014; Maedche, 2016). Although the idea of fostering collaboration across business units and breaking functional silos is by no means new in IS research, the literature on DT highlights the reality that in many instances, a significant chasm must still be crossed for these forms of collaboration to emerge and to fuse organizational and IS strategy together (Duerr et al., 2017; Li et al., 2016; Seo, 2017; Svahn et al., 2017a). One way to achieve this objective is through the creation of a separate unit that maintains a degree of independence from the rest of the organization (Maedche, 2016; Sia et al., 2016). With this structure, the unit is granted with a relative degree of flexibility propitious to innovation while maintaining access to existing resources. Another way is to create cross-functional teams that remain within the current organization (Dremel et al., 2017; Svahn et al., 2017a). For instance, Dremel et al. (2017) studied the multi-year development of an analytics capability at Audi AG. They found that the formation of multidisciplinary *competence networks* that transcend Audi's traditional organizational structure helped the organization use analytics as an IT-driven initiative for the benefit of business units.

Organizational culture. The disruption spurred by DT also requires that the culture of the focal organization changes (Hartl and Hess, 2017). In incumbent firms for instance, there is evidence that the traditional separation between IT and business functions is so ingrained into the fabric of the organization that they become part of the organization's values (Haffke et al., 2017). In the newspaper industry, Karimi and Walter (2015) found that the ability for a firm to build the capabilities required to alter their value proposition using digital platforms is founded upon a combination of variables including *values* – which comprise an innovative culture, a common language, and a multimedia mindset. A question that arises from these findings therefore relates to our understanding of what a "digital culture looks like" (Kane et al., 2016:9). A common theme across studies points to the need for firms to cultivate a willingness to take risks and to experiment (Fehér and Varga, 2017) with digital technologies on a small scale before scaling these successful experiments to the rest of the organization (Dremel et al., 2017). This theme highlights the necessity to align actions with the principles of agility (Horlach et al., 2017; Leonhardt et al., 2017) inspired by software development practices (Gust et al., 2017). In doing so firms can foster learning through small, incremental and iterative changes while maintaining their ability to adapt long-term plans based on the outcomes of such experiments as well as ongoing changes in their environment (Jöhnk et al., 2017).

Table 6
Structural changes required to alter value creation and capture processes.

Organizational structure (n = 59)	
Source type	Sources
Research paper – empirical (n = 24)	Berghaus and Back (2016), Berghaus and Back (2017), Boland et al. (2003), Bolton et al. (2017), Driver and Gillespie (1992), Duerr et al. (2018), Duerr et al. (2017), Haffke et al. (2017), Holotiuk and Beimborn (2017), Horlach et al. (2017), Klötzer and Pflaum (2017), Leonardi and Bailey (2008), Lucas Jr. and Goh (2009), McGrath et al. (2008), Mueller and Renken (2017), Piccinini et al. (2015b), Resca et al. (2013), Roecker et al. (2017), Ross et al. (2016), Selander and Jarvenpaa (2016), Svahn et al. (2017a), Tumbas et al. (2015), Yeow et al. (2017), Zhu et al. (2006)
Research paper – other (n = 17)	Dixon et al. (2017), Fischer et al. (2018), Günther et al. (2017), Jöhnk et al. (2017), Kahre et al. (2017), Krumeich et al. (2012), Krumeich et al. (2013), Legner et al. (2017), Loebbecke and Picot (2015), Lucas Jr. et al. (2013), Lyytinen and Rose (2003a), Matt et al. (2015), Morakanyane et al. (2017), Neumeier et al. (2017), Schmid et al. (2017), Tilson et al. (2010), Weiß et al. (2018)
Practitioner outlet (n = 18)	Demirkan et al. (2016), Dremel et al. (2017), Du et al. (2016), Earley (2014), Fitzgerald (2014c), Fitzgerald (2016a), Hansen and Sia (2015), Hess et al. (2016), Kane (2017b), Kane et al. (2017), Kane et al. (2016), Kohli and Johnson (2011), Maedche (2016), Porter and Heppelmann (2014), Sebastian et al. (2017), Singh and Hess (2017), Svahn et al. (2017b), Wulf et al. (2017)
Organizational culture (n = 36)	
Source type	Sources
Research paper – empirical (n = 22)	Berghaus and Back (2017), Bolton et al. (2017), Chatfield et al. (2015), Dasgupta and Gupta (2010), Duerr et al. (2018), Haffke et al. (2017), Hartl and Hess (2017), Holotiuk and Beimborn (2017), Kamel (2015), Karimi and Walter (2015), Klötzer and Pflaum (2017), Li et al. (2017), Li et al. (2016), Lucas Jr. and Goh (2009), Mueller and Renken (2017), Piccinini et al. (2015b), Roecker et al. (2017), Schmidt et al. (2017), Scott (2007), Svahn et al. (2017a), Tan et al. (2017), Töytäri et al. (2017)
Research paper – other (n = 2)	Jöhnk et al. (2017), Morakanyane et al. (2017)
Practitioner outlet (n = 12)	Dremel et al. (2017), Fitzgerald (2014c), Gust et al. (2017), Hansen and Sia (2015), Kane (2016a), Kane et al. (2016), Sebastian et al. (2017), Svahn et al. (2017b), Watson (2017), Weill and Woerner (2018), Westerman et al. (2011), Wulf et al. (2017)
Leadership (n = 62)	
Source type	Sources
Research paper – empirical (n = 27)	Agarwal et al. (2011), Becker et al. (2018), Bekkhus (2016), Benlian and Haffke (2016), Berghaus and Back (2016), Berghaus and Back (2017), Chanias (2017), Chanias and Hess (2016), Chatfield et al. (2015), Duerr et al. (2018), Fehér et al. (2017), Gimpel et al. (2018), Haffke et al. (2017), Haffke et al. (2016), Hesse (2018), Holotiuk and Beimborn (2017), Horlacher et al. (2016), Li et al. (2017), Li et al. (2016), Liere-Netheler et al. (2018), Oestreicher-Singer and Zalmanson (2012), Scott (2007), Tan et al. (2015a), Tanniru et al. (2016), Tiefenbacher and Olbrich (2016), Töytäri et al. (2017), Xie et al. (2014)
Research paper – other (n = 5)	Bharadwaj et al. (2013), Kahre et al. (2017), Legner et al. (2017), Matt et al. (2015), Riedl et al. (2017)
Practitioner outlet (n = 30)	Andriole (2017), Demirkan et al. (2016), Dery et al. (2017), Du et al. (2016), Earley (2014), Fitzgerald (2013), Fitzgerald (2014c), Fitzgerald (2016b), Fitzgerald et al. (2014), Hansen et al. (2011), Hansen and Sia (2015), Hess et al. (2016), Kane (2015a), Kane (2015b), Kane (2017c), Kane et al. (2017), Kane et al. (2016), Kohli and Johnson (2011), Maedche (2016), Nehme et al. (2015), Sebastian et al. (2017), Sia et al. (2016), Singh and Hess (2017), Weill and Woerner (2018), Westerman (2016), Westerman and Bonnet (2015), Westerman et al. (2014), Westerman et al. (2011), Wulf et al. (2017), Yee and Ng (2015)
Employee roles and skills (n = 69)	
Source type	Sources
Research paper – empirical (n = 31)	Agarwal et al. (2011), Asgarkhani (2005), Chatfield et al. (2015), Delmond et al. (2017), Driver and Gillespie (1992), Duerr et al. (2018), Fehér et al. (2017), Gimpel et al. (2018), Hartl and Hess (2017), Hjalmarsson et al. (2014), Holotiuk and Beimborn (2017), Joshi et al. (2017), Klötzer and Pflaum (2017), Li et al. (2017), Li et al. (2016), Liere-Netheler et al. (2018), Lucas Jr. and Goh (2009), Lyytinen and Rose (2003b), McGrath et al. (2008), Petrikina et al. (2017), Remane et al. (2017), Richter et al. (2017), Roecker et al. (2017), Ross et al. (2016), Shahlaei et al. (2017), Svahn et al. (2017a), Tan et al. (2015a), Tiefenbacher and Olbrich (2016), Utesheva et al. (2012), Xie et al. (2014), Zhu et al. (2006)
Research paper – other (n = 12)	Bharadwaj et al. (2013), Fichman et al. (2014), Günther et al. (2017), Jöhnk et al. (2017), Legner et al. (2017), Loebbecke and Picot (2015), Lyytinen and Rose (2003a), Matt et al. (2015), Morakanyane et al. (2017), Prifti et al. (2017), Sørensen (2016), Weiß et al. (2018)
Practitioner outlet (n = 26)	Demirkan et al. (2016), Dery et al. (2017), Dremel et al. (2017), Fitzgerald (2014b), Fitzgerald (2014c), Fitzgerald (2016a), Fitzgerald (2016b), Fitzgerald et al. (2014), Gust et al. (2017), Hess et al. (2016), Kane (2015a), Kane (2016a), Kane (2016b), Kane (2017a), Kane (2017d), Kane et al. (2017), Kane et al. (2016), Maedche (2016), Nehme et al. (2015), Porter and Heppelmann (2014), Singh and Hess (2017), Watson (2017), Weill and Woerner (2018), Westerman et al. (2014), Westerman et al. (2011), Wulf et al. (2017)

