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ORIGINAL ARTICLE

What is digital transformation? A survey on the perceptions of decision-makers in business

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Abstract

In the past years we have observed enormous adoption and use of digital technologies in almost all domains of human life. In this context, researchers and practitioners have been using the term "digital transformation" (DT) to characterize phenomena related to the changes caused by increased use of digital technologies. The progression and contributions of corresponding discussions significantly depend on a common understanding and conceptualization of DT. Accordingly, the information systems research community has started working toward conceptual clarity. Importantly, the current debate focuses on theoretical contributions by academic researchers. Hence, data on the practitioners' perspective on DT is missing. Against this background, we investigated general understandings of DT in practice. Our analysis comprises data of N = 529 business decision-makers in the UK. Our results show a significant discrepancy between science (i.e., conceptualizations and definitions of DT in the academic literature) and practice (i.e., business decision-makers' perceptions and corresponding survey responses). Specifically, for a large proportion of the respondents their decision to classify concrete digitalization examples from the literature as DT or no DT was largely independent of the degree of organizational change caused by the use of digital technologies. This is a surprising result, as high-caliber academic literature proposes this degree to be a critical factor to characterize DT. Another key finding is that a remarkable number of practitioners consider a digitalization initiative as DT based on the mere occurrence of specific buzzwords related to digital technologies in the corresponding descriptions. In particular, the buzzword "digital technology" led the survey participants to classify a definition as instance for DT. We discuss implications of our results and limitations.

Keywords Digitalization · Digital transformation · Buzzword · Definition · Semantic primitive · Survey study

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1 Introduction

Increased adoption and use of digital technologies in individual, organizational, and societal contexts have dramatically changed human life. Change and adoption of digital technologies fuel this phenomenon of digital transformation (DT) (Drechsler et al. 2020), and reactions to it by organizations, government bodies, business networks, industries, media, and scientific communities have become omnipresent topics of discussion (Gong and Ribiere 2021). Recent research has focused on distinguishing the concept of DT from previous concepts, such as information technology (IT)-enabled organizational transformation (Wessel et al. 2021), as well as more general concepts, such as different waves of technology use within organizations (Teubner and Stockhinger 2020). Tumbas et al. (2018) investigated the differences between the terms "digital" and "IT" on the basis of the associated management functions of a Chief Digital Officer (CDO) and a Chief Information Officer (CIO), pointing out that the responsibilities of a CIO are more on an operational level, whereat those of the CDO are of strategic importance. Importantly, the progression and contributions of these discussions significantly depend on a common understanding and conceptualization of DT. Accordingly, the information systems (IS) research community has recently started working toward conceptual clarity, which has led to an improved understanding of the DT phenomenon in academia (Soluk and Kammerlander 2021; Vial 2019; Wessel et al. 2021), although "the IS field still lacks the conceptual and empirical clarity needed to benefit from theoretical diversity about digital transformation" (Markus and Rowe 2023, p. 1). The wide variety of what the umbrella term DT has been used for in the literature so far „risks obscuring the value of diverse theoretical formulations" (Markus and Rowe 2023, p. 1).

Accordingly, it is hardly surprising that recently Wessel et al. (2021) argued that practitioners still "struggle to grasp what digital transformation really is" (p. 102). In essence, the problem to which Wessel et al. (2021) and other researchers point is that the scientific discourse on the DT phenomenon is largely unaffected by practitioners' perceptions and opinions. In one of the few studies to address this issue, Mergel et al. (2019) examined the understanding of DT in public administration based on expert interviews. They point out that the specific characteristics of public administration organizations (e.g., the focus is not on business model development, but on service delivery based on legal mandate) lead to a differentiated, specific conceptual understanding of DT in this sector (Mergel et al. 2019) that is not representative of all sectors. Thus, the current scientific literature lacks data on practitioners' general understandings of DT. In essence, today it is unclear how decision-makers in business characterize DT.

