A survey on incumbent digital transformation: a paradoxical perspective and research agenda

Tiziano Volpentesta and Esli Spahiu
Luiss University, Rome, Italy, and
Pietro De Giovanni
SDA Bocconi School of Management, Milan, Italy

Abstract

Purpose – Digital transformation (DT) is a major challenge for incumbent organisations, as research on this phenomenon has revealed a high failure rate. Given this consideration, this paper reviews the literature on DT in incumbent organisations to identify the main themes and research directions to be undertaken.

Design/methodology/approach – The authors adopt a systematic literature review (SLR) and computational literature review (CLR) employing a machine learning algorithm for topic modelling (LDA) to surface the themes discussed in 103 peer-reviewed studies published between 2010 and 2022 in a multidisciplinary article sample.

Findings – The authors identify and discuss the five main themes emerging from the studies, offering the state-of-the-art of DT in established firms' literature. The authors find that the most discussed topics revolve around the DT of healthcare, the process of renewal and change, the project management, the changes in value performances and capabilities and the consequences on the products of DT. Accordingly, the authors identify the topics overlooked by literature that future studies could tackle, which concern sustainability and contextualisation of the DT phenomenon.

Practical implications – The authors further propose managerial insights which equip managers with a revolutionary mindset that is not constraining but, rather, integration-seeking. DT is not only about technology (Tabrizi B *et al.*, 2019). Successful DT initiatives require managerial capabilities that foster a sustainable departure from the current organising logic (Markus, 2004). This study pinpoints and prioritises the role that paradox-informed thinking can have to sustain an effective digital mindset (Eden *et al.*, 2018) that allows for the building of momentum in DT initiatives and facilitates the renewal process. Indeed, managers lagging behind DT could shift from an "either-or" solutions mindset where one pole is preferred over the other (e.g. digital or physical) to embracing a "both-and-with" thinking balancing between poles (e.g. digital and physical) to successfully fuse the digital and the legacy (Lewis and Smith, 2022b; Smith, Lewis and Edmondson, 2022), enact the renewal, and build and maintain momentum for DTs. The outcomes of adopting a paradox mindset in managerial practice are enabling learning and creativity, fostering flexibility and resilience and, finally, unleashing human potential (Lewis and Smith, 2014).

Social implications – The authors propose insight that will equip managers with a mindset that will allow DT to fail less often than current reported rates, which failure may imply potential organisational collapse, financial bankrupt and social crisis.

Originality/value – The authors offer a multidisciplinary review of the DT complementing existing reviews due to the focus on the organisational context of established organisations. Moreover, the authors advance paradoxical thinking as a novel lens through which to study DT in incumbent organisations by proposing an

array of potential research questions and new avenues for research. Finally, the authors offer insights for managers to help them thrive in DT by adopting a paradoxical mindset.

Keywords Digital transformation, Incumbents, Paradox theory, Systematic literature review, Computational literature review

Paper type Literature review

1. Introduction

Digital transformation (DT) is a complex, interdisciplinary and multifaceted phenomenon involving a profound change imposed on individuals, organisations, ecosystems and whole societies (Appio *et al.*, 2021). DT extends beyond a sole technology upgrade but entails the re-configuration of the deep structures of the organisation, such as changes in strategy, work processes, culture and identity (Vial, 2019). DT is expected to positively impact productivity, create value and enhance social welfare by disrupting current practices (Ebert and Duarte, 2018). DT allows firms to revamp their internal and external strategies to create and retain market value and enjoy numerous business benefits (Westerman and Bonnet, 2015; Reis *et al.*, 2018). Furthermore, DT plays an essential role in modifying competition and entrepreneurial models whilst implying new organisational challenges (Crupi *et al.*, 2022).

Although DTs have been massively initiated, it is challenging to achieve them successfully. In particular, extant research shows that incumbent organisations (i.e. established large-scale players born in a pre-digital age) have failure rates of up to 70% in pursuing DT journeys (Forth *et al.*, 2020; Nadkarni and Prügl, 2020). DT is particularly challenging for incumbents, and their failure implies potential organisational collapse, financially bankrupt and social crisis. The literature investigated DT challenges using case studies, such as the case of General Electric (GE), whose DT led to suboptimal results due to internal silos that hampered the change processes (Lanzolla *et al.*, 2021). Moreover, evidence suggests that the DT of incumbent organisations is imbued with enduring paradoxical tensions, which lead to a challenging transformational journey (Smith, 2021; Dąbrowska *et al.*, 2022). Paradoxes are "contradictory yet interrelated elements that exist simultaneously and persist over time" (Smith and Lewis, 2011, p. 382). The paradox perspective represents a new paradigm in management research which explores the substance and dynamics of contradictory demands on organisations (Lewis and Smith, 2022b). Paradox research informs that contingency thinking is not in vogue today, as organisations must simultaneously attend to multiple requirements and achieve various objectives. Companies must attend to multiple, apparently contradictory and simultaneous demands, such as offering digital and physical products and services, pursuing profit and sustainability, and reaching flexibility and efficiency. During the incumbent's DT, paradoxes arise from disparate sources across organisational levels, with challenging implications on the process of organising. For example, paradoxes arise from the coexistence of apparently contradictory corporate strategies (e.g. digital vs non-digital, top-down vs bottom-up approaches) and structures (e.g. legacy vs digital systems, old vs new work practices, and physical or digital products), which characterise DT as a challenging.

Although the word paradox has been mentioned across DT studies (Drechsler *et al.*, 2020; Wimelius *et al.*, 2021; Danuso *et al.*, 2022), it has primarily been referred to as a label, and not as a rich theoretical repertoire to draw upon (Schad *et al.*, 2016). Indeed, existing studies enhanced the understanding of DT by employing disparate perspectives such as organisational change (Hanelt *et al.*, 2021), institutional change (Hinings *et al.*, 2018) or the identity perspective (Wessel *et al.*, 2021). However, a recent review highlights that the DT debate neglects the paradox lens (Plekhanov *et al.*, 2022) and forgoes systematic literature reading through a paradox perspective (Drechsler *et al.*, 2020). Moreover, according to our literature analysis, existing reviews overlook the role of organisational context. However, the

organisational context shapes different DT pathways (Vial, 2019; Hanelt *et al.*, 2021); for example, the DT of the mining industry would be substantively different from the DT of media (Markus and Rowe, 2021), and hence it is paramount to be context-specific when discussing DT. While the current literature disregards these two ingredients, we consider both and seek to answer two interim questions: *What are the key topics of concern in the digital transformation of incumbents? How can topics be framed via a paradox lens in the study of incumbent digital transformation?*

To address these questions, we adopted a systematic literature review approach (Tranfield *et al.*, 2003). We inspected a multidisciplinary literature sample on incumbent organisations' DT, published in high-quality, peer-reviewed academic journals from 2010 to 2022. We identified 103 documents and employed an advanced computational algorithm for the literature review (Berente *et al.,* 2019). More specifically, we adopted the Latent Dirichlet allocation (LDA). The LDA is a topic modelling algorithm widely employed in social science research to surface hidden topics in a document corpora (Mohr and Bogdanov, 2013; Hannigan *et al.*, 2019). We employed the LDA to content-analyse the research articles (Antons *et al.*, 2020), which led to identifying five main latent themes in the debate over incumbent DTs. We then interpreted these topics considering a theoretical paradox framework to propose research questions and insights geared towards the DT of incumbent organisations.

Our first contribution adds to the DT debate. We complement existing studies by offering a multidisciplinary incumbent-focused review, further identifying what the current debate is neglecting. Second, we propose research questions in line with paradoxical thinking (Lewis and Smith, 2014), which is advanced as a novel and, heretofore, neglected perspective. Third, we propose practical suggestions that will equip managers with a mindset allowing DT to fail less often than current reported rates. Moreover, we demonstrate and guide a novel methodological instantiation of topic modelling for computational-review in innovation management research (Berente *et al.*, 2019; Antons *et al.*, 2020), broadening the application of the "grounded paradigm" (Walsh *et al.*, 2015).

The research is structured as follows. The next section details the related research covering prominent DT studies concerning incumbents and paradoxes in our reference domain. In section 3, we identify the methodology involved in our research. Section 4 summarises the main findings, followed by a discussion of these findings and our investigation's main implications and limitations.

2. Related works

2.1 Digital transformation

Conceptual clarity and differentiation from existing concepts are two core elements of a valid and enduring research program (Berger *et al.*, 1972). Although the academic literature on DT is emerging and fragmented, review articles have recently consolidated the conceptual clarity of the phenomenon (Vial, 2019; Gong and Ribiere, 2021). Consequently, DT has been distinguished from seemingly similar phenomena, such as digitisation and digitalisation (Baskerville *et al.*, 2018; Baiyere *et al.*, 2020). Indeed, digitisation refers to the technical process of "*converting analog signals into a digital form*" (Tilson *et al.*, 2010), while digitalisation is a sociotechnical process that consists of "*the transformation of sociotechnical structures that were previously mediated by non-digital artifacts or relationships into ones that are mediated by digitized artifacts and relationships*" (Yoo *et al.*, 2010, p. 5). Instead, although the DT phenomenon presupposes digitisation and digitalisation coexistence, it is substantively more significant than other digital-led transformations (Vial, 2019). Finally, DT differentiates from IT-enabled organisational change that, as the name suggests, focuses exclusively on the technical aspect of change while neglecting the wider-scale consequences (Wessel *et al.*, 2021). To sum up, DT entails a greater magnitude, scale and depth of the involved change, which

qualitatively modifies the deep structure of the organisation (e.g. routines, beliefs, assumptions, identity) thanks to digital innovations (Baptista *et al.*, 2020). Consequently, DT is not just "old wine in a new bottle" (Lanzolla *et al.*, 2020) but instead requires novel and revisited theories (Markus and Rowe, 2021; Kohtamäki *et al.*, 2022).

DT is at the forefront of organisational agendas across industries and has accelerated due to the COVID-19 pandemic (LaBerge *et al.*, 2020). Additionally, DT has multiple objectives. On the one hand, it searches for strategies to properly transform processes, products and all organisational aspects beyond the technology itself; on the other hand, it seeks to align the new strategies with IT and functional strategies (Matt *et al.*, 2015). Although DT extensively leverages digital innovations (Hinings *et al.*, 2018), the latter is insufficient to finalise a DT, which also requires changes in structures, strategy, culture and work practices (Kane, 2019). Therefore, DT is not about technology alone but requires modifications and adjustments of business strategies, customer experience and mindset (Tabrizi *et al.*, 2019). Furthermore, the most successful DT experiences are linked to products in combination with digital activities and strong leadership (Westerman *et al.*, 2014). Furthermore, researchers have investigated the antecedents of successful DT, finding that a digital orientation, intensity and maturity lead to organisational transformation (Nasiri *et al.*, 2022).