Table 7
Barriers to changing value creation and capture processes.

Inertia (n = 35)	
Source type	Sources
Research paper – empirical (n = 21)	Bolton et al. (2017), Delmond et al. (2017), Hildebrandt et al. (2015), Karagiannaki et al. (2017), Kleinschmidt and Peters (2017), Li et al. (2017), Lucas Jr. and Goh (2009), Mithas et al. (2013), Rauch et al. (2016), Remane et al. (2017), Schmidt et al. (2017), Scott (2007), Srivastava and Shainesh (2015), Töytäri et al. (2017), Tumbas et al. (2015), Wenzel et al. (2015), Woodard et al. (2012), Xie et al. (2014), Yang et al. (2012), Yeow et al. (2017), Zhu et al. (2006)
Research paper – other (n = 6)	Dixon et al. (2017), Granados et al. (2008), Legner et al. (2017), Nambisan et al. (2017), Schmid et al. (2017), Tilson et al. (2010)
Practitioner outlet (n = 8)	Andriole (2017), Fitzgerald (2014b), Fitzgerald et al. (2014), Kane (2016a), Kane (2016b), Kohli and Johnson (2011), Sia et al. (2016), Westerman et al. (2011)
Resistance (n = 40)	
Source type	Sources
Research paper – empirical (n = 22)	Barua et al. (2004), Bazarhanova et al. (2018), Becker et al. (2018), Chatfield et al. (2015), Ciriello and Richter (2015), Duerr et al. (2018), Elbanna and Newman (2016), Hjalmarsson et al. (2014), Kleinschmidt and Peters (2017), Liere-Netheler et al. (2018), Lucas Jr. and Goh (2009), Mohagheghzadeh and Svahn (2016), Omar and Elhaddadeh (2016), Paavola et al. (2017), Petrikina et al. (2017), Piccinini et al. (2015b), Selander and Jarvenpaa (2016), Serrano and Boudreau (2014), Svahn et al. (2017a), Töytäri et al. (2017), Yeow et al. (2017), Zhu et al. (2006)
Research paper – other (n = 4)	Bichler et al. (2016), Günther et al. (2017), Matt et al. (2015), Schmid et al. (2017)
Practitioner outlet (n = 14)	Andriole (2017), Dery et al. (2017), Du et al. (2016), Fitzgerald et al. (2014), Gust et al. (2017), Hansen et al. (2011), Hansen and Sia (2015), Kane (2016a), Kane et al. (2017), Kohli and Johnson (2011), Singh and Hess (2017), Svahn et al. (2017b), Westerman et al. (2011), Wulf et al. (2017)

Leadership. In the context of DT, organizational leaders must work to ensure that their organizations develop a digital mindset while being capable of responding to the disruptions associated with the use of digital technologies (Benlian and Haffke, 2016; Hansen et al., 2011). To that end, the literature highlights the creation of new leadership roles (Haffke et al., 2016; Horlacher et al., 2016). For example, the creation of a chief digital officer (CDO) position signals the strategic nature of DT for the entire organization. CDOs are tasked to ensure that digital technologies are properly leveraged and aligned with the objectives of the organization (Horlacher et al., 2016; Singh and Hess, 2017). They act as boundary spanners that can help to implement digital business strategy into series of concrete actions that influence a firm's *organizing logic* (Sambamurthy and Zmud, 2000) and foster close collaboration between business and IT functions. In a few instances, the CDO position is also seen as an important but temporary role (Singh and Hess, 2017:16), suggesting that there may be an end state to DT consistent with the notion of digital transformation strategy (Matt et al., 2015).

Employee roles and skills. In the context of DT, changes to the structure as well as the culture of an organization lead employees to assume roles that were traditionally outside of their functions. Specifically, the literature highlights the idea that DT fosters situations where employees who are not part of the IT function take the lead on technology-intensive projects (Yeow et al., 2017). Conversely, members of the IT function are expected to become active, business-savvy participants in the realization of those projects (Dremel et al., 2017). As digital technologies enable new forms of automation (Neumeier et al., 2017) and decision-making processes (Dremel et al., 2017; Hess et al., 2016), questions on the need to develop the skills of existing workers (Hess et al., 2016) as well as the skills required for future workers who will form the *digital workforce* (Colbert et al., 2016) are also becoming increasingly relevant (Watson, 2017). Far from removing the need for organizations to depend on human capital, DT requires employees to depend more heavily on their analytical skills to solve increasingly complex business problems (Dremel et al., 2017), and accompanying employees through this transition poses significant challenges that extend beyond the domain of human resources (Karimi and Walter, 2015; Singh and Hess, 2017).

Barriers to changing the value creation process

Notwithstanding these changes, inertia and resistance can hinder the unfolding of an organization's DT, in line with the literature on IT-enabled organizational transformation (see Table 7).