Regardless of the actual alignment of practical and academic understanding of DT, the lack of data on this relationship poses a significant threat to both communities. On the one hand, a potential mismatch can distort empirical research results especially when a mutual understanding of the term is assumed by researchers. On the other hand, it limits the ability of both fields to accept and overcome the paradoxes of academic-practitioner relationships (Bartunek

and Rynes 2014), especially when considering that a major purpose of scientific research—specifically in the context of DT—is to give advice to managers (Markus and Rowe 2021). Against this background, in the current paper we address the following research question: *Is the understanding of DT as elaborated in the academic literature reflected in the understanding of business decision-makers, and if not, what discrepancies exist?*

What follows is that the research we present in this paper investigated general understandings of DT in practice, with a focus on maintaining congruence with established definitions and possible instantiations which we identified in the scientific literature. Because IS research is strongly related to practice, our quantitative analyses of business decision-makers' survey responses on DT are a valuable complement to more theoretical perspectives in the scientific literature, in which the development of conceptualizations and definitions is the focus (e.g., Gong and Ribiere 2021; Hanelt, 2021; Legner et al. 2017; Nadkarni et al., 2021; Verhoef et al. 2021; Vial 2019; Wessel et al. 2021). Moreover, our research can improve the relevance and implementation of future academic contributions by examining—and potentially reducing—a gap in understanding and communication (Kauffman and Weber 2018; Majchrzak et al. 2016; Markus and Rowe 2020).

The remainder of this article is structured as follows. In Sect. 2, we discuss related work on the concept of DT. In Sect. 3, we present our empirical research approach, outlining our survey and analysis methods. In Sect. 4, we present the survey results, a discussion of which follows in Sect. 5. Finally, in Sect. 6, we provide concluding comments.

2 Related work

2.1 Research on digital transformation

The availability and increasing use of digital technologies have led to various and sometimes disruptive changes in organizations and their environments (Gurbaxani and Dunkle 2019; Robey et al. 2013; Yayla and Lei 2020). In this context, the term "digital transformation" first emerged in academic research in the early 2000s, gained relevance in the early 2010s, and has continued to increase in significance in the 2020s (Hanelt et al. 2021). The current state of DT research can best be described as fragmented, spanning different disciplines and including different views and research approaches. This is illustrated by the numerous reviews published in leading journals, which have viewed DT research from procedural (Vial 2019), organizational change (Hanelt et al. 2021), innovation and entrepreneurship (Nadkarni and Prügl 2021), and multidisciplinary (Verhoef et al. 2021), perspectives. Table 1 summarizes these major reviews and specifies their conceptual contributions to the DT literature.

Table 1 Summary of major reviews on digital transformation from different perspectives

Reference	Title	Conceptual contribution to DT literature
Vial (2019)	Understanding digital transformation: A review and a research agenda	A DT framework consisting of eight building blocks is presented based on an analysis of the literature: (1) use of digital technologies, (2) disruptions, (3) strategic responses, (4) changes in value creation paths, (5) structural changes, (6) organizational barriers, (7) negative impacts, and (8) positive impacts
Hanelt et al. (2021)	A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change	A multidimensional framework of DT is presented, differentiating between (1) contextual conditions triggering and shaping DT, (2) mechanisms linking contextual conditions with outcomes, and (3) outcomes referring to the consequences of DT at the organizational, economic, and spillover levels
Nadkarni and Prügl (2021)	Digital transformation: A review, synthesis and opportunities for future research	A thematic map is presented based on an analysis of the literature. The map distinguishes two dimensions: technology and actor. The technology dimension comprises the following themes: (1) pace of change and time to market, (2) technology capability and integration, (3) consumer and other stakeholder interfaces, (4) distributed value creation and capture, and (5) market environment and rules of competition. The actor dimension comprises the following themes: (1) transformative leadership, (2) managerial and organizational capabilities, (3) company culture, and (4) work environment
Verhoef et al. (2021)	Digital transformation: A multidisciplinary reflection and research agenda	Based on an analysis of the literature, the paper identifies three stages for DT: digitization, digitalization, and digital transformation. Each stage entails specific demands on firms' digital resources, organizational structure, growth strategies, and metrics

Based on the insights presented in Table 1, we drew two major conclusions regarding DT, which then informed the design of our research approach and data analysis.

First, the increasing diffusion and use of digital technologies is the central factor motivating the need for DT.[1] The increasing ubiquity and deployment of digital technologies has led to the changes in market environments, customer expectations, global value networks, and rules of competition that define our current environment (Hanelt et al. 2021; Nadkarni and Prügl 2021; Verhoef et al. 2021; Vial 2019).

Second, DT refers to changes in value creation at various levels of analysis (i.e., individual, organizational, societal), but the organizational level is dominant.[2] The papers summarized in Table 1 provide insights into the aspects of value creation influenced and altered through organizational DT. As an example, Verhoef et al. (2021) understand a change in an organization's business model as *the* distinguishing aspect of DT compared to the related concepts digitization and digitalization. This view, however, contrasts with other perspectives, which also include further alterations affecting organizational value creation as DT, such as changes in organizational capabilities, structures, and processes (Nadkarni and Prügl 2021), general organizational change (Hanelt et al. 2021), and other significant changes to organizational properties (Vial 2019).