DT should not be considered and managed as a one-shot technical project aimed at enhancing performance through digital technology but as a continuous and emergent change process that profoundly affects the organisation. To do so, novel elements such as digital reality, integrating technology with the business model and sponsors operating under new business strategies should be considered (Reis *et al.*, 2018; De Giovanni, 2021).

2.2 The digital transformation of incumbents
Compared to digital natives, pre-digital, large and old incumbent enterprises should undergo a deep digital transformation by reconfiguring organisational routines, structures and business models. At the same time, incumbents should overcome an organisational dimension imbued with inertia, path dependency, core rigidities and threat-rigidity effects, which threaten incumbent re-organisation during change periods (Lucas and Goh, 2009; Haskamp *et al.*, 2021), making DT "particularly relevant" (Verhoef *et al.*, 2021) for incumbent organisations. Therefore, DT represents a significant threat for incumbent players compared to digitally-born ventures such as Airbnb, Amazon and Netflix, which have proven to be disruptive through their inbuilt digital services and ensuite technologies (Biber *et al.*, 2017; Rosenstand *et al.*, 2018). In several instances, digital-born ventures can grow exponentially in a process of creative destruction that can lead incumbents to struggle in response (Eggers and Francis Park, 2017). Indeed, research reports DT as having a high failure rate, especially in incumbent organisations (Boutetière *et al.*, 2018; Tabrizi *et al.*, 2019), although some successful cases are reported as well (Correani *et al.*, 2020; Narasimhan *et al.*, 2020).

Research investigating topics pertaining to DT and focusing on incumbent organisations has emphasised how they align with DT, their innovation journey, and the tensions, as well as the main strategic responses; all these directions have been researched by drawing from disparate perspectives and analysing the phenomenon from different angles. For example, Oberländer *et al.* (2021) draw from a resource-based view and ambidexterity literature to propose a taxonomy of digital business opportunities of incumbent organisations offered by DT (Oberländer *et al.*, 2021). D'Ippolito *et al.* (2019) instead propose four archetypes of incumbents' responses to digital technologies to show that DT differs depending on the resources (D'Ippolito *et al.*, 2019). Siachou *et al.* (2021) apply the concepts of absorptive capacity and partner interdependency to advance a framework identifying why traditional organisations struggle with DT initiatives (Siachou *et al.*, 2021). Subsequent studies argue that digital transformation is achieved in incumbent organisations through multiple digital

innovation initiatives that diffuse across the organisation (Gregory *et al.*, 2019; Drechsler *et al.*, 2020). For example, Svahn *et al.* (2017) present the journey and associated tensions that emerge while diffusing digital innovations in Volvo, and they also identify competing concerns for the incumbent (Svahn *et al.*, 2017). Conversely, Steiber *et al.* (2020) and Danuso *et al.* (2022) focus on traditional industrial players, identifying the strategies, contributors and hindering factors for General Electric and Siemens when undergoing DT initiatives (Steiber *et al.*, 2020; Danuso *et al.*, 2022). Jöhnk *et al.* (2022) highlight how incumbents are required to manage multiple concurrent initiatives that are a complementary duality rather than a dualism, which means they are not deemed to cannibalise each other but, rather, are two facets of the same coin (Jöhnk *et al.*, 2022). Cozzolino *et al.* (2018) investigated the business model re-configuration of an Italian incumbent media player stemming from DT and related drivers, strategies and disruption processes (Cozzolino *et al.*, 2018).

To summarise, DT is a novel phenomenon which directly impacts established organisations. After all, the word "transformation" implies a pre-existing form to be changed, and in this regard, incumbents are a particularly relevant context to illuminate the phenomenon. Indeed, the extant research vividly and disparately investigated DT in incumbent organisations, highlighting the difficulties and tensions encountered in such an organisational context. However, the current research has focused on single case studies and single organisations and is missing a systematic study focusing on the organisational context, which deeply characterises the DT trajectory. Moreover, a recent review by Plekhanov *et al.* (2022) shows that current research neglects the paradox perspective among all the varied foci of investigation in DT. In order to fill this gap, we systematically retrieve and analyse the debate on the DT of incumbents and further adopt a paradox perspective to enrich the discussion.

3. Methodology

To pursue the objective of this study, we combined a systematic and a computational literature review on the literature discussing the DT of incumbent organisations. We selected peer-reviewed articles published in top journals between 2010 and 2022. Moreover, we opted for a multidisciplinary stance to highlight the peculiarities of the DT phenomenon (Appio *et al.*, 2021). Hence, we searched the Combined Journal Guide of the British Association of Business Schools (ABS) fields of Information Systems (IS), Innovation Management (IM), Operation Management (OM), Strategic Management (SM) and General Management (GM). For the computational literature review (Antons *et al.*, 2021), we adopted the Latent Dirichlet allocation (LDA) algorithm, which has been leveraged in social science (Hannigan *et al.*, 2019) and innovation management research (Antons *et al.*, 2020). Our combined strategy is similar to the approach of Rabetino *et al.* (2021) and allows us to surface concepts inductively from the data (Rabetino *et al.*, 2021) and gain insights to fulfil the purposes of this survey paper.

3.1 Systematic literature review (SLR)

To create a dataset that accomplishes the needs of this study, we followed a systematic literature review procedure (Tranfield *et al.*, 2003). The sampled articles were assembled using a "backward" and "forward" search (Webster and Watson, 2002). The backward search begins from existing reviews to identify articles discussing the DT of incumbents. We expand the corpora through the Scopus search engine database, bounding the search to journals ranked level 3 and above by the ABS ranking and excluding books and conference proceedings; we believe that this ensures that only high-quality scholarship outputs that have undergone rigorous peer reviews are included, consistent with findings demonstrating

the relationship between journal ranking and rigour (Aytug *et al.*, 2012). We adopted search terms that have proven successful for other DT reviews containing keywords for the focal phenomena and their permutations, further capturing the organisational context of incumbent organisations (Vial, 2019; Hanelt *et al.*, 2021; Verhoef *et al.*, 2021). We searched the title, abstract and keywords of articles published from 2010 forward, written in English. We adopted this timeframe as other reviews reported that the DT label started to spread in scholarly investigations in 2010 (e.g. Vial, 2019; Kraus *et al.*, 2021; Plekhanov *et al.*, 2022). The query is reported in Table 1.

The query resulted in 492 items on June 2022 – moreover, the backward search identified six papers starting from existing review articles. Hence, the total number of documents retrieved is 498. Pre-specified inclusion/exclusion criteria guided the document screening process, as shown in Table 2.

A total of 398 article titles and abstracts were screened by three researchers (Hiebl, 2021). The final corpus comprises 103 research articles, the details of which are displayed in Table 3.

3.2 Computational literature review (CLR)

We used a computational literature review (CLR) methodology (Antons *et al.*, 2021) employing the LDA topic modelling algorithm to discover hidden themes present in the corpora (i.e. the dataset consisting of all of the documents) of academic articles. Topic modelling is an increasingly adopted machine learning algorithm in social sciences, which allows for discovering and extracting macro-patterns that are challenging to analyse from a closer perspective (Hannigan *et al.*, 2019). The LDA is a Bayesian-based unsupervised technique for the content analysis of unstructured data to detect patterns by clustering words

Key terms	Term 1	Term 2
	"digital transformation" AND	incumbent* AND
Synonyms	"digital innovation" OR	"large" OR
	"digitalisation" OR	"old" OR
	"digitalise" OR	"big" OR
	"transformation" OR	"established" OR
	"transform" OR	"traditional"
	"technology" OR	Organisation
	"disrupt"	
Rationale	To capture the digital transformation phenomenon	To capture the organisational context of incumbents
Source(s): Authors work		

Table 1.
Research query

No	Exclusion criteria	Inclusion criteria
1	The article does not provide a thoughtful description of the context in which the research was conducted	The article must provide an overview of the empirical study context. Included articles are empirically grounded in incumbent organisations
2	Articles not relevant to digital transformation, such as articles dealing with the use of technology for a specific task (e.g. applying big data for a specific task)	We included articles primarily focusing on the digital transformation or digital-induced transformation of organisations
Source(s): Authors work		

Table 2.
Exclusion and
inclusion criteria

Stage	Database query
Identification	Records identified from
	• Journals IS ($n = 223$)
	• Journals OM ($n = 119$)
	• Journals GM ($n = 80$)
	• Journals IM ($n = 62$)
	• Journals SM ($n = 14$)
Screening	Records screened ($n = 498$)
	Records excluded ($n = 395$)
	Records excluded
	• No context provided/incumbent ($n = 286$)
	• Not configurable as DT ($n = 59$)
	• Other reasons ($n = 56$)
Analysis	Studies included in the review ($n = 103$)

Table 3.
Complete review
process

Source(s): Authors work

according to their co-occurrence (Blei *et al.*, 2003). LDA isolates the hidden topics in the corpora, assuming that multiple topics generate each document and provide the most representative "topic descriptors", which are the most prominent topics associated with a single theme, as well as the relative constellation of words that co-occur most frequently in the topic. Moreover, LDA allows for polysemy, as the same word can belong to multiple topics, although they might have different meanings (Blei *et al.*, 2003). For example, Paul DiMaggio *et al.* (2013) interpreted the word "museum" in different topics, highlighting the nuances across topics (i.e. referencing the tangible spatial environment, the institution and exhibitions) by inspecting the other terms appearing in the topic (DiMaggio *et al.*, 2013). Even if LDA has a different understanding of languages than humans, it can map the statistical structure of written language (Ru, 2022) to produce outputs that match a human understanding of the text (Blei and McAuliffe, 2009).

The unit of analysis in text mining approaches is the document, and within the document, the tokens are the semantic word-level units. Hence, before submitting the corpora to the algorithm, it is paramount to preprocess the document to remove unnecessary words reflexively. In doing so, the analysis becomes more consistent and reaches higher levels of quality and meaningfulness (Hickman *et al.*, 2020). We developed a Python script to massively convert the academic articles from a PDF (i.e. portable document format) to a TXT (i.e. text file) format and employed the open-source software KNIME Analytics to preprocess the corpora systematically. During the preprocessing, it is fundamental to apply procedures based on the specific analysis reflexively. In our particular analysis, it was paramount to remove the bibliography, the names of authors and the journal's name, as they would interfere with the execution of the LDA algorithm. We ran the LDA through the Mallet package and the Gibbs sampling procedure (McCallum, 2002).