Inertia. One of the most significant barriers to DT is inertia (35 sources). Inertia is relevant where existing resources and capabilities can act as barriers to disruption (Islam et al., 2017; Svahn et al., 2017a), highlighting the relevance of path dependence as a constraining force for innovation through digital technologies (Srivastava and Shainesh, 2015; Wenzel et al., 2015). For example, incumbent firms are deeply embedded in existing relationships with customers and suppliers, have well-established production processes that are highly optimized, but often rigid (Andriole, 2017) and rely on resources that cannot easily be reconfigured (Kohli and Johnson, 2011; Woodard et al., 2012).

These issues have been identified in both research (Roecker et al., 2017; Töytäri et al., 2017) and practitioner (Westerman et al., 2011) literature. For example, the Kodak case (Lucas Jr. and Goh, 2009) illustrates how the core capabilities of an organization can

become core rigidities that prevent the radical transformation afforded by digital technologies (in this instance, digital photography). Töytäri et al. (2017) found that organizational culture, identity and legitimacy form strong institutional barriers that hinder the development of smart services. In all those instances, the issue is not that the organization's top management does not consider digital technologies as potentially beneficial to the organization. Rather, the structural components of the organization, both tangible (e.g., means of production) and intangible (e.g., organizational culture), are so embedded within everyday practices that they stifle the innovative and disruptive power of digital technologies.

Resistance. Another barrier to DT is the resistance that employees can demonstrate when disruptive technologies are introduced in the organization (40 sources) (Fitzgerald et al., 2014; Kane, 2016a; Lucas Jr. and Goh, 2009; Singh and Hess, 2017). The issue of resistance raises important questions with regards to the ways and the pace at which technologies are introduced into an organization and the practitioner literature highlights "innovation fatigue" (Fitzgerald et al., 2014:9) as one of the causes of resistance. Singh and Hess (2017) found that the CDO position can be leveraged to ensure that digital technologies are used in a way that remains consistent with the organizational culture that employees are accustomed to and favor their acceptance. Conversely, Schmid et al. (2017) argued that resistance is a product of inertia rooted in everyday work that cannot be addressed by simply altering the behavior of employees. Rather, it requires that processes be altered to enable flexibility in the face of change. Svahn et al. (2017a:242) show that resistance can also be explained by a lack of visibility on the potential benefits of digital technologies. They found that workshops that involve organizational actors who will be affected by DT can help prevent resistance and improve cross-functional collaboration.

Assessing the impacts of digital transformation

It has been argued that DT has the potential to have wide ranging impacts (see Table 8), including at the society level (Agarwal et al., 2010; Majchrzak et al., 2016). Nevertheless, we find those impacts to be primarily assessed at the organization level, as illustrated in Appendix C.

Organizational level impacts

Operational efficiency. Although digital technologies have the potential to transform an organization, we found 36 studies highlighting operational efficiency – which includes the automation (Andriole, 2017), the improvement of business processes (Gust et al., 2017) as well as costs savings (Pagani, 2013), as a benefit of DT. For instance, cloud computing provides on-demand, elastic resources that do not need to be provisioned, managed and maintained by IT staff (Kane, 2015b). Big data and analytics are expected to speed up the decision-making process (Bharadwaj et al., 2013), enabling faster response time while smart products and services, through the embedding of artificial intelligence that leverages (big) data, can enable automated, algorithmic decision-making (Loebbecke and Picot, 2015; Newell and Marabelli, 2015).

Organizational performance. DT is also associated with increases in several dimensions of organizational performance, including innovativeness (Svahn et al., 2017a), financial performance (Karimi and Walter, 2015), firm growth (Tumbas et al., 2015), reputation (Kane, 2016c; Yang et al., 2012) as well as competitive advantage (Neumeier et al., 2017). For example, under the freemium model, a firm can use online communities to increase the sense of belonging of users and motivate them to purchase premium accounts (Oestreicher-Singer and Zalmanson, 2012). In the context of entrepreneurial firms where the growth rate is nonlinear, Tumbas et al. (2015) found that successful firms put up a "digital façade" to enable connectivity with customers and business partners while later using this façade as an instrument to foster relationships with other customers and suppliers. This and other examples (e.g., Setia et al., 2013) show how digital technologies can, through higher customer engagement and participation, foster higher profits for firms. At a conceptual level, it has been proposed that digital technologies can support a firm's ability to sense the complexity of its environment in order to design a response that can help maximize its chances of survival through the adaptation or the redefinition of its core activities (Tanriverdi and Lim, 2017).

Higher-level impacts

Positive impacts. Several articles also reflect on the impacts of DT at higher levels, including at the industry and the society levels. Research has argued that digital technologies afford a tremendous potential for the improvement of the quality of life of individuals (Agarwal et al., 2010; Pramanik et al., 2016). One such example is healthcare (Agarwal et al., 2010), where various types of technologies, including electronic health records (Kane, 2015b), big data and analytics (Kane, 2016c; Kane, 2017a), as well as augmented physical products (Bravhar and Juric, 2017) are perceived as valuable contributions to a sector that has traditionally been a laggard in technology adoption (Lucas Jr. et al., 2013). Recent research has specifically highlighted those benefits in geographical areas that are impacted by poverty and resource disparities. For example, Srivastava and Shainesh (2015) studied the use of tele-ophthalmology in rural India and found that digital technologies enable healthcare organizations to increase access to care while simultaneously reducing costs for both the organization (e.g., by minimizing the physical space required to operate the clinic) and patients (e.g., by not having to travel long distances to reach a clinic). They likened this virtuous circle to a mechanism of "value reinforcement", where "the value created through one parameter can be leveraged to create value through another parameter" (p. 257).

Undesirable outcomes. Notwithstanding these positive outcomes, the literature also reflects on the potential issues associated with the pervasive use of digital technologies, primarily in the domain of security and privacy. For instance, Newell and Marabelli (2015)

Table 8
Impacts of digital transformation.