In contrast to the reviews presented in Table 1, some authors even challenge the assumption that DT should be considered a distinguishable and novel concept; for example, Chen and King (2022) write that "DT might be the latest in a succession of names, tied to the context of their time, signifying the increasing importance of information technology" (p. 403). This radical view is related to the challenge to strike a balance between avoiding the reinvention of the wheel and capitalizing on opportunities (e.g., those related to research funding) when dealing with new phenomena—or, at least, developments that appear new at first glance. Numerous scientific findings (e.g., Chen and King 2022; Mertens and Wiener 2018, Steininger et al. 2009) indicate that the IS field has a tendency to deal with fad-like topics that resist sustainable nomenclatures and conceptualizations of the discipline's phenomena. Considering this fact, it is even more important to deal with the nature of DT and how it is different from related phenomena.[3]

[1] See, for example, "use of digital technologies" in Vial (2019) and the "technology dimension" in Nadkarni and Prügl (2021).

[2] Hanelt et al. (2021) refers to "consequences of DT at the organizational, economic, and spillover levels", thereby going beyond the organizational level. However, Vial (2019), Nadkarni and Prügl (2021), and Verhoef et al. (2021) directly focus on the organizational level.

[3] Riedl et al. (2017) argue that educational guidelines, public funding schemes, and scientific journals' recent calls for papers have adopted terms such as DT or digitalization, perhaps in attempts to attract research attention through using trending terminology. As outlined in this paper, some researchers argue that such behavior is eventually legitimate if one scientific discipline (e.g., IS) is in competition with another one (e.g., management, computer science) for students, research funding, and scientific impact.

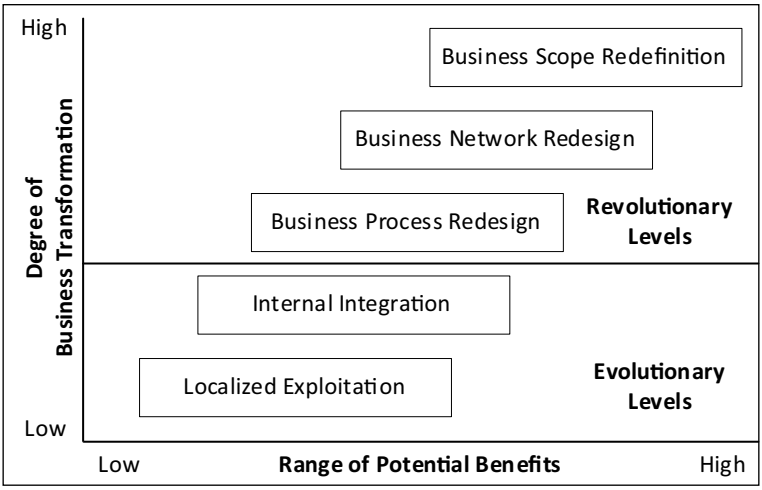


Fig. 1 Five levels of IT-enabled business transformation (based on Venkatraman 1994)

2.2 Research on IT-enabled business transformation

The concepts of organizational transformation and IT-enabled organizational transformation are commonly identified as the conceptual roots of DT (Ismail et al. 2017; Nadkarni and Prügl 2021; Vial 2019; Wessel et al. 2021). The concept of IT-enabled organizational transformation (ITOT) received increasing attention in media outlets focusing on business in the early 1990s and was defined by the Corporate Renewing Centre at INSEAD as a "fundamental change in organizational logic, which resulted in or was caused by a fundamental shift in behaviors" (Muzyka et al. 1995, p. 348). This highlights that IT's impact on organizations was already significant several decades ago, with practitioners describing the information revolution as one of three central drivers of organizational transformation (Muzyka et al. 1995). As outlined in reviews by Wessel et al. (2021) and Vom Brocke et al. (2021), following studies on the transformative impact of enterprise resource planning (ERP) systems in the 1990s, the IS community developed the concept of ITOT to explore the prominent role of digital technologies as a driver of organizational transformation. Within the broad body of knowledge accumulated under the ITOT term, Venkatraman's (1994) seminal framework was among the first to provide a clear conceptualization of IT-enabled business transformation. This framework is divided into two dimensions—degree of business transformation and range of potential benefits—and proposes five levels of IT-enabled business transformation (Fig. 1).