Moreover, we performed the following preprocessing steps, consistent with the literature (Antons *et al.*, 2021). We converted cases to lowercase; this is done because the algorithm is case-sensitive and would otherwise mark the word "Car" (uppercase) as different from the word "car" (lowercase). We removed emoticons, asterisks, wingdings, punctuation signs and numbers, as they would interfere and are not meaningful. We removed short words by setting the minimum length to three characters, and we removed ubiquitous and meaningless stop-words such as articles, pronouns and auxiliary verbs. We filtered out mark-up tags to remove links, similar tags and non-ASCII characters. We removed from the corpora names of persons, organisations, dates and times, tables and graphs using the Natural Language Processing NE technique; this step has proven crucial due to the context of our review, which excludes the

bibliography and other items. Debortoli *et al.* (2016) suggested that the search terms should be removed from the corpora. Accordingly, we removed them to avoid repetitions in the composition of a topic (Debortoli *et al.*, 2016). Finally, as words have different forms, we lemmatised the corpora to maintain only the root form of the words and remove inflectional endings and derivations, such as plurals (e.g. "emissions" to "emission") and different verb tenses. Overall, the preprocessing enhances topic interpretability and reduces the computational complexity of the LDA. After preprocessing, we count over one hundred thousand unique words in the corpora. We report the system configurations and the statistics on the computational performances in Table A1.

The LDA is an inductive, unsupervised method, and hence there is no *a priori* assumption inputted from the researcher; however, the number of topics to be surfaced and the model hyperparameters must be selected by the researcher. Topics surfaced by the LDA can differ in their inherent interpretability depending on the concertation of the topic descriptors within the corpora and the reader's familiarity with the topic. Hence, some emerging topics could be less interpretable to the human cognition of inexperienced readers (Sievert and Shirley, 2016). As Mohr and Bogdanov (2013) explain, "With topic models, researchers are responsible for knowing enough about the phenomena under investigation to be able to understand what the discourse field is about" (Mohr and Bogdanov, 2013). We followed established procedures to decide on the optimal number of topics underlying the corpus. Specifically, we approached the task to "identify a number of substantively meaningful and analytically useful topics" (DiMaggio *et al.*, 2013, p. 583) by running multiple instances of the LDA with various configurations. Then, we independently and iteratively interpreted and labelled the extracted topics to finally converge on five topics with 10 words, which provided the most coherent set of interpretable and analytically useful topics (Lafferty and Blei, 2009, p. 12). With the final and most interpretable configuration, we discussed the topic descriptors and reconciled them for a unique topic label description presented in the findings.

4. Findings
We extract the top five key topics most preponderant in the corpora and the related top ten terms, ordered as indicating the preponderance of the term in the topic. As detailed in the methodology section, topic modelling is not a labelling algorithm. Hence, the researchers must inspect the high-probability words to advance a topic label in a way that intuitively and parsimoniously describes each key topic (Huang *et al.*, 2018). In the following paragraphs, we tabulated the five surfaced topic descriptors extracted through the LDA (Table 4) and exemplified the topics which appear to be currently neglected.

4.1 Topic 1: the digital transformation of the healthcare industry
The first and most prominent topic identifies healthcare as an organisational setting that figures into the DT academic discourse. Indeed, the final sample of articles in the review is composed of several papers discussing and reviewing DT in healthcare organisational settings (Agarwal *et al.*, 2010; Kraus *et al.*, 2021). This trend grew exponentially after COVID-19 hit (Tortorella *et al.*, 2022), as the pandemic encouraged a focus on the DT of healthcare organisations (e.g. telemedicine, case predictions, patient monitoring) and across industries (LaBerge *et al.*, 2020). In particular, the topic is consistent with a focus on incumbent organisations. Indeed, the healthcare sector is characterised by established rules and procedures of best practices and regulations that foster the status quo (Temin, 1979; Volpentesta *et al.*, 2021). This topic deals with the adoption and diffusion of digital technology in the daily practices of the healthcare sector, such as introducing AI or surgical robot equipment into professional routines (Sergeeva *et al.*, 2018), towards the advancement of hospitals' digital transformation (Kraus *et al.*, 2021).

Topic keywords	Topic label	Topics for future research
Topic #1: *Hospital, healthcare, patient, health, doctor, care, activity, practice, desk, sale*	DT in healthcare	- The interplay between DT and the sectorial restrictions faced by incumbents - Sustainability opportunities enabled by DT to advance health
Topic #2: *digital, system, practice, renewal, service, process, transformation, change, innovation, platform*	DT's processes of renewal and change	- The role of DT in facing disruptions - The long-term temporal dynamics of DT
Topic #3: *project, system, industry, technology, manufacture, process, management, framework, decision, development*	DT's project management in industrial settings	- The nuanced differences between industrial and service industries DT - Framework to manage DT, tailored to the context
Topic #4: *business, technology, change, firm, value, performance, service, analytic, capability, customer*	DT's impacts on business value, performance, consumers and capabilities	- The DT-enabled monitoring of the performance of processes, people and interactions
Topic #5: *business, innovation, application, unit, strategic, model, system, capability, product, renewal*	DT's strategic consequences on product applications	- How can DT enable sustainability (circular economy, reduction of emissions)

Source(s): Authors work

Table 4.
Topic descriptors, labels and future topics of research

4.2 Topic 2: digital transformation's processes of renewal and change

The second-most prominent topic retrieved by the LDA algorithm emphasises the actual and inherent processes of digital transformation. Renewal and transformative processes and mechanisms deeply characterise DT journeys, especially in established organisations that "have to go" digital by continuously transforming rigid organisational structures and elements (Warner and Wäger, 2019). Focusing on the DT process rather than on DT as the outcome requires investigating the "how to" of digital transformation (Li, 2020). Moreover, the topic represents articles discussing DT's implications that move beyond the single organisation towards digital platforms and ecosystems (Cennamo *et al.*, 2020). Process models of DT in established organisations (Sebastian *et al.*, 2017; Svahn *et al.*, 2017; Chanias *et al.*, 2019) vividly represent this topic. These topics highlight the trend of studying DT from a processual point of view. Hence, rather than focusing on DT implications, these studies propose various ways to achieve DT, unveiling the phenomenon's deep mechanisms and unfolding (Cozzolino *et al.*, 2018; Markus and Rowe, 2021).

4.3 Topic 3: digital transformation's project management in industrial settings

The third most prominent latent topic in the corpora relates to the DT of industrial organisations, with a focus on project management. Words like *development* and *framework* underlie typical project management approaches recently applied to DT (Baiyere *et al.*, 2020). Indeed, DT has been extensively treated from a project management perspective (Chirumalla, 2016). Researchers offered staged models and descriptive accounts of managing DT as projects. At the same time, however, researchers criticised a view of DT as a "project". Scholars prefer to frame the phenomenon as a continuous and emergent process rather than a linear one, not manageable using traditional approaches (Bianchi *et al.*, 2020; Brock *et al.*, 2020; Baiyere *et al.*, 2022). This strand of research also investigated whether project

managers, IT professionals and business managers should lead DT initiatives (Jöhnk *et al.*, 2022). The project management view co-occurs with a focus on companies in the manufacturing industry as a setting for executing DT in a controlled manner. Indeed, studies often investigate DT in established manufacturing systems (Rauch *et al.*, 2020), industrial and pre-digital industries (Björkdahl, 2020; Sjödin *et al.*, 2021; Danuso *et al.*, 2022). This trend highlights how contextual organisational factors deeply substantiate different DT trajectories. Indeed it is crucial to unpack the dynamics and challenges of DT according to the specific industry in which the organisation operates (De Giovanni, 2021).

4.4 Topic 4: DT's effects on value, performances, consumers and capabilities

The fourth topic reveals a set of studies oriented towards an outcome-based view of DT, highlighting investigations focused on the final impact of DT on services, customer expectations and value creation. Studies associated with this topic focus on a consumer-centric (Shi *et al.*, 2022) and value-oriented view of DT (Saldanha *et al.*, 2017). The topic represents investigations of DT's outcome rather than DT's process as the previous topic, discussing the implications that DT brings to products, customer relationships (Vial, 2019) and value creation paths (Smith, 2021). This aligns with previous studies that underline how DT should be expectedly to be associated with a change in customer experience and mindset rather than only focusing on technology (Tabrizi *et al.*, 2019). This view also relates to the end objective in terms of what DT brings to transformed value propositions, capabilities (Warner and Wäger, 2019) and business model changes due to digitalisation and digital transformation (Cozzolino *et al.*, 2018; Caputo *et al.*, 2021), rather than emphasising a processual onto-epistemology. Indeed, a focus on performance was predominant in the initial discussions on DT (Vial, 2019), centring on increased operational performance in organisations, rather than a more recent focus on DT strategic and organisational consequences (Hanelt *et al.*, 2021). Instead, the broader consequences of digital transformation arise from the increasing interconnectivity between firms, leading to digital ecosystems where data is the new exchange token and all of the infrastructure-related changes that have consequences for organising logic (Yoo *et al.*, 2010).

4.5 Topic 5: DT's strategic consequences on product applications

DT tremendously alters products and their applications, leading as a consequence for organisations to execute organisation-wide change impacting strategy, governance and structure (Nadkarni and Prügl, 2020). This is consistent with previous literature, highlighting how DT seeks to transform various organisational aspects within companies (Matt *et al.*, 2015) and requires modifications to organisational structures, strategies and work practices (Reis *et al.*, 2018; Kane, 2019). The fifth top topic gives justice to articles discussing the implications of digital value creation from the dematerialisation of tangible products (Gregory *et al.*, 2021), applications (Wangenheim *et al.*, 2017; Alaimo and Kallinikos, 2021) and whole industries and markets (Kallinikos and Mariátegui, 2011; Diaz-Rainey *et al.*, 2015) that have been digitally transformed within a very short period. These changes require building new and complementary capabilities such as digital ambidexterity (Magnusson *et al.*, 2020), digital competition (Dąbrowska *et al.*, 2022), digital business strategies (Bharadwaj *et al.*, 2013) and changing competition dynamics (Cennamo *et al.*, 2020) to address the blurring industry boundaries and redefined industry logics.