Organizational level impacts Operational efficiency (n = 36)	
Source type	Sources
Research paper – empirical (n = 10)	Deliyannis et al. (2009), Holotiuk and Beimborn (2017), Liere-Netheler et al. (2018), Pagani (2013), Richter et al. (2017), Roecker et al. (2017), Ross et al. (2016), Schellhorn (2016), Scott (2007), Svahn et al. (2017a)
Research paper – other (n = 7)	Agarwal et al. (2010), Bhimani (2015), Fischer et al. (2018), Heilig et al. (2017), Morakanyane et al. (2017), Neumeier et al. (2017), Weiß et al. (2018)
Practitioner outlet (n = 19)	Andal-Ancion et al. (2003), Cummings (2012), Demirkan et al. (2016), Du et al. (2016), Fitzgerald (2013), Fitzgerald (2016a), Fitzgerald et al. (2014), Gray et al. (2013), Gust et al. (2017), Kane (2015b), Kane (2017a), Kohli and Johnson (2011), NetworkWorld Asia (2015), Porter and Heppelmann (2014), Sebastian et al. (2017), Westerman (2016), Westerman and Bonnet (2015), Westerman et al. (2014), Westerman et al. (2011)
Organizational performance (n = 49)	
Source type	Sources
Research paper – empirical (n = 33)	Barua et al. (2004), Chanias (2017), Delmond et al. (2017), Felgenhauer et al. (2017), Freitas Junior et al. (2017), Gimpel (2015), Hildebrandt et al. (2015), Karimi and Walter (2015), Kauffman et al. (2010), Leischnig et al. (2017), Lienhard et al. (2017), Liere-Netheler et al. (2018), Mithas et al. (2013), Nwankpa and Datta (2017), Nwankpa and Roumani (2016), Oestreicher-Singer and Zalmanson (2012), Oh (2009), Pagani (2013), Piccinini et al. (2015b), Remane et al. (2017), Saldanha et al. (2017), Schellhorn (2016), Selander et al. (2010), Shivendu and Zhang (2016), Srivastava and Shainesh (2015), Srivastava et al. (2016), Staykova and Damsgaard (2015b), Svahn et al. (2017a), Tan et al. (2015a), Trantopoulos et al. (2017), Woodard et al. (2012), Yeow et al. (2017), Zhu et al. (2006)
Research paper – other (n = 11)	Bharadwaj et al. (2013), Bhimani (2015), Dixon et al. (2017), Gerster (2017), Granados et al. (2008), Krumeich et al. (2013), Lucas Jr. et al. (2013), Myunsoo and Byungtae (2013), Neumeier et al. (2017), Tanriverdi and Lim (2017), Yoo et al. (2010b)
Practitioner outlet (n = 5)	Basole (2016), Du et al. (2016), Kane et al. (2017), Nambisan et al. (2017), Sia et al. (2016)
Higher level impacts Societal impacts and well-being (n = 40)	
Source type	Sources
Research paper – empirical (n = 15)	Andrade and Doolin (2016), Asgarkhani (2005), Chan et al. (2016), Chatfield et al. (2015), Deng et al. (2016), Ganju et al. (2016), Hanelt et al. (2015b), Jha et al. (2016), Leong et al. (2016), Miranda et al. (2016), Nastjuk et al. (2016), Oreglia and Srinivasan (2016), Selander and Jarvenpaa (2016), Srivastava and Shainesh (2015), Venkatesh et al. (2016)
Research paper – other (n = 19)	Agarwal et al. (2010), Bara-Slupski (2016), Barrett et al. (2015), Bryant (2010), de Reuver et al. (2017), Eymann et al. (2015), Fichman et al. (2014), Günther et al. (2017), Legner et al. (2017), Loebbecke and Picot (2015), Lucas Jr. et al. (2013), Majchrzak et al. (2016), Newell and Marabelli (2014), Newell and Marabelli (2015), Rajan (2002), Riedl et al. (2017), Tilson et al. (2010), Urquhart and Vaast (2012), Yoo et al. (2010a)
Practitioner outlet (n = 6)	Earley (2014), Fitzgerald et al. (2014), Kane (2014), Soava (2015), Watson (2017), Westerman (2016)
Security & privacy issues (n = 44)	
Source type	Sources
Research paper – empirical (n = 19)	Asgarkhani (2005), Bazarhanova et al. (2018), Chatfield et al. (2015), Dillon et al. (2015), Fehér et al. (2017), Gimpel et al. (2018), Islam et al. (2017), Kamel (2015), Kiefer (2000), Korpela et al. (2017), McGrath (2016), Medaglia et al. (2017), Paavola et al. (2017), Piccinini et al. (2015b), Roecker et al. (2017), Sachse et al. (2012), Tiefenbacher and Olbrich (2016), Töytäri et al. (2017), Zhu et al. (2006)
Research paper – other (n = 14)	Agarwal et al. (2010), Arens and Rosenbloom (2003), Arner et al. (2017), Eymann et al. (2015), Fichman et al. (2014), Fischer et al. (2018), Goes (2015), Günther et al. (2017), Legner et al. (2017), Newell and Marabelli (2014), Newell and Marabelli (2015), Pousttchi et al. (2015), Rai and Sambamurthy (2006), Tilson et al. (2010)
Practitioner outlet (n = 11)	Dremel et al. (2017), Gray et al. (2013), Kane (2015b), Kane et al. (2016), Nehme et al. (2015), Ng (2016), Porter and Heppelmann (2014), Singh and Hess (2017), Watson (2017), Woon (2016), Wulf et al. (2017)

argue that algorithmic decision-making, for all its potential benefits, also carries significant risks for individuals and society in general and that security, privacy and safety should remain important areas of consideration for researchers, government bodies as well as practitioners. In the automobile industry, Piccinini et al. (2015b) found that data security and privacy were also important issues. While our sample includes 19 empirical works containing references to security and privacy, our analysis reveals that these works do not address the crucial question as to *how* security and privacy can be effectively turned from a potential issue into a source of positive impacts for an organization as well as society. Rather, the focus is currently set on acknowledging these issues and their ramifications for organizations, society, as well as individuals (Newell and Marabelli, 2015).

Digital transformation and IT-enabled transformation

Having reviewed the literature on DT, we now turn to the question of the novelty of the phenomenon. The notion that IT carries

Table 9
Strategic Roles of IT.
adapted from Dehning et al., 2003:639;653–654.

Automate	Description: Replacing human labor Goals: improve existing capabilities, efficiency and effectiveness. Outcomes: clearly identifiable and measurable
Informate-up	Description: Providing information to top management. Goals: improve decision-making, coordination and collaboration. Outcomes: difficult to anticipate because they may include intangible benefits.
Informate-down	Description: Providing information to employees across the firm. Goals: improve decision-making, coordination and collaboration. Outcomes: difficult to anticipate because they may include intangible benefits.
Transform	Description: Redefining the business model, business processes and relationships of the firm. Goals: Alter existing capabilities, acquire new capabilities, both internally (through reconfiguration) and externally (through strategic partnerships). Outcomes: difficult to anticipate, include both tangible and intangible benefits; fundamentally alters the fabric of the firm.

transformative potential is not new and has long been acknowledged in the literature (Zuboff, 1988). In their study of IT investment announcements by public firms, Dehning et al. (2003) built on the seminal work of Zuboff (1988) and argued that the strategic role of IT falls into one of four main categories (see Table 9). Using these rules, Lucas Jr. et al. (2013) assessed IT's transformative impact in three areas (financial markets, healthcare, customer experience). In two of those areas – financial markets and customer experience, they argued that a profound transformation has already taken place as processes, market structures and value networks have changed significantly. In the context of healthcare, Agarwal et al. (2010) observed that "an IT-enabled transformation of health care is just beginning, and it cannot happen too fast" (p. 377).

Although these criteria are referenced within our sample, they can be difficult to apply because studies often focus on innovation rather than change, while change is seen as a necessary step toward the achievement of organizational performance and operational efficiency. Nevertheless, if we consider that changes to one or more of the constituting dimensions of a firm's business model are reflective of a *transformation* (as per Dehning et al.'s criteria), then even the reconfiguration of key business activities using digital technologies is reflective of a transformation. For instance, algorithmic decision-making can be conceptualized as a form of automation. Yet as Newell and Marabelli (2015) argue, its implications are more far-reaching than that. As evidenced by our review, digital technologies (e.g., through the emergence of platforms and ecosystems) have significantly altered the way firms create value (Tan et al., 2015a). Even firms that build physical products are now faced with the pressing need to incorporate services and software as part their core offerings, turning their physical products into conduits for the generation, the collection and the exchange of valuable data (Porter and Heppelmann, 2014).