Venkatraman (1994) describes the characteristics of each level with corresponding examples. The two levels denoting a lower degree of business transformation are categorized as evolutionary and the three levels with a higher degree as revolutionary (Venkatraman 1994). Specifically, higher levels of transformation (Fig. 1, from left lower corner to right upper corner) are characterized by a broader scope of business transformation. Consequently, Mertens et al. (2017) indicate that the

revolutionary levels should be considered as DT, while the evolutionary levels should not. What follows is that according to Mertens et al. (2017) the model can be used to derive DT from specific levels of Venkatraman's (1994) framework. It should be noted, however, that this does not imply that ITOT and DT are equivalent. Venkatraman's framework is one of the most cited papers in the field of IT-enabled business transformation (Vom Brocke et al. 2021). Although the framework was published around three decades ago, its ongoing relevance is demonstrated by its recent use as an analytical tool (Vom Brocke et al. 2021) and a methodological foundation (Blanka et al. 2022), as well as by its inclusion in recent editions of seminal IS textbooks (Hess 2022; Mertens et al. 2017).

3 Research design

3.1 Motivation of the survey

While the discussion in the literature has been primarily informed by conceptual theorizations and extensive studies of relevant literature (Table 1), we propose that empirically studying practitioners' perspectives of what constitutes DT can provide fresh insights, especially through developing a new, empirically grounded perspective on the defining characteristics of DT. In what follows, we deem a purely conceptual understanding of DT to be insufficient, and while our survey study was informed by the existing literature reviewed in Sect. 2, we intend to complement prior papers with empirical data. Specifically, we collected survey data on two aspects: (1) the congruence between current DT definitions in the scientific literature and their understanding by business decision-makers, and (2) the evaluation of concrete DT examples which we identified in the scientific literature by business decision-makers. Generally, definitions constitute an essential foundation for progress in a specific research domain and are crucial for communicating meaning among researchers, and between researchers and practitioners (Hodgson 2019). However, the highly dynamic nature of many IS phenomena inherently poses challenges with regard to providing stable conceptualizations for emerging phenomena such as DT. Importantly, the literature provides a plethora of definitions for DT, as illustrated by Gong and Ribiere's (2021) recent analysis identifying 146 definitions of DT in different publication outlets. In line with the results of previous analyses of DT definitions (e.g., Vial 2019), Gong and Ribiere (2021) indicate that existing definitions may not be scientifically sound. Indeed, one major problem in defining DT lies in the broadening of definitional terms, a phenomenon known as conceptual stretching (Osigweh 1989). When it comes to DT, this leads to the problem that almost every phenomenon related to digital technologies with even minimal consequences—and hence little potential for change—is considered a DT phenomenon. Tellingly, Gong and Ribiere (2021) argue:

> The concept of DT has become so faddish that it is in danger of being stretched until it becomes virtually a synonym for talk of any kind in both academic and

practitioner communities, leading to theoretical vacuity and practical confusion. (p.6)

This conceptual ambiguity creates another challenge: distinguishing DT from related phenomena. As a solution to this challenge, Vial (2019) and Gong and Ribiere (2021) used a semantic decomposition process originally described by Akmajian et al. (2017) to identify the semantic primitives of existing definitions. Next, we describe our research approach and methodology in detail.

3.2 Preliminary work on understanding DT: the semantic decomposition process

A semantic primitive is a term or concept innately understood by most people which cannot be conceptualized in simpler ways (Goddard and Wierzbicka 2014). After establishing four primitives (i.e., target entity, scope, means, expected outcome), Vial (2019) defined DT as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (p. 118). Gong and Ribiere (2021) developed six primitives (i.e., nature, scope, target entity, means, expected outcome, impact) and further evaluated their description of DT through expert interviews, ultimately developing the following DT definition: "a fundamental change process, enabled by the innovative use of digital technologies accompanied by the strategic leverage of key resources and capabilities, aiming to radically improve an entity" (p. 12). These semantic primitives provide a meta-structure of DT definitions and thus form a frame of reference for different approaches to distinguishing DT from related phenomena. Table 2 summarizes the meanings of the identified primitives.