4.6 Topics for future research

Among the themes emerging from the analysis, some themes still require investigation through future research, which could be aggregated into two main patterns:

contextualisation and sustainability. We detail these here and report a series of future research avenues in Table 4.

We suggest future research to study the interplay between the organisational environment and DT: for example, how and why the restriction of an organisational environment influences DT. Indeed, the internal (e.g. size, age) and external (regulations, industry, geographical location) organisational environment can profoundly affect the space of possibility to realise different DT pathways (De Giovanni and Folgiero, 2023). Practically speaking, the DT of a newspaper company radically differs from the DT of a mining or healthcare company due to technical and socio-historical reasons. Therefore, DT investigation should be sensible in delineating the DT phenomenon, as it is relevant to the specific organisational environment. Hence, we call for future DT studies to account for the heterogeneity that inhabits DTs (Hergesell and Kallinikos, 2022) and be sensitive to contextual factors, as this will lead to context-informed, embedded and grounded research contributions towards a more nuanced understanding of DT.

With the advent of the metaverse, a new DT can undoubtedly provide exciting opportunities and innovations. While this technology offers the promise of connecting people across the globe, there is a risk that excessive immersion in virtual worlds may lead to a disconnection from physical reality and face-to-face interactions. In the future, finding ways to ensure that the metaverse enhances social connections rather than replacing them will be crucial to ensure DT's social sustainability (De Giovanni, 2023).

Moreover, the LDA analysis did not find the topic of sustainability as preponderant, which seems to be neglected in the sample of articles. Digital responsibility, sustainability and ethics are all concepts that deserve deeper investigations to understand the wider social consequences that DT entails for people, organisations and societies. Future studies could investigate the space of opportunities that DT can create: for example, to increase the accessibility of services and products in developing countries unleashed using digital technologies or the enabling role that digital technologies have in creating sustainable systems (Cardinali and De Giovanni, 2022). Another topic of research could be the role of DT in facing disruptions. Because today's environments are extremely dynamic, it is necessary to unveil DT's role in facing disruptions (e.g. pandemics, wars, climate change and inequalities). However, DT can entail unintended consequences for individuals, organisations and societies. Hence, uncovering the long-term dynamics of DT is equally important, as the effects and new equilibria brought by DT will be observable only in the long term. For example, increase energy consumption or privacy concern is a societal-wide challenge. Indeed, organisations can now collect and analyse an increasing amount of digital trace data about people, processes and interactions. Big data can have great implications for changing what metrics can be captured and used for evaluation, leading to omnipresent surveillance (Leonardi, 2021). To conclude, both the practice and scholar community need a more nuanced understanding of the double-edged sword and intertwined effect that digital and sustainability have in organisations.

5. Applying a paradox perspective in incumbents' DT
In this section, we propose and decline the paradox theoretical perspective as a novel and heretofore neglected lens (Plekhanov *et al.*, 2022) to enrich the debate on incumbent DT (Lanzolla *et al.*, 2021; Dąbrowska *et al.*, 2022).

The paradox theory is a comprehensive meta-theoretical repertoire which advises that mismanaging paradoxes cause chaos, decline and ambivalence, while effective management generates learning, sustainability, legitimacy and long-term performance (Lewis and Smith, 2014). Smith and Lewis's (2011) seminal review identified four main categories of paradoxes: performing, belonging, organising and learning (Smith and Lewis, 2011).

Performing paradoxes result in competing strategies (e.g. mission and market, ends and means), belonging paradoxes refer to issues of identity (e.g. we and they), organising paradoxes result in competing processes and trajectories to reach a goal (e.g. emergence and planning, control and flexibility), while learning paradoxes result when organisations change and renew (e.g. short term and long term, stability and change), leading to the coexistence of traditional and modern ways of doing.

Nowadays, organisations simultaneously fix multiple, heterogonous, competing targets. For example, organisations increasingly try to meet flexibility and efficiency, profit and sustainability, and global and local demand; meanwhile, they leverage centralised and decentralised infrastructures, physical and digital products, services and processes. The most common paradigm in management research is contingency thinking. Contingency thinking entails "either–or" approaches, implying *de facto* constraints on managers' thinking that must choose one strategic pole over another (i.e. either profits or sustainability, or either digital or physical) and can lead to vicious cycles (Soh *et al.*, 2022). In contrast, a paradoxical approach to decisions emphasises "both and with", "more–than" and "neither–and" responses (Lewis and Smith, 2022a), thanks to which managers in organisations can approach both poles at the same time. Indeed, the paradox theory has been used to understand better grand challenges such as the climate crisis, inequalities and poverty (Lewis and Smith, 2022a). Moreover, paradoxical thinking helps managers achieve long-term sustainability by simultaneously embracing apparently different and opposing logic (Smith and Lewis, 2011).

Competing goals, strategies, learnings, ambiguities and oppositions characterise DT. In incumbent settings, legacy apparatuses (e.g. processes, products, business models, units) representing the "old" organisation and newer digital systems must coexist, making DT particularly challenging. For example, pursuing DT for incumbents entails managing the paradoxes between the traditional resource base that made the organisation successful in the past, but that can act as a "straightjacket" (Teece *et al.*, 1997), and the new digital assets (Gregory *et al.*, 2019; Vial, 2019; Drechsler *et al.*, 2020), leading to both learning and identity paradoxes. Other DT-generated paradoxes for incumbents arise from the strategies of structural separation, which entail the creation of new and separated digital units and functions in charge of the DT. Moreover, Dąbrowska *et al.* (2022) proposed a series of paradoxes in DTs, such as the one "between the organisational intent of engaging in DT (and creating specific structures to support this change) and the inherent transformative properties of digital technologies that transcend existing structures and boundaries" (Dąbrowska *et al.*, 2022). Wimelius *et al.* (2021) prioritised the paradoxical tensions enacted during the incumbents' DT process of renewal emerging from the coexistence of legacy systems and the new digital systems (Wimelius *et al.*, 2021). Svahn *et al.* (2017) highlighted four contradictory tensions in pursuing incumbents' DT: existing vs requisite, product vs process, internal vs external and control vs flexibility (Svahn *et al.*, 2017). Jöhnk *et al.* (2022) identified tensions related to ambidexterity during incumbent DT, highlighting the need to exploit current business while exploring new digital opportunities simultaneously (Jöhnk *et al.*, 2022). While existing research employed the term paradox, tensions and similar labels, paradox theory has not been employed as an entire theoretical perspective (Plekhanov *et al.*, 2022; Soh *et al.*, 2022).

We use the paradox perspective to interpret the topics extracted through the LDA and to propose paradox-informed research questions and avenues, presented in Table 5 and discussed thereafter. First, future studies could investigate the complex journeys that professionals inside healthcare organisations (e.g. established hospitals and clinics, health organisations) face while managing paradoxes generated by the introduction of new technologies. As the healthcare ecosystem has undergone major digital initiatives over the last decade, especially after the COVID-19 pandemic hit (Kraus *et al.*, 2021), research should deeply and longitudinally

Topic	Paradox-informed research questions
Topic 1 Digital transformation in healthcare	- What types of paradoxes do healthcare organisations face during DT? - How do healthcare organisations manage paradoxes in times of DT? - How do healthcare organisations manage the co-existence of digital and traditional logic in delivering services?
Topic 2 Digital transformation's processes of renewal and change	- How does the process of renewal enacted through DT shape paradoxes? - What strategies do incumbent organisations employ to cope with DT-generated paradoxes? - How do paradoxes generate in DT journeys unfold longitudinally over time?
Topic 3 Digital transformation's project management in industrial settings	- How do micro-level (individual, groups) paradoxes enact systemic DT? - How does DT's emergent and generative process coexist with traditional (e.g. deterministic, control-seeking) project management logic? - How can paradoxes among functional managers during DTs be managed?
Topic 4 DT's impacts on business value, performance, consumers, and capabilities	- Do incumbent businesses perceive DT as an opportunity or a threat? How do they manage this paradox? - How do established organisations manage multiple and concurrent digital and non-digital transformation initiatives? - How can established firms manage legacy and digital technologies in their DT?
Topic 5 DT's strategic consequences on product applications	- How can incumbents strategically manage digital and physical hybrid ecosystems? - How can tensions between organisational units (e.g. digital units/traditional units) during DT be managed? - How do traditional change initiatives and DT coexist in incumbents?

Source(s): Authors work

Table 5.
Exemplar research questions for future paradox-informed research

investigate the medium to long-term paradoxes generated by these changes. Second, the renewal and transformational processes inherent to DTs should be studied by adopting longitudinal and processual methodologies (Langley, 1999) to unpack the temporal unfolding of DT paradoxes in the context of established firms, highlighting the dynamics, movements and flows as the core of DT paradoxes over time. The key point of differentiation is to focus on the temporal dynamics and how paradoxes change and become more nuanced over time. Because DT is a lengthy process to be fully observed, it is interesting to stress how paradoxes are born, maintained, modified and solved during DTs, which is largely neglected. For example, how firms manage the established business's cannibalisation processes or how to manage the ongoing renewal of legacy and new technological and business architectures. Third, the research could investigate the paradoxes arising from the coexistence of multiple and interdependent realities and strategies for managing the incumbent's DT metamorphosis. In particular, while DT is considered emerging and inherently dynamic, the most common DT initiatives employ execution approaches based on linear and stage-gated innovation management models (Cooper and Sommer, 2016) that do not fit with digital innovation management (Nambisan et al., 2017; Bianchi et al., 2020) due to their inability to manage paradoxes arising from the fluidity and emergence of the phenomena. In particular,