Still, the question remains: is DT different from other forms of IT-enabled transformation? To investigate this issue, we looked at prior literature on the topic of IT-enabled transformation (see Appendix D). We analyzed evidence presented in studies on IT-enabled transformation against the evidence found in DT literature to compare both phenomena (see Table 10). We referred to the four properties of DT uncovered during the semantic decomposition process we used to build our definition of DT and augmented these

Table 10
Comparing IT-enabled transformation and digital transformation.

Property	IT-enabled organizational transformation	Digital transformation
Impetus	Organizational decision.	Society and industry trends; organizational decision.
Target entity	Single organization or, less frequently, an organization along with its immediate value network.	Organization, platform, ecosystem, industry, society.
Scope	The transformation can, in some instances, be profound but is typically limited to an organization's processes and its immediate value network (e.g., suppliers).	The transformation can be profound and has implications beyond the organization's immediate value network (e.g., society, customers).
Means	Single IT artifact primarily focused on operations (e.g., ERP).	Combinations of digital technologies (e.g., analytics and mobile apps).
Expected outcome	Business processes are optimized and efficiency gains are realized; in some instances the business model of the focal organization is altered. Existing institutions remain unchanged.	Business processes are transformed and the business model of the focal organization is altered; in some instances business processes are optimized. Because of its ramifications at higher levels, the transformation raises important questions with regards to the relevance of current institutions (e.g., regulatory framework, ethics).
Locus of uncertainty	Internal: located inside the organization.	External (first): located outside of the organization. Internal (second): located inside the organization.
Illustrative example	A firm purchases an ERP and reengineers its business processes according to industry best practices as well as institutionalized accounting principles. The ERP implementation also enables increased coupling between the firm and its supply chain partners.	As consumers increasingly rely on mobile devices to purchase goods and services, a firm decides to capitalize on this trend by developing a mobile application to engage with customers. In doing so, it also captures and analyzes the data generated through customer interactions with their mobile application to increase customer proximity and enhance customer experience.

properties with two other dimensions, which we labelled *impetus* and *locus of uncertainty* that emerged during our analysis. Together these observations lead us to view DT as an evolution of IT-enabled transformation. In our view, DT better reflects the complexity of the environment within which firms operate and the disruptive impacts of digital technologies on individuals, organizations and society. As a result, we concur with Bharadwaj et al.'s (2013) arguments on the relevance of the strategic role of digital technologies and their ability to impact the *scale* and the *scope* of the changes associated with their use along with the *speed* at which those changes take place.

Digital transformation: a research agenda

Our review highlights the significant contributions that research has made toward our understanding of DT. In this section, we extend these contributions through the outline of an ambitious agenda comprising two avenues for future strategic IS research and practice on DT. The first avenue is the contribution of dynamic capabilities as a theoretical foundation to study DT. The second avenue is the incorporation of ethics in strategic IS research on DT.

Avenue 1: How dynamic capabilities contribute to digital transformation

Our review and our inductive framework highlight the nature of DT as a process where digital technologies create an impetus for organizations to implement responses to gain or maintain their competitive advantage. Key questions related to the efficacy of these responses are the ability for firms to sense disruptions, seize them (e.g., through strategic responses), and to reconfigure elements of their business model accordingly. In this first avenue, we propose dynamic capabilities (DC) as a theoretical foundation to study those mechanisms that enable firms to engage with DT to enable strategic renewal. Specifically, we propose that research focus on three key areas. The first is the building of organizational dynamic capabilities to support the ongoing DT of a firm. The second is the role of integrative capabilities, an understudied form of dynamic capabilities, in the context of digital platforms and ecosystems. The third is the microfoundations that help us understand and explain how DT unfolds in practice.

Building organizational dynamic capabilities for digital transformation

The DC perspective contributes to explain how firms build and sustain competitive advantage (Helfat and Raubitschek, 2018; Schilke et al., 2018; Teece, 2007). DC extends the resource-based view of the firm (RBV) and focuses on the ability for firms to *purposefully alter* their resource base to increase their degree of fitness with their environment and ensure their survival (Jiang et al., 2015; Schilke et al., 2018). DC posits that firms possess both ordinary as well as dynamic capabilities. The former relate to "the performance of administrative, operational, and governance-related functions that are (technically) necessary to accomplish tasks"; the latter "involve higher-level activities that can enable an enterprise to direct its ordinary activities toward high-payoff endeavors" (Teece, 2014:328). Dynamic capabilities enable firms to innovate and adapt to changes in their environment through three main mechanisms (Teece, 2007): *sensing*, i.e., the "identification, development, codevelopment, and assessment of technological opportunities in relationship to customer needs" (p. 332); *seizing*, i.e., *the "*mobilization of resources to address needs and opportunities, and to capture value from doing so" (p. 332); and *transforming*, that is, the "continued renewal" (p. 332) of the firm as its resources are reconfigured to strategically seize opportunities and respond to threats. Although DC has been found useful in IS research in general, and, as outlined in our review, in the context of DT (8 studies within our sample), we argue that research on DT could benefit from further engaging with this perspective.

There is an interesting fit between DC as a conceptual foundation and DT as a phenomenon of interest. The literature highlights the nature of DT as a source of *continuous* change and disruption in a firm's competitive environment. The ability for firms to design mechanisms that enable repeatable, continuous adaptation in spite of such rapid changes is therefore an important question. The contributions of DC have been found most useful in contexts fraught with environmental turbulence or hypercompetition as ordinary capabilities cannot explain—on their own—how firms build and sustain competitive advantage (Teece, 2014:329). As physical resources—including products—become comparatively less relevant than services, as consumers contribute to influence trends related to the use of digital technologies, and as value networks become broader and more complex, firms experience higher levels of uncertainty. To manage this uncertainty, mechanisms to sense and adapt to changes that originate outside of the firm's competitive environment (e.g., Netflix entering the movie making business) and locus of control (e.g., online users moving away from Facebook and adopting Instagram) must be put in place. Although we have some evidence of firms managing to adapt to these changes (e.g., Yeow et al., 2017), our understanding of the ability for firms to design *repeatable* mechanisms for this purpose is limited. Recent developments in DT literature have proposed the concept of *digital maturity* (Kane, 2017c) as a capacity to respond to change in an appropriate manner and we argue that DC may help us understand how firms achieve digital maturity as they design and maintain these higher level mechanisms that enable adaptability through successive waves of digital innovation.

The role of integrative capabilities to support digital platforms and ecosystems

In the context of multi-sided platforms (MSP), research in organizational policy has argued that three types of dynamic capabilities are also relevant: innovation capabilities, environmental scanning and sensing capabilities, and integrative capabilities (Helfat and Raubitschek, 2018). Research on DT has touched upon some elements of the first two (albeit without specifically referring to DC) (e.g., Tiefenbacher and Olbrich, 2016), while the third has been largely left unexplored in DT literature as well as in IS research in general. Integrative capabilities (IC) "provide the capacity for reliable, repeatable communication and coordination activity directed toward the introduction and modification of: products; resources and capabilities; business models." (p. 1395) They

can be internal (within the firm) or external (across firms, e.g., through alliances and partnerships).