Regarding the primitive *nature*, DT is typically understood as an instance of organizational change. The nature of this change has been framed differently—for example, as transformation (Demirkan et al. 2016), process (Verhoef et al. 2021; Vial 2019), or unspecified change (Hess et al. 2016; Legner et al. 2017). The primitive *scope* reflects the extent of change implemented by an organization. If used in a DT definition, it tends to indicate a major change rather than a minor one. This is best illustrated by authors imposing the necessity for changes to be "fundamental" (Gong and Ribiere 2021, p. 9), "profound" (Demirkan et al. 2016, p. 14), "significant" (Vial 2019, p. 118), or "radical" (Westerman et al. 2011, p. 5; Westerman et al. 2014, p. 108; Karagiannaki et al. 2017, p. 4). Regarding the primitive *target entity*, Gong and Ribiere (2021) identified individual organizations, business networks, and industries as common target entities of DT definitions. Various definitions include organizations as target entities (Kane et al. 2015; Verhoef et al. 2021; Wessel et al. 2021), while others either do not specify a target entity (Andriole 2017; Legner et al. 2017) or intentionally use the term "entity" and therefore deliberately remain abstract (Gong and Ribiere 2021; Vial 2019).

Identifying DT through the primitive of *means* is a common aspect of DT definitions. While Vial's (2019) understanding of this primitive mainly focuses on digital technologies as means, Gong and Ribiere's (2021) primitive adopts a broader approach reflecting the strategies, resources, and capabilities involved in creating

Table 2 Semantic primitives of digital transformation definitions

Primitive	Meaning according to Vial (2019)	Meaning according to Gong and Ribiere (2021)
Nature	–	The reality of DT
Scope	The extent of the changes taking place within the target entity's properties	The extent of the changes taking place within the target entity in terms of its nature, outcome, and impact
Target entity	The unit of analysis affected by DT	The unit of analysis affected by DT
Means	The technologies involved in creating the change within the target entity	The methods involved in creating the change within the target entity
Expected outcome	The outcome of DT	The consequences of DT that relate to processes, offerings, changes in processes, and the quality of the entity's relationship with others, such as competitiveness, advantages, and efficiency
Impact	–	The unquantifiable long-term effects that the change may have (e.g., value creation)

the change. This demarcation is commonly based on the technological constructs used (e.g., certain sets of technology categories; Fitzgerald et al. 2013; Vial 2019) or more abstract technology constructs, such as (new) digital technologies (Fitzgerald et al. 2013; Verhoef et al. 2021; Wessel et al. 2021) or IT (Legner et al. 2017; Li et al. 2018). Further demarcations have also been made based on the capabilities involved, such as innovative use of digital technologies (Gong and Ribiere 2021) or adoption of disruptive technologies (Nadkarni and Prügl 2021).

Various authors have also conceptualized DT based on the primitives *expected outcome* and *impact*. In addition to vague definitions of expected outcomes, such as "improvements" (Fitzgerald et al. 2013, p. 2; Vial 2019, p. 120; Westerman et al. 2011, p. 37), more concrete outcomes have also been described, including "(re)defining an organization's value proposition" (Wessel et al. 2021, p. 102), creating "new business models" (Fitzgerald et al. 2013, p. 2; Verhoef et al. 2021, p. 891), "changed products or organizational structures or […] automation of processes" (Hess et al. 2016, p. 124), and changed tasks (Legner et al. 2017). Wessel et al. (2021) identify the emergence of a new organizational identity as a defining result of DT compared with ITOT. Other approaches are, again, more vague in their identified impacts—for example, "appropriat[ing] more value for the firm" (Verhoef et al. 2021, p. 889) or ensuring effective competition in a digital world (Kane et al. 2015). Comparison of the primitives in existing definitions reveals significant differences regarding the necessity of means, expected outcome, and impact to distinguish between mere organizational change and DT.

3.3 Preparation of the survey

To investigate the congruence of understanding of DT among business decision-makers with that of academics based on (1) definitions and (2) real-world examples, we took a three-stage approach when developing our survey (Fig. 2). First, we derived a set of candidate definitions and examples from the academic literature. Second, we reduced our set of candidate definitions and examples using a pre-study and expert interviews, aiming to develop a diverse set of distinct definitions and a set of contextually complete examples for DT spread evenly over the five levels of IT-enabled business transformation presented by Venkatraman (1994; Fig. 1). Third, we delivered our main survey study using our final set of definitions and examples (Tables 3 and 4).

We derived our candidate set of definitions based on Vial (2019), who analyzed a total of 282 works and thus represents the most thorough and broad review of the DT field to date. We established the final set of definitions following a collaborative process aimed at identifying a set of diverse definitory approaches that did not exceed practical limits (i.e., the time required to respond to the questions). This process included the authors of this paper and six additional people with significant expertise in the DT field. The final set (see Table 3) consisted of definitions derived from four sources: eight definitions identified by Vial (2019) as well as Vial's (2019) unified definition of DT; Venkatraman's (1994) definitions of the five levels of IT-enabled business transformation; and two definitions from recently published papers