contradictions arise between the deterministic project management stance and the fluidity and emergent nature of the phenomenon. Indeed, to positively impact DT success, managers should handle different logic during DT change initiatives. Fourth, future studies could investigate the broad class of the "old" vs "new" paradoxes arising during DT initiatives. Research could focus on better understanding how incumbent managers can simultaneously manage multiple and inconsistent structures, competencies, strategies and business logics. For example, how to align and integrate different strategies (e.g. traditional and digital strategies) that can be led bottom-up (driven by business units) and from the top-down (driven by innovation labs and chief roles). Moreover, it is worthwhile to research how incumbents cope with paradoxes arising from adopting structural and spatial separations. Frequently, incumbent companies separate digital ventures and competence centres from traditional business units. Hence, paradoxes arise from the simultaneous management of independent units but interconnected with the mainstream business, especially when dealing with technologies like the metaverse (De Giovanni, 2023). A promising approach might rely on structural integration strategies, which entail creating a hybrid form of organising that diffuses digital competencies inside traditional units (Smith, 2021). Moreover, researchers should unveil how to manage the coexistence of digital and physical products, focusing on the unintended consequences paradoxes play in these efforts. We interpret the "phi-digital" phenomenon as an empirical manifestation directly related to paradoxes in the DT of products. Indeed, the effective ensemble of digital and non-digital resources is a precondition to thriving DT journeys (Lundberg *et al.*, 2020), and phi-digital systems represent a means by which to solve the digital and physical paradox through integration and synthesis, which is in sharp contrast to a contingency-informed approach that would have given preference to one at the expense of the other. Future studies could unpack how the two poles are not distinct but are, rather, dynamically interrelated relative to each other and assume meaning in relation to each other. Moreover, due to the rapidly changing technological environments faced during DT times, established organisations try to keep up by relying on a make-or-buy decision, such as when deciding whether to develop software in-house or relying on contractual outsourcing agreements or pre-packaged software. Each decision comes with benefits and challenges regarding costs, time and quality, and know-how development (Pisano, 1990). However, while traditional contingency thinking considers these decisions as opposing realities, a paradox mindset encourages organisations not to constrain a polarised decision. For example, the open innovation paradigm (Chesbrough, 2012) aligns with a paradox perspective as it allows organisations to "open up" their organisational boundaries, similarly to what an outsourcing contract would do, while allowing the internal exploitation of innovations, as a traditional make in-house decision would entail. Additionally, future studies could integrate the findings outflowing from paradox-informed research into other topics (e.g. profit vs sustainability) and assess the extent to which similar mechanisms of managing paradoxes could be employed during the DT initiatives of incumbents. Future studies on DT should embrace approaches borrowing from the paradox theory and apply them to investigate how to manage or cope with paradoxes in DT initiatives in the organisational context of incumbents.

Within this topic, incumbents should be aware of the new paradoxes emerging through DT and linked to sustainability. For example, the use of blockchain and artificial intelligence in a circular economy allows incumbents to better estimate the feedstock in terms of quality, quantity and time for circularity, enabling optimisation of planning and resources; however, these digital technologies consume high amounts of energy, worsening the environment through high emissions (De Giovanni and Folgiero, 2023). The development of metaverse technology will allow incumbents to shorten the supply chain and remove all unnecessary activities, leading to lower usage of natural resources and carbon-intensive activities, even though the metaverse can also generate negative issues for society due to reduced social relationships and contact with the reality (De Giovanni, 2023). When incumbents invest in smart mobility technologies to increase the

level of service and respect the delivery time, they surely achieve excellent customer satisfaction and ensure perpetual purchasing over time; however, the intelligent system adjusting the speed of smart vehicles can induce higher fuel and energy consumption, leading to higher emissions (Vishkaei and De Giovanni, 2023). Accordingly, incumbents are asked to systematically use paradox theory to analyse all the possible trade-offs emerging from DT and identify the best paths to solve them correctly.

We further propose managerial insights which equip managers with a revolutionary mindset that is not constraining but, rather, integration-seeking. DT is not only about technology (Tabrizi et al., 2019). Successful digital transformation initiatives require managerial capabilities that foster a sustainable departure from the current organising logic (Markus, 2004). Our study pinpoints and prioritises the role that paradox-informed thinking can have in sustaining an effective digital mindset (Eden et al., 2018) that allows for the building of momentum in DT initiatives and facilitates the renewal process. Indeed, managers lagging behind DT could shift from an "either-or" solutions mindset where one pole is preferred over the other (e.g. digital or physical) to embracing a "both-and-with" thinking balancing between poles (e.g. digital and physical) to successfully fuse the digital and the legacy (Lewis and Smith, 2022b; Smith et al., 2022), enact the renewal, and build and maintain momentum for DTs. Adopting a paradoxical mindset in managerial practice enables learning and creativity, fosters flexibility and resilience, and unleashes human potential (Lewis and Smith, 2014).

As we showed, the paradoxical perspective can be a useful managerial paradigm to think about DT-generated challenges in pursuing DT for established organisations, which requires a shift in how managers approach challenges. By unpacking and translating the paradox perspective for incumbent firms, we complement existing research by proposing a managerial mindset for dealing with DT challenges in incumbents.

6. Conclusion and future research

Compared to digital natives, organisations born in the pre-digital era face unique challenges regarding digital transformation. This can lead to digital transformation in such organisations being met with a limited success rate. In this paper, we performed a multidisciplinary, systematic and automated topic modelling content analysis to identify the state-of-the-art and corresponding neglected topics in the literature of incumbent DT.

The findings emerging from the analysis suggested that DT in the healthcare industry remains a domineering topic in the academic discourse, especially after the recent pandemic. In addition, we found evidence of discourses focusing on the transformative processes characterising the DT journey and approaches in terms of project management to DT. Findings also suggest how topics pertaining to the final impact that DT can have externally (to services, customers and value creation) and internally (to strategy and governance) were predominantly covered. Other than developing a multidisciplinary understanding of the state-of-the-art regarding the DT of incumbent firms, we identified a complementary lack of studies concerning two important thematic domains: contextualisation and sustainability. Acknowledging the absence of studies on these themes should drive future studies to investigate further the DT phenomena in light of the organisational environment, digital responsibility, sustainability and ethics.

With this research, we intend to highlight that digital transformation characterises differently according to the nature and complexity of organisations. Incumbent organisations face particular challenges regarding DT and hence deserve detailed and systematic investigations. Moreover, future studies should also consider the industry, as the DT of asset-intensive industries (e.g. pharmaceuticals, mining, oil) radically differentiates from customer-oriented industries (e.g. restaurants, media, banking). Therefore, future

theorising should be closely sensitive and account for delineating the peculiarities of the DT-specific journeys.

Moreover, as DT is not only about technology but requires a shift in mindset and culture (Markus, 2004; Tabrizi *et al.*, 2019), we advance the heretofore neglected (Plekhanov *et al.*, 2022) paradox perspective (Schad *et al.*, 2016) to interpret the emerging topics extracted from the LDA and offer directions for future studies through paradox-informed research questions and thinking. We believe that a paradox perspective could be helpful mindset leaders can embrace when considering DT-related challenges. In this regard, we offer practical managerial insights aimed to stimulate and foster paradoxical thinking for managers who deal with the incumbent's DT, which are practically adaptable in local organisational contexts to build momentum and become DT champions rather than laggards and avoid negative consequences in wider society. We encourage future studies to translate other paradigmatic shifts in management research to offer novel and disparate frameworks that managers in organisations can adopt to think differently about digital challenges.

To conclude, our study is not free of limitations. In this regard, first and foremost, our sample composition is influenced by our decision to select specific and limited disciplinary fields of study. In addition, the specific timeframe and publishing outlets applied to the systematic and computation literature review could have led to studies to have been omitted in the process. Nonetheless, the representativeness of our analysis should be considered within the boundaries of our sampling strategy. Given such limitations, future studies could focus on a more comprehensive array of sources, disciplines and timelines. Moreover, limitations can arise from using an unsupervised computational machine learning methodology involving "interpretive uncertainty" (DiMaggio, 2015) regarding how topics are interpreted.

However, these research methods are increasingly adopted by scientists and offer several benefits to scientific inquiry, hence the corresponding inability to observe all topics. In addition, this paper only adopts one particular framework, namely the paradoxical thinking to study DT in incumbent organisations. Drawing on such limitations, future research efforts should investigate and provide a comparative overview of the main trends in DT in incumbent organisations from alternative analytical approaches and frameworks.

References

Agarwal, R., Gao, G.G., DesRoches, C. and Jha, A.K. (2010), "Research commentary—the digital transformation of healthcare", *Information Systems Research*, Vol. 21 No. 4, pp. 796-809, doi: 10.1287/ISRE.1100.0327.

Antons, D., Grünwald, E., Cichy, P. and Salge, T.O. (2020), "The application of text mining methods in innovation research: current state, evolution patterns, and development priorities", *R and D Management*, Vol. 50 No. 3, pp. 329-351, doi: 10.1111/radm.12408.

Alaimo, C. and Kallinikos, J. (2021), "Managing by data: algorithmic categories and organizing", *Organization Studies*, Vol. 42 No. 9, pp. 1385-1407, available at: https://doi.org/10.1177/0170840620934062

Antons, D., Breidbach, C.F., Joshi, A.M. and Salge, T.O. (2021), "Computational literature reviews: method, algorithms, and roadmap", *Organizational Research Methods*, Vol. 26 No. 1, pp. 107-138, doi: 10.1177/1094428121991230.

Appio, F.P., Frattini, F., Petruzzelli, A.M. and Neirotti, P. (2021), "Digital transformation and innovation management: a synthesis of existing research and an agenda for future studies", *Journal of Product Innovation Management*, Vol. 38 No. 1, pp. 4-20, doi: 10.1111/jpim.12562.

Aytug, Z.G., Rothstein, H.R., Zhou, W. and Kern, M.C. (2012), "Revealed or concealed? Transparency of procedures, decisions, and judgment calls in meta-analyses", *Organizational Research Methods*, Vol. 15 No. 1, pp. 103-133, doi: 10.1177/1094428111403495/ASSET/IMAGES/LARGE/10.1177_1094428111403495-FIG1.JPEG.

Baiyere, A., Salmela, H. and Tapanainen, T. (2020), "Digital transformation and the new logics of business process management", *European Journal of Information Systems*, Vol. 29 No. 3, pp. 238-259, doi: 10.1080/0960085X.2020.1718007.

Baiyere, A., Mosconi, E., Wessel, L. and Indulska, M. (2022), "Special issue: frontiers in digital transformation research", *Information Systems Journal*.

Baptista, J., Stein, M.K., Klein, S., Watson-Manheim, M.B. and Lee, J. (2020), "Digital work and organisational transformation: emergent Digital/Human work configurations in modern organisations", *Journal of Strategic Information Systems*, Vol. 29 No. 2, 101618, doi: 10.1016/j.jsis.2020.101618.

Baskerville, R., Baiyere, A., Gregor, S., Hevner, A. and Rossi, M. (2018), "Design science research contributions: finding a balance between artifact and theory", *Journal of the Association for Information Systems*, Vol. 19 No. 5, pp. 358-376, doi: 10.17705/1jais.00495.

Berente, N., Seidel, S. and Safadi, H. (2019), "Data-driven computationally intensive theory development", *Information Systems Research*, Vol. 30 No. 1, pp. 50-64, doi: 10.1287/isre.2018.0774.