In the context of DT, we argue that external IC are essential because the value networks that firms rely on to create and capture value are increasingly large and complex. For instance, firms have little choice but to depend on multiple parties to participate in platforms and ecosystems, whether they are leaders (Tan et al., 2015a), complementors (Ghazawneh and Henfridsson, 2013), or customers (Li et al., 2017). The *integration* of digital technologies provided by multiple parties is a crucial piece of the puzzle enabling a firm to successfully participate in a digital platform or ecosystem. Most studies on DT acknowledge the need for firms to engage with other parties to generate digital innovation (e.g., Hansen and Sia, 2015; Nehme et al., 2015). However, how these firms manage to remain abreast of the changes that take place within their value network remains unexplored. From the perspective of a platform leader for instance, the need to balance new functionality and technical debt, control and openness (Constantinides et al., 2018; Wessel et al., 2017) is paramount to recruit complementors and customers without running the risk of platform envelopment (Eisenmann et al., 2006) or desertion (Tiwana, 2015). From the perspective of a complementor, sensing the extent of the changes implemented by platform leader(s) to reconfigure one's own processes is an equally important question.

Although research in strategy and organizational policy has indeed begun to turn toward digital platforms and ecosystems (Helfat and Raubitschek, 2018), its coverage of the actual designs of the technological artifacts involved in these platforms and ecosystems and the impacts of those designs on the ability for firms to adapt to change in an appropriate and timely manner remains superficial. One notable exception is the case study of Alibaba by Li et al. (2017) who found that platform providers rely on *mentoring, facilitating and rule-making* as mechanisms to facilitate the building of cross-border e-commerce capabilities by SMEs. Nevertheless, there is a dire need to better understand how communication and coordination take place in the context of digital platforms and ecosystems.

Microfoundations of dynamic capabilities: how digital transformation unfolds in practice

At a micro level, the literature has called for research to further study the micro processes that support the building and the maintenance of dynamic capabilities (Schilke et al., 2018). Indeed, although they are conceptualized as organizational competencies, DC are founded on the performance of routines as repeated patterns of interdependent actions (Feldman and Pentland, 2003), and are therefore anchored in the performances of individuals, including managers (Helfat and Martin, 2015; Yeow et al., 2017). Notwithstanding the advances research in strategy has made to understand the contributions of individuals to the building and maintenance of DC (e.g., Abell et al., 2008), calls have been made to further engage with the nature of the work *performed* by actors that support these capabilities (Schilke et al., 2018; Teece, 2007). In the context of DT, we view these calls as an opportunity for IS research to make a contribution to the literature on DC.

The literature on DT highlights changes to an organization's leadership structure as an important enabler of new business models. Specifically, it has been argued that DT calls for organizations to appoint Chief Digital Officers (CDO) to help them undertake their transformation (e.g., Horlacher et al., 2016; Sia et al., 2016; Weill and Woerner, 2018). However, we currently know very little with regards to the actual work CDOs do other than the fact that it is sometimes considered a temporary position (Singh and Hess, 2017:16). One way to understand the implications of this new position would be to study the contributions of different leadership structures (e.g., firms with CEOs, CIOs and CDOs versus firms with CEOs and CIOs only) toward the decisions that enable the building of DC. This might involve for example (1) *sensing* changes in markets by developing an analytics competency; (2) judiciously *seizing* upon these trends by augmenting products with services using mobile applications and social media; and (3) *transforming* the organization to become a platform provider enabling customers to act as complementors of the firm's digital services, thereby further contributing data that can be leveraged for future sensing.

Over the years, the need to build a better understanding of the performance of work underlying the alignment of business and IT strategies has become increasingly relevant. Specifically, it has been argued that a focus on the *practices* that undergird this process can help draw contributions that are closer to the actual work individuals perform and can better explicate the mechanisms that have been overlooked in the variance-based models that have been the hallmark of strategic alignment research since the early 1990s (Karpovsky and Galliers, 2015; Peppard et al., 2014). This position is consistent with DC's account of the work of individuals (Schilke et al., 2018) and we posit that it can also help contribute to literature on DT, e.g., by unearthing those practices that are most effective depending on the "region of complexity" (Tanriverdi and Lim, 2017) where a firm is situated at a given point in time based on the pace of digital innovation in a given competitive landscape.

In recent years, the strategy-as-practice (SaP) literature has applied and extended the contributions of the practice literature in strategy research (Jarzabkowski et al., 2007; Kaplan and Orlikowski, 2013) to focus on IS strategy formulation and performance (Peppard et al., 2014). At a high level, the SaP literature seeks to understand what "managers and other organizational actors *do* in their day-to-day activities to achieve alignment" (Karpovsky and Galliers, 2015:137), thereby switching the focus from the study of alignment to that of *aligning* as a process accounting for "all activities that may contribute to tightening links between IT and business across an organization" (pp. 137–138). In their review of IS strategy articles on the topic, Karpovsky and Galliers (2015) identified 8 core categories of practices pertaining to four overarching metaphors of the aligning process (see Table 11). In the DT literature, there is evidence of the importance of those practices in practitioner outlets (e.g., Sia et al., 2016; Singh and Hess, 2017), but we could only find one research article within our sample that focused on the aligning process itself (Yeow et al., 2017). Gaining a better understanding of those practices and their relevance at different points in times during the digital transformation process would not only inform research, but also practitioners on this topic.

Additionally, it could help us study links between high level DC and the actual practices performed by organizational actors. For instance, it has been argued that research on DC currently has little knowledge on the decision-making processes that actors rely on, including heuristics (Schilke et al., 2018:415). These processes could be mapped onto the *decision-making* aligning activity category unearthed by Karpovsky and Galliers (2015) and applied to the context of DT. Specifically, it has been argued that dynamic problem-

Table 11
Categories of aligning activities.
adapted from Karpovsky and Galliers, 2015:141–142.

Aligning metaphor	Activity categories	Illustrations in the context of DT
Adaptation	Evaluating	Analyzing user-generated and third party data to *sense* shifts in consumer demand, possibly in real-time (Kane, 2016c; Setia et al., 2013; Tiefenbacher and Olbrich, 2016)
Translation	Developing	Writing a mobile application that enables direct business to consumer communication to increase customer proximity (Hansen and Sia, 2015)
	Reconfiguring	Adapting an operational backbone to leverage digital services (Kohli and Johnson, 2011; Sebastian et al., 2017)
Integration	Strengthening	Breaking functional silos to enable close collaboration between business and IT (Dremel et al., 2017; Maedche, 2016)
	Signaling	Hiring a CDO to highlight the importance of a DT initiative in an organization (Horlacher et al., 2016; Singh and Hess, 2017)
Experience	Negotiating	Creating forums to reconcile long-term strategic transformation objectives with short-term operational objectives (Svahn et al., 2017a; Yeow et al., 2017)
	Learning	Enacting a digital transformation strategy to enable knowledge sharing between business and IT units (Leonhardt et al., 2017; Matt et al., 2015)
	Decision-making	Using analytics to alter the decision-making process from one that is based largely on intuition to one that is based on evidence (Newell and Marabelli, 2015; Watson, 2017)

solving and decision-making are paramount for successful digital innovation management (Nambisan et al., 2017). Yet it has been observed that "dynamic capability enables the repeated and reliable performance of an activity directed toward strategic change, as distinct from entirely *ad hoc* problem solving" (Schilke et al., 2018:393). How do organizational actors design such dynamic problem-solving processes— e.g., using digital technologies, including algorithmic decision-making—that are not only effective and efficient, but also repeatable across waves of digital innovation is an important question that remains to be answered.