Berger, J., Anderson, B. and Zelditoh, M. (1972), *Sociological Theories in Progress*, Houghton Mifflin, Boston.

Bharadwaj, A., El Sawy, O.A., Pavlou, P.A. and Venkatraman, N. (2013), "Digital business strategy", *MIS Quarterly*, Vol. 37 No. 2, pp. 471-482, doi: 10.25300/MISQ/2013/37:2.3.

Bianchi, M., Marzi, G. and Guerini, M. (2020), "Agile, stage-gate and their combination: exploring how they relate to performance in software development", *Journal of Business Research*, Vol. 110, pp. 538-553, doi: 10.1016/j.jbusres.2018.05.003.

Biber, E., Light, S.E., Ruhl, J.B. and Salzman, J. (2017), "Regulating business innovation as policy disruption: from the model t to airbnb", *Vanderbilt Law Review*, Vol. 70 No. 5, pp. 1561-1626.

Björkdahl, J. (2020), "Strategies for digitalization in manufacturing firms", *California Management Review*, Vol. 62 No. 4, pp. 17-36, doi: 10.1177/0008125620920349.

Blei, D.M. and McAuliffe, J.D. (2009), "Supervised topic models", *Advances in Neural Information Processing Systems 20 - Proceedings of the 2007 Conference*.

Blei, D.M., Ng, A.Y. and Jordan, M.I. (2003), "Latent Dirichlet allocation", *Journal of Machine Learning Research*, Vol. 3 Nos 4-5, pp. 993-1022, doi: 10.1017/9781009218245.012.

Boutetière, H., Montagner, A. and Reich, A. (2018), *The Keys to a Successful Digital Transformation*, McKinsey & Company Survey, New York.

Brock, K., den Ouden, E., Langerak, F. and Podoynitsyna, K. (2020), "Front end transfers of digital innovations in a hybrid agile-stage-gate setting", *Journal of Product Innovation Management*, Vol. 37 No. 6, pp. 506-527, doi: 10.1111/JPIM.12556.

Caputo, A., Pizzi, S., Pellegrini, M.M. and Dabić, M. (2021), "Digitalization and business models: where are we going? A science map of the field", *Journal of Business Research*, Vol. 123, pp. 489-501, doi: 10.1016/J.JBUSRES.2020.09.053.

Cardinali, P.G. and De Giovanni, P. (2022), "Responsible digitalization through digital technologies and green practices", *Corporate Social Responsibility and Environmental Management*, Vol. 29 No. 4, pp. 984-995, doi: 10.1002/CSR.2249.

Cennamo, C., Dagnino, G.B., Di Minin, A. and Lanzolla, G. (2020), "Managing digital transformation: scope of transformation and modalities of value co-generation and delivery", *California Management Review*, Vol. 62 No. 4, pp. 5-16, https://doi.org/10.1177/0008125620942136.

Chanias, S., Myers, M.D. and Hess, T. (2019), "Digital transformation strategy making in pre-digital organizations: the case of a financial services provider", *Journal of Strategic Information Systems*, Vol. 28 No. 1, pp. 17-33, doi: 10.1016/j.jsis.2018.11.003.

Chesbrough, H. (2012), "Open innovation: where we've been and where we're going", *Research Technology Management*, Vol. 55 No. 4, pp. 20-27, doi: 10.5437/08956308X5504085.

Chirumalla, K. (2016), "Organizing lessons learned practice for product–service innovation", *Journal of Business Research*, Vol. 69 No. 11, pp. 4986-4991, doi: 10.1016/J.JBUSRES.2016.04.065.

Cooper, R.G. and Sommer, A.F. (2016), "The agile–stage-gate hybrid model: a promising new approach and a new research opportunity", *Journal of Product Innovation Management*, Vol. 33 No. 5, pp. 513-526, doi: 10.1111/jpim.12314.

Correani, A., De Massis, A., Frattini, F., Petruzzelli, A.M. and Natalicchio, A. (2020), "Implementing a digital strategy: learning from the experience of three digital transformation projects", *California Management Review*, Vol. 62 No. 4, pp. 37-56, doi: 10.1177/0008125620934864.

Cozzolino, A., Verona, G. and Rothaermel, F.T. (2018), "Unpacking the disruption process: new technology, business models, and incumbent adaptation", *Journal of Management Studies*, Vol. 55 No. 7, pp. 1166-1202, doi: 10.1111/JOMS.12352.

Crupi, A., Del Sarto, N., Di Minin, A. and Kenney, M.F. (2022), "Disentangling the importance of digital platforms and absorptive capacity in digital business ecosystems", *Handbook on Digital Business Ecosystems: Strategies, Platforms, Technologies, Governance and Societal Challenges*, pp. 40-49, doi: 10.4337/9781839107191.00009.

Dąbrowska, J., Almpanopoulou, A., Brem, A., Chesbrough, H., Cucino, V., Di Minin, A., Giones, F., Hakala, H., Marullo, C., Mention, A.L., Mortara, L., Nørskov, S., Nylund, P.A., Oddo, C.M., Radziwon, A. and Ritala, P. (2022), "Digital transformation, for better or worse: a critical multi-level research agenda", *R and D Management*, Vol. 52 No. 5, pp. 930-954, doi: 10.1111/radm.12531.

Danuso, A., Giones, F. and Ribeiro da Silva, E. (2022), "The digital transformation of industrial players", *Business Horizons*, Vol. 65 No. 3, pp. 341-349, doi: 10.1016/j.bushor.2021.04.001.

De Giovanni, P. (2021), "Dynamic quality models and games in digital supply chains", *Dynamic Quality Models and Games in Digital Supply Chains*, [Preprint], doi: 10.1007/978-3-030-66537-1.

De Giovanni, P. (2023), "Sustainability of the metaverse: a transition to industry 5.0", *Sustainability (Switzerland)*, Vol. 15 No. 7, p. 6079, doi: 10.3390/su15076079.

De Giovanni, P. and Folgiero, P. (2023), "Strategies for the circular economy: circular districts and networks", *Strategies for the Circular Economy: Circular Districts and Networks*, pp. 1-144, doi: 10.4324/9781003378846.

Debortoli, S., Müller, O., Junglas, I., vom Brocke, J. and Brocke, V. (2016), "Text mining for information systems researchers: an annotated topic modeling tutorial", *Communications of the Association for Information Systems*, Vol. 39 No. 7, pp. 110-135, doi: 10.17705/1CAIS.03907.

Diaz-Rainey, I., Ibikunle, G. and Mention, A.L. (2015), "The technological transformation of capital markets", *Technological Forecasting and Social Change*, Vol. 99, pp. 277-284, doi: 10.1016/J.TECHFORE.2015.08.006.

DiMaggio, P. (2015), "Adapting computational text analysis to social science (and vice versa)", *Big Data and Society*, Vol. 2 No. 2, pp. 1-5, doi: 10.1177/2053951715602908.

DiMaggio, P., Nag, M. and Blei, D. (2013), "Exploiting affinities between topic modeling and the sociological perspective on culture: application to newspaper coverage of U.S. government arts funding", *Poetics*, Vol. 41 No. 6, pp. 570-606, doi: 10.1016/J.POETIC.2013.08.004.

D'Ippolito, B., Messeni Petruzzelli, A. and Panniello, U. (2019), "Archetypes of incumbents' strategic responses to digital innovation", *Journal of Intellectual Capital*, Vol. 20 No. 5, pp. 662-679, doi: 10.1108/JIC-04-2019-0065.

Drechsler, K., Gregory, R.W., Wagner, H. and Tumbas, S. (2020), "At the crossroads between digital innovation and digital transformation", (May), doi: 10.17705/1CAIS.044XX.

Ebert, C. and Duarte, C.H.C. (2018), "Digital transformation", *IEEE Software*, Vol. 35 No. 4, pp. 16-21, doi: 10.1109/MS.2018.2801537.

Eden, R., Jones, A.B., Casey, V. and Draheim, M. (2018), "Digital transformation requires workforce transformation", *MIS Quarterly Executive*, Vol. 18 No. 1, pp. 1-17, doi: 10.17705/2msqe.00005.

Eggers, J.P. and Francis Park, K. (2017), "Incumbent adaptation to technological change: the past, present, and future of research on heterogeneous incumbent response", *Academy of Management Annals*, Vol. 12 No. 1, pp. 257-389, doi: 10.5465/annals.2016.0051.

Forth, P., Reichert, T., de Laubier, R. and Chakraborty, S. (2020), *Flipping the Odds of Digital Transformation Success*, Boston Consulting Group, Boston.

Gong, C. and Ribiere, V. (2021), "Developing a unified definition of digital transformation", *Technovation*, Vol. 102 December, 102217, doi: 10.1016/j.technovation.2020.102217.

Gregory, R.W., Wagner, H.T., Tumbas, S. and Drechsler, K. (2019), "At the crossroads between digital innovation and digital transformation", *40th International Conference on Information Systems, ICIS 2019*, [Preprint], (May), doi: 10.17705/1CAIS.044XX.

Gregory, R.W., Hendfridsoson, O., Kaganer, E. and Kyriakou, H. (2021), "The role of artificial intelligence and data network effects for creating user value", *Academy of Management Review*, Vol. 46 No. 3, pp. 534-551, doi: 10.5465/amr.2019.0178.

Hanelt, A., Bohnsack, R., Marz, D. and Antunes Marante, C. (2021), "A systematic review of the literature on digital transformation: insights and implications for strategy and organizational change", *Journal of Management Studies*, Vol. 58 No. 5, pp. 1159-1197, doi: 10.1111/JOMS.12639.

Hannigan, T.R., Haan, R.F.J., Vakili, K., Tchalian, H., Glaser, V.L., Wang, M.S., Kaplan, S. and Jennings, P.D. (2019), "Topic modeling in management research: rendering new theory from textual data", Academy of Management Annals, Vol. 13 No. 2, pp. 586-632, doi: 10.5465/annals.2017.0099.

Haskamp, T., Dremel, C., Marx, C. and Uebernickel, F. (2021), "Understanding inertia in digital transformation: a literature review and multilevel research framework", *Forty-Second International Conference on Information Systems*, p. 1, available at: https://www.alexandria.unisg.ch/264311/1/ICIS2021_Inertia in Digital Transformation.pdf

Hergesell, S. and Kallinikos, J. (2022), "Digital transformation(s): on the entanglement of long-term processes and digital social change; an introduction", *Historical Social Research*, Vol. 47 No. 3, pp. 7-39, doi: 10.12759/hsr.47.2022.25.