Avenue 2: The strategic relevance of ethics in digital transformation

The literature on DT focuses primarily on impacts located at the organizational level. Our review also points to a smaller but growing body of literature calling for a more comprehensive—and perhaps nuanced—understanding of the impacts of DT at different levels of analysis, including for individuals (Newell and Marabelli, 2015) and society (Majchrzak et al., 2016). In this research avenue, we build on these calls to offer *ethics*, broadly defined as "abstract and theoretical reflection on moral statements" that "asks for the grounds on which moral statements are made." (Stahl, 2012:641), as a reference discipline to tackle the question of the multifaceted nature of the impacts of DT. Specifically, we argue that theoretical approaches pertaining to ethics offer different vantage points through which we can better understand the long-term and higher level impacts of DT. We do not purport that ethics provide a safeguard *against* DT. Rather, we view ethics as a complementary perspective that can help us peer into aspects of the phenomenon that are currently understudied. Central to those arguments is the notion that a firm must strike a *balance* between elements—an increasing number of which are outside of its locus of control—to ensure that it can generate and sustain performance.

We couch our arguments along three key areas for future research. The first is the role of ethics as a means to account for the multilevel implications of DT. The second is the growing need for firms to balance the tension between organizational performance and ethics. The third is the use of ethics as a means to address the concurrent, and often conflicting needs of value co-creators. Through this research avenue, our ambition is to foster strategic IS research on the role of ethics to study questions that are highly relevant for firms in the context of DT.

Ethics and the multilevel nature of digital transformation

Contrary to traditional views on IT-enabled organizational transformation, the ability for firms to innovate using digital technologies takes place within a context where environmental disruptions originate from the increased use of digital technologies at the industry and society levels. From a multilevel perspective, we can treat a firm's use of digital technologies as an outcome of a lower level process, or as an antecedent of a higher level outcome.

Focusing on the firm's use of digital technologies as the outcome of a lower level process, research on DT can study the alignment—or lack thereof—between decisions related to the firm's business model and the values and principles of their employees in the context of attracting and retaining a digital workforce (Baptista et al., 2017; Colbert et al., 2016). To illustrate the relevance of this question, we refer to the case of Google. As part of its initial public offering in 2004, the company that is at the source of many of the profound changes that continue to redefine the competitive landscape and influence our experiences as individuals stated: "Don't be evil. We believe strongly that in the long term, we will be better served—as shareholders and in all other ways—by a company that does good things for the world even if we forgo some short term gains" (The New York Times, 2004). A somewhat similar consideration remains in the code of conduct of its parent company, Alphabet: "Employees of Alphabet and its subsidiaries and controlled affiliates ("Alphabet") should *do the right thing*" (Alphabet Inc., 2015, emphasis added). In spite of these claims, the company came under scrutiny from its employees and later the U.S. government following news that it was working on the development of a censored version of its search engine for the Chinese market (Google employees against Dragonfly, 2018). Considering the growing

capabilities of digital technologies and the speed at which information spreads across networks, firms must now deal with the strategic imperative of ensuring that their objectives do not run against the moral views of their employees even if it may be counterintuitive from the perspective of financial performance.

Turning toward the impacts of DT at higher levels of analysis, theories of ethics can help us engage with broader objectives of strategic IS research to "stay abreast as well as anticipate the emerging organizational and societal problems around the world" (Galliers et al., 2012:90). Indeed, it has been argued that the ethical implications of DT lie beyond the level of a firm's strategy and can impact society itself (Ganju et al., 2016; Majchrzak et al., 2016). Notwithstanding, research that has engaged with this aspect of DT has thus far remained scarce (e.g., Leonardi et al., 2016) and has focused primarily on DT in emerging environments. From this perspective, future research on DT may benefit from engaging with other streams of literature that focus on the higher level implications of IT, including ICT4D as well as ICT4S. In other, non-emerging contexts, empirical studies on the higher level impacts of DT remain scarce and discussions have primarily focused on issues of digital divide (Yoo et al., 2010a) as well as security and privacy (Newell and Marabelli, 2015). However we still know very little on the role of ethics in digital strategy formulation and execution as a means to ensure that the firm-level positive impacts of DT remain consistent at higher levels.

We argue that normative theories of ethics can help us better understand how the efforts undertaken by firms translate into higher level impacts for industries and society. *Consequentialist* or *teleological* theories (e.g., utilitarianism) focus on evaluating the benefits of the ends that are sought through action. *Deontological* theories (e.g., Kantian ethics) are based on the existence of higher level principles that provide a frame of reference against which actions are evaluated and generally focus on the means that are employed rather than their outcomes. Together these theoretical foundations can help us gain a deeper understanding of the rationale behind firms' strategic decisions and the impacts of those decisions at higher levels of analysis. For example, we may find that some firms operate based on the existence of higher level principles that guide their actions while others take a more consequentialist approach in reaching their objectives without much consideration for the means employed to achieve them (e.g., selling personal data to third parties). It is when these different approaches coexist and collide with one another that higher level impacts may emerge through processes of *emergence* or *composition* (Klein and Kozlowski, 2000) but our knowledge on these important questions that can guide IS and business strategy is limited.

In parallel, ethical theories can help us study the emergence of field-level disruptions. Indeed, in several instances, digital technologies have been under development for a period of time but their disruptive potential is only realized when individuals adopt them. For example, the failed introduction of Google Glass and the ongoing development of this project point to the notion that the timing of the introduction of digital innovations also accounts for the public's willingness to adopt digital technologies, beyond the technical or the financial feasibility of these technologies.

Sustaining organizational performance: the role of ethical performance

Consistent with the majority of strategic IS research, the literature on DT focuses on the ability for a firm to alter its business model and the short to medium term impacts of those changes on organizational performance (Karimi and Walter, 2015; Yeow et al., 2017). Although it may be attributable to the relative nascence of the phenomenon, we also find that the *sustaining* of organizational performance is much less discussed or studied in this body of literature. We argue that this question is highly relevant in the context of strategic research on DT as firms increasingly rely on digital technologies (e.g., mobile applications) used by multiple categories of stakeholders (e.g., individuals, other firms) to achieve their goals. As value networks become more complex (Andal-Ancion et al., 2003; Nehme et al., 2015) and involve more—and different—actors (Gray et al., 2013), exerting total control over a firm's ability to sustain organizational performance over time becomes more challenging. Within this context, we view ethics as particularly relevant because they can contribute to guide the design as well as use of digital technologies to ensure that the achievement of short-term goals does not compromise a firm's ability to sustain their performance over time, as illustrated in Fig. 2.