Hickman, L., Thapa, S. and Tay, L. (2020), "Text preprocessing for text mining in organizational research : review and recommendations", pp. 1-33, doi: 10.1177/1094428120971683.

Hiebl, M.R.W. (2021), "Sample selection in systematic literature reviews of management research", *Organizational Research Methods*, Vol. 26 No. 2, pp. 229-261, doi: 10.1177/1094428120986851.

Hinings, B., Gegenhuber, T. and Greenwood, R. (2018), " Digital innovation and transformation: an institutional perspective", *Information and Organization*, Vol. 28 March, pp. 52-61, doi: 10.1016/j.infoandorg.2018.02.004.

Huang, A.H., Lehavy, R., Zang, A.Y. and Zheng, R. (2018), "Analyst information discovery and interpretation roles: a topic modeling approach", *Management Science*, Vol. 64 No. 6, pp. 2833-2855, doi: 10.1287/mnsc.2017.2751.

Jöhnk, J., Ollig, P., Rövekamp, P. and Oesterle, S. (2022), "Managing the complexity of digital transformation—how multiple concurrent initiatives foster hybrid ambidexterity", *Electronic Markets*, Vol. 32 No. 2, pp. 547-569, doi: 10.1007/s12525-021-00510-2.

Kallinikos, J. and Mariátegui, J.C. (2011), "Video as digital object: production and distribution of video content in the internet media ecosystem", *Information Society*, Vol. 27 No. 5, pp. 281-294, doi: 10.1080/01972243.2011.607025.

Kane, G. (2019), "The technology fallacy: people are the real key to digital transformation", *Research-Technology Management*, Vol. 62 No. 6, pp. 44-49, doi: 10.1080/08956308.2019.1661079.

Kohtamäki, M., Rabetino, R., Parida, V. and Ritala, P. (2022), "Special issue call for papers strategy in the digital transformation era", *International Journal of Management Reviews*, [Preprint], doi: 10.1111/(ISSN)14682370/homepage/ForAuthors.html.

Kraus, S., Schiavone, F., Pluznikova, A. and Invernizzi, A.C. (2021), "Digital transformation in healthcare: analyzing the current state-of-research", *Journal of Business Research*, Vol. 123, pp. 557-567, doi: 10.1016/J.JBUSRES.2020.10.030.

LaBerge, L., O'Toole, C., Schneider, J. and Kate, S. (2020), *How COVID-19 Has Pushed Companies over the Technology Tipping Point-And Transformed Business Forever*, McKinsey Global Publishing, New York, pp. 1-9, October.

Lafferty, J. and Blei, D. (2009), "Topic models", pp. 71-93, doi: 10.1201/9781420059458.ch4.

Langley, A. (1999), "Strategies for theorizing from process data", *The Academy of Management Review*, Vol. 24 No. 4, p. 691, doi: 10.2307/259349.

Lanzolla, G., Lorenz, A., Miron-Spektor, E., Schilling, M., Solinas, G. and Tucci, C.L. (2020), "Digital transformation: what is new if anything ? Emerging patterns and management research", *Academy of Management Discoveries*, Vol. 6 No. 3, pp. 341-350, doi: 10.5465/amd.2020.0144.

Lanzolla, G., Pesce, D. and Tucci, C.L. (2021), "The digital transformation of search and recombination in the innovation function: tensions and an integrative framework*", *Journal of Product Innovation Management*, Vol. 38 No. 1, pp. 90-113, doi: 10.1111/jpim.12546.

Leonardi, P.M. (2021), "COVID-19 and the new technologies of organizing: digital exhaust, digital footprints, and artificial intelligence in the wake of remote work", *Journal of Management Studies*, Vol. 58 No. 1, pp. 247-251, doi: 10.1111/joms.12648.

Lewis, M.W. and Smith, W.K. (2014), "Paradox as a metatheoretical perspective: sharpening the focus and widening the scope", *The Journal of Applied Behavioral Science*, Vol. 50 No. 2, pp. 127-149, doi: 10.1177/0021886314522322.

Lewis, M.W. and Smith, W.K. (2022), "Reflections on the 2021 Amr decade award: navigating paradox is paradoxical", *Academy of Management Review*, Vol. 47 No. 4, pp. 528–548, doi: 10.5465/amr.2022.0251.

Lewis, M.W. and Smith, W.K. (2022a), "Reflections on the 2021 AMR decade award: Navigating paradox is paradoxical", *Academy of Management Review*, doi: 10.5465/AMR.2022.0251.

Li, F. (2020), "Leading digital transformation: three emerging approaches for managing the transition", *International Journal of Operations and Production Management*, Vol. 40 No. 6, pp. 809-817, doi: 10.1108/IJOPM-04-2020-0202/FULL/PDF.

Lucas, H.C. and Goh, J.M. (2009), "Disruptive technology: how Kodak missed the digital photography revolution", *Journal of Strategic Information Systems*, Vol. 18 No. 1, pp. 46-55, doi: 10.1016/j.jsis.2009.01.002.

Lundberg, O., Sandberg, J. and Nylén, D. (2020), "Cycles of innovation and alignment in digital transformation: investigating the dynamics of resource recombination in a construction firm", *Proceedings of the Annual Hawaii International Conference on System Sciences, 2020-Janua*, pp. 4346-4355, doi: 10.24251/hicss.2020.531.

Magnusson, J., Koutsikouri, D. and Päivärinta, T. (2020), "Efficiency creep and shadow innovation: enacting ambidextrous IT Governance in the public sector", *European Journal of Information Systems*, Vol. 29 No. 4, pp. 329-349, doi: 10.1080/0960085X.2020.1740617.

Markus, M.L. (2004), "Technochange management: using IT to drive organizational change", *Journal of Information Technology*, Vol. 19 No. 1, pp. 4-20, doi: 10.1057/PALGRAVE.JIT.2000002.

Markus, M.L. and Rowe, F. (2021), "Guest editorial: theories of digital transformation: a progress report", *Journal of the Association for Information Systems*, Vol. 22 No. 2, pp. 273-280, doi: 10.17705/1jais.00661.

Matt, C., Hess, T. and Benlian, A. (2015), "Digital transformation strategies", *Business and Information Systems Engineering*, Vol. 57 No. 5, pp. 339-343, doi: 10.1007/S12599-015-0401-5/FIGURES/2.

McCallum, A.K. (2002), *Mallet: MAchine Learning for LanguagE Toolkit*, Mallet, Massachusetts, available at: http://mallet.cs.umass.edu

Mohr, J.W. and Bogdanov, P. (2013), "Introduction-Topic models: what they are and why they matter", *Poetics*, Vol. 41 No. 6, pp. 545-569, doi: 10.1016/j.poetic.2013.10.001.

Nadkarni, S. and Prügl, R. (2020), *Digital Transformation: A Review, Synthesis and Opportunities for Future Research, Management Review Quarterly*, Springer International Publishing, doi: 10.1007/s11301-020-00185-7.

Nambisan, S., Lyytinen, K., Majchrzak, A. and Song, M. (2017), "Digital innovation management: reinventing innovation management research in a digital world", *MIS Quarterly: Management Information Systems*, Vol. 41 No. 1, pp. 223–238, doi: 10.25300/MISQ/2017/41:1.03.

Narasimhan, A., Hautekerke, C.Van, Sti, P. and Liao, L. (2020), "Digital transformation at Merck", *Harvard Business School Case Study*, https://www.imd.org/research-knowledge/strategy/case-studies/digital-transformation-at-merck/.

Nasiri, M., Saunila, M. and Ukko, J. (2022), "Digital orientation, digital maturity, and digital intensity: determinants of financial success in digital transformation settings", *International Journal of Operations and Production Management*, Vol. 42 No. 13, pp. 274-298, doi: 10.1108/IJOPM-09-2021-0616/FULL/PDF.

Oberländer, A.M., Röglinger, M. and Rosemann, M. (2021), "Digital opportunities for incumbents – a resource-centric perspective", *The Journal of Strategic Information Systems*, Vol. 30 No. 3, 101670, doi: 10.1016/J.JSIS.2021.101670.

Pisano, G.P. (1990), "The R&D boundaries of the firm: an empirical analysis", *Administrative Science Quarterly*, Vol. 35 No. 1, p. 153, doi: 10.2307/2393554.

Plekhanov, D., Franke, H. and Netland, T.H. (2022), "Digital transformation: A review and research agenda", *European Management Journal*, doi: 10.1016/j.emj.2022.09.007.

Rabetino, R., Kohtamäki, M., Brax, S.A. and Sihvonen, J. (2021), "The tribes in the field of servitization: discovering latent streams across 30 years of research", *Industrial Marketing Management*, Vol. 95, pp. 70-84, doi: 10.1016/j.indmarman.2021.04.005.

Rauch, E., Linder, C. and Dallasega, P. (2020), "Anthropocentric perspective of production before and within Industry 4.0", *Computers & Industrial Engineering*, Vol. 139, 105644, doi: 10.1016/J.CIE.2019.01.018.

Reis, J., Amorim, M., Melão, N. and Matos, P. (2018), "Digital transformation: a literature review and guidelines for future research", *Advances in Intelligent Systems and Computing*, Vol. 745, pp. 411-421, doi: 10.1007/978-3-319-77703-0_41.

Rosenstand, C., Gertsen, F. and Vesti, H. (2018), "A definition and a conceptual framework of digital disruption A definition and a conceptual framework of digital disruption", *The ISPIM Innovation Conference – Innovation, The Name of The Game*, Stockholm, Sweden, [Preprint].

Ru, M. (2022), "Topic modeling revisited : new evidence on algorithm performance and quality metrics", pp. 1-25, doi: 10.1371/journal.pone.0266325.

Saldanha, T.J.V., Mithas, S. and Krishnan, M.S. (2017), "Leveraging customer involvement for fueling innovation: the role of relational and analytical information processing capabilities", *MIS Quarterly: Management Information Systems*, Vol. 41 No. 1, pp. 267-286, doi: 10.25300/MISQ/2017/41.1.14.

Schad, J., Lewis, M.W., Raisch, S. and Smith, W.K. (2016), "Paradox research in management science: looking back to move forward", *Academy of Management Annals*, Vol. 10 No. 1, pp. 5-64, doi: 10.1080/19416520.2016.1162422.

Sebastian, I.M., Moloney, K.G., Ross, J.W., Fonstad, N.O., Beath, C. and Mocker, M. (2017), "How big old companies navigate digital transformation", *MIS Quarterly Executive*, Vol. 16 No. 3, pp. 197-213, doi: 10.4324/9780429286797-6.

Sergeeva, A., Huysman, M. and Faraj, S. (2018), "Losing touch: how robots transform the practice of surgery", *78th Annual Meeting of the Academy of Management, AOM 2018*, [Preprint], (March 2020), doi: 10.5465/AMBPP.2018.215.

Shi, Y., Cui, T. and Liu, F. (2022), "Disciplined autonomy: how business analytics complements customer involvement for digital innovation", *The Journal of Strategic Information Systems*, Vol. 31 No. 1, 101706, doi: 10.1016/J.JSIS.2022.101706.

Siachou, E., Vrontis, D. and Trichina, E. (2021), "Can traditional organizations be digitally transformed by themselves? The moderating role of absorptive capacity and strategic interdependence", *Journal of Business Research*, Vol. 124, pp. 408-421, doi: 10.1016/J.JBUSRES.2020.11.011.

Sievert, C. and Shirley, K. (2016), "LDAvis: interactive visualization of topic models", *CRAN*, available at: https://cran.r-roject.org/web/packages/LDAvis/LDAvis.pdf

Sjödin, D., Kamalaldin, A., Parida, V. and Islam, N. (2021), "Procurement 4.0: how industrial customers transform procurement processes to capitalize on digital servitization", *IEEE Transactions on Engineering Management*, doi: 10.1109/TEM.2021.3110424.

Smith, P. (2021), "The Gordian knot of practicing digital transformation: coping with emergent paradoxes in ambidextrous organizing structures", *Journal of Product Innovation Management*, Vol. , Vol. 38 No. 1,, pp. 166-191, doi: 10.1111/jpim.12548.

Smith, W.K. and Lewis, M.W. (2011), "Toward a theory of paradox: a dynamic equilibrium model of organizing", *Academy of Management Review*, Vol. 36 No. 2, pp. 381-403, doi: 10.5465/amr.2011. 59330958.

Smith, W.K., Lewis, M.W. and Edmondson, A.C. (2022), *Both/and Thinking : Embracing Creative Tensions to Solve Your Toughest Problems*, Harvard Business Review Press, p. 310.

Soh, C., Yeow, A., Wei Goh, Q. and Wei, Q. (2022 Submitted for publication), "Shaping digital transformation pathways: dynamics of paradoxical tensions and responses", *JAIS Preprints (Forthcoming)*, Vol. 21 No. 1, doi: 10.17705/1jais.00790.

Steiber, A., Alänge, S., Ghosh, S. and Goncalves, D. (2020), "Digital transformation of industrial firms: an innovation diffusion perspective", *European Journal of Innovation Management*, Vol. 24 No. 3, pp. 799-819, doi: 10.1108/EJIM-01-2020-0018/FULL/PDF.

Svahn, F., Mathiassen, L. and Lindgren, R. (2017), "Embracing digital innovation in incumbent firms: how Volvo Cars managed competing concerns", *MIS Quarterly: Management Information Systems*, Vol. 41 No. 1, pp. 239-253, doi: 10.25300/MISQ/2017/41.1.12.

Tabrizi, B., Lam, E., Girard, K. and Irvin, V. (2019), "Digital transformation is not about technology", *Harvard Business Review*, pp. 1-6.

Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533, doi: 10.1002/(SICI)1097-0266(199708) 18:73.0.CO;2-Z.

Temin, P. (1979), "Technology, regulation, and market structure in the modern pharmaceutical industry", *The Bell Journal of Economics*, Vol. 10 No. 2, p. 429, doi: 10.2307/3003345.

Tilson, D., Lyytinen, K. and Sørensen, C. (2010), "Digital infrastructures: the missing IS research agenda", *Information Systems Research*, Vol. 21 No. 4, pp. 748-759, doi: 10.1287/isre.1100.0318.

Tortorella, G.L., Fogliatto, F.S., Saurin, T.A., Tonetto, L.M. and McFarlane, D. (2022), "Contributions of Healthcare 4.0 digital applications to the resilience of healthcare organizations during the COVID-19 outbreak", *Technovation*, Vol. 111, 102379, doi: 10.1016/J.TECHNOVATION.2021. 102379.

Tranfield, D., Denyer, D. and Smart, P. (2003), "Towards a methodology for developing evidence-informed management knowledge by means of systematic review", *British Journal of Management*, Vol. 14 No. 3, pp. 207-222, doi: 10.1111/1467-8551.00375.

Verhoef, P.C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Qi Dong, J., Fabian, N. and Haenlein, M. (2021), "Digital transformation: a multidisciplinary reflection and research agenda", *Journal of Business Research*, Vol. 122 July 2018, pp. 889-901, doi: 10.1016/j.jbusres.2019.09.022.

Vial, G. (2019), "Understanding digital transformation: a review and a research agenda", *Journal of Strategic Information Systems*, Vol. 28 No. 2, pp. 118-144, doi: 10.1016/j.jsis.2019.01.003.

Vishkaei, B.M. and De Giovanni, P. (2023), "Rescheduling multiproduct delivery planning with digital technologies for smart mobility and sustainability goals", *IEEE Transactions on Engineering Management [Preprint]*, doi: 10.1109/TEM.2023.3247565.

Volpentesta, T., Miozza, M. and Satwekar, A. (2021), "Blockchain in the biopharmaceutical industry", in *Blockchain Technology Applications in Businesses and Organizations*, IGI Global, pp. 119-140, doi: 10.4018/978-1-7998-8014-1.ch006.

Walsh, I., Holton, J.A., Bailyn, L., Fernandez, W., Levina, N. and Glaser, B. (2015), "What grounded theory is…A critically reflective conversation among scholars", *Organizational Research Methods*, Vol. 18 No. 4, pp. 581-599, doi: 10.1177/1094428114565028.

Wangenheim, F., Wünderlich, N.V. and Schumann, J.H. (2017), "Renew or cancel? Drivers of customer renewal decisions for IT-based service contracts", *Journal of Business Research*, Vol. 79, pp. 181-188, doi: 10.1016/J.JBUSRES.2017.06.008.

Warner, K.S.R. and Wäger, M. (2019), "Building dynamic capabilities for digital transformation: an ongoing process of strategic renewal", *Long Range Planning*, Vol. 52 No. 3, pp. 326-349, doi: 10.1016/j.lrp.2018.12.001.

Webster, J. and Watson, R.T. (2002), "Analyzing the past to prepare for the future: writing a literature review", *MIS Quarterly*, Vol. 26 No. 2, pp. xiii-xxiii, doi: 10.1.1.104.6570.

Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J. and Jensen, T.B. (2021), "Unpacking the difference between digital transformation and IT-enabled organizational transformation", *Journal of the Association for Information Systems*, Vol. 22 No. 1, p. 6, doi: 10.17705/1jais.00655.

Westerman, G. and Bonnet, D. (2015), "Revamping your business through digital transformation", *MIT Sloan Management Review*, avaiable at: https://sloanreview.mit.edu/article/revamping-your-business-through-digital-transformation/.

Westerman, G., Bonnet, D. and McAfee, A. (2014), "The nine elements of digital transformation", *MIT Sloan Management Review*, https://sloanreview.mit.edu/article/the-nine-elements-of-digital-transformation/.

Wimelius, H., Mathiassen, L., Holmström, J. and Keil, M. (2021), "A paradoxical perspective on technology renewal in digital transformation", *Information Systems Journal*, Vol. 31 No. 1, pp. 198-225, doi: 10.1111/isj.12307.

Yoo, Y., Henfridsson, O. and Lyytinen, K. (2010), "The new organizing logic of digital innovation: an agenda for information systems research", *Information Systems Research*, Vol. 21 No. 4, pp. 724-735, doi: 10.1287/isre.1100.0322.

Appendix

Machine requirements	
Operative System	Windows 11 Home (64bit)
Hardware	Intel i5 8 GB RAM
Software Versioning	
KNIME	• KNIME v4.6.4
	• Text Processing Plug-in v4.6.2
Python	• Python 3.9.7
	• Jupiter IDE IPython 7.29.0
Computation Time Statistics	
Execution Time for full-text analysis	• Aggregated Execution 1680000 ms
	• Parallel LDA 360000 ms
Execution Time for abstract-based analysis	• Aggregated Execution 540000 ms
	• Parallel LDA 147000 ms
Source(s): Authors work	

Table A1.
System, software and computation details

About the authors

Tiziano Volpentesta is a PhD Candidate and Teaching Assistant in Management at Luiss Guido Carli in Rome. His research examines the digital transformation of organisations at the intersection between digital innovations and organisational routines. Moreover, Tiziano conducts qualitative and engaged research to develop new understandings of how digital technologies are tethered into and change professionals' daily practices. His research typically investigates these questions in knowledge-intensive settings such as healthcare. Tiziano holds a master's degree in Management from the University of Calabria (Cosenza, Italy) and has been a visiting researcher at York University (Toronto, Canada) and visits the DCU Business School (Dublin, Ireland) as PhD Candidate. Before joining Luiss, Tiziano worked as a data scientist at Ernst and Young (Milan, Italy) and other organisations. He has published in international outlets such as the IEEE Transactions on Engineering Management. Tiziano Volpentesta is the corresponding author and can be contacted at: tvolpentesta@luiss.it

Esli Spahiu is a PhD Candidate in Management at LUISS Guido Carli in Rome, Italy. Her doctoral research concerns the application and adoption of blockchain as an alternative to current practices and its effects on the governance and architecture of platforms and infrastructures. Since joining the PhD program, she has also served as a research assistant for CLIO–Center for Leadership, Innovation and Organisations at LUISS and as a teacher assistant in various courses in the same University. Prior to starting her PhD she received her MSc. Degree in Strategic Marketing from Imperial College London.

Pietro De Giovanni is a Professor of Practice in Operations and Supply Chain Management at SDA Bocconi School of Management. Prior to his appointment at SDA Bocconi, he held academic positions at Luiss University (Rome, Italy), ESSEC Business School (Paris–Singapore), Vrije Universiteit (VU) Amsterdam (Amsterdam, the Netherlands), and NOVA School of Business and Economics (Lisbon, Portugal), where he was a Professor of Circular Economy, Sustainable Strategies, Operations, and Supply Chain Management. Pietro has published in several academic journals, among which: *Journal of Operations Management, Research Policy, European Journal of Operations and Production Management, and International Journal of Operations and Production Management*. Currently, he serves as an Associate Editor of the following academic journals: *International Transactions of Operations Research, 4OR Springer and Annals of Operations Research*.