For example, firms are able to increase customer proximity and tailor service offerings based on latent preferences that seldom need to be made explicit through the analysis of data collected from primary (e.g., social media, hardware) and/or secondary sources (e.g., data brokers). Although such tactics can be beneficial to a firm's performance, recent news has shown that there can be undesirable consequences associated with the very practices that make a firm successful in the first place (Cadwalladr and Graham-Harrison, 2018), as illustrated with the case of Facebook (Neate, 2018). In many instances, the undesirable outcomes of such tactics do not occur because they are illegal. Rather, it is because they are deemed morally reprehensible by some of the stakeholders who are co-creators of value for the firm.

Although ethical considerations have been conceptualized as an important element of a firm's strategy (Carroll, 1999), their

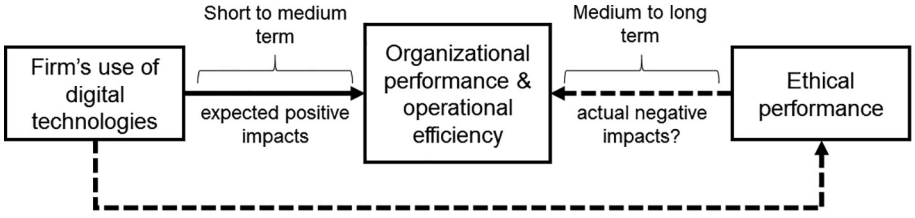

Fig. 2. The contribution of ethics to long term organizational performance.

relationship to IT has thus far been largely ignored by IS research, save for a few notable exceptions (Smith, 2002; Smith and Hasnas, 1999; Stahl, 2012). In a context where digital technologies occupy an increasing portion of the value proposition of firms, traditional constructs that embed ethical considerations (e.g., corporate social responsibility) need to be revisited based on the building blocks of the DT process uncovered during our review. In light of the current manifestations of such considerations in the realm of practice (e.g., http://datafordemocracy.org, https://www.partnershiponai.org/, and more recently, https://www.blog.google/topics/ai/aiprinciples/), we argue that it is time for strategic IS research to (re)engage with these topics by leveraging concepts that impact strategic research in related areas such as ethical performance, information ethics and data governance (Floridi, 2018) which provide part of the scaffolding that can help us study these topics. In doing so, we will gain a more comprehensive, theoretically richer understanding of DT while addressing questions that are highly relevant for practitioners (Newton, 2018; Westerman, 2016).

Using ethics to account for the conflicting demands of value co-creators

Related to the previous argument is the notion that the increased complexity of value networks leads to a situation where firms must tend to the multiple, sometimes conflicting demands of value co-creators. This issue is particularly permeable for multi-sided platforms and digital ecosystems which, by definition, rely on the contributions of multiple parties (Tan et al., 2015a; Wessel et al., 2017). In other instances, the business model of a firm may depend on the collection, the sharing and the selling of data. These data are not a by-product of a firm's operations—as was often the case in the past—but are an integral part of the value proposition of the firm.

Within this context, firms must adequately balance the demands of multiples parties as well as the respective frames of reference that guide their perception of what is considered right and wrong. For a platform owner, the challenge resides in ensuring that tending to one party's needs does not happen at the expense of others'. For example, granting more access to data to one party might be perceived as a breach of security and privacy by another (Newell and Marabelli, 2015). To study this issue, we propose that strategic IS research turn toward normative theories of ethics. Specifically, theories of business ethics, such as stakeholder theory or social contract theory underline the challenges associated with the evaluation of actions and goals in pluralistic business contexts in general and in the context of technology design and use by multiple parties in particular (Smith, 2002; Stahl et al., 2014). In this instance again, regulatory frameworks and institutional pressures may prove insufficient to gain a deep understanding of the challenges firms face in a digital world because they provide a single frame of reference. In contrast, value networks associated with DT translate into contexts where multiple frames of reference exist and firms must devise ways to strike a balance between the needs of multiple parties, without compromising the performance of the firm itself or its ability to sustain competitive advantage. How to study these plural contexts is a complex issue that is currently under-researched or has primarily been studied from the perspective of the economics of digital platforms and ecosystems (Constantinides et al., 2018).

Together, these two research avenues highlight six key areas where research on DT is currently lacking. In our view, they represent exciting opportunities for strategic IS research to engage with topics that are interesting from a research standpoint as well as highly relevant in light of current debates on the phenomenon. Over the years, strategic IS research has established itself as a crucial link bridging the realms of technology and business. These two research avenues contribute to this tradition by calling for a better understanding of the theoretical linkages between the process of DT and its associated outcomes at different levels of analysis as well as over time.

Limitations

Our work has four limitations. Although care was taken to ensure that the review process was performed with rigor and *systematicity* (Rowe, 2014:243), the analysis was performed by a single researcher. To help overcome this limitation, we engaged with professionals and scholars working on DT throughout our analysis to assess the face validity of our findings. Second, our review is restricted to the IS discipline in spite of the relevance of DT in other domains (e.g., Preuveneers et al., 2016). While this limits the generalizability of our findings, we found that the size of IS literature on the topic was sufficient to adopt this focus and future research could use our findings to inform other disciplines where DT is relevant. Third, we acknowledge that DT is a very active topic in IS research, as evidenced by the conference papers in our sample. Although this means that some of the avenues or questions offered in our research agenda may already be under study, we welcome this possibility as a testament to the relevance of DT. Finally, our objective to take stock of current knowledge on DT called for an approach that favored breadth over depth. While this means that the intricacies of the relationships we have studied are not presented in the current paper, we deemed it necessary to provide this overall picture of DT. Future research on the topic may zoom in on specific relationships that have emerged from our analysis.

Conclusion

Our review of IS research on the digital transformation phenomenon highlights a rich body of literature that contributes to our understanding of the benefits as well as the challenges associated with digital transformation at multiple levels. Our findings underline the increasing complexity of the environment within which firms operate. As digital technologies afford more information, computing, communication, and connectivity, they enable new forms of collaboration among distributed networks of diversified actors. In doing so, they also create dependencies among actors whose interests may not fully be aligned. This new reality offers tremendous potential for innovation and performance in organizations, and extends beyond the boundaries of the firm to affect individuals, industries, and society. At the same time, it renders firms' ability to sustain their competitive advantage more fragile than ever as they control fewer elements of their operating environment.

Although they are by no means exhaustive, we believe that the two research avenues that we have proposed can help us better understand the strategic implications of DT and the dynamic interactions that take place between firms and their environment as digital technologies continue to impact these interactions. Beyond these avenues, future research may use our framework as a guide to zoom in and investigate specific relationships of our inductive framework such as to determine under which conditions an organizational design performs better than another (e.g., cross-functional teams versus digital ventures) or explore under-researched relationships (e.g., a potential feedback loop between firms' use of digital technologies and changes in consumer behavior and expectations). Overall, we hope that this review contributes to help future research further explore the nature and the implications of this highly relevant phenomenon for organizations as well as for society.

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Appendices. Supplementary material

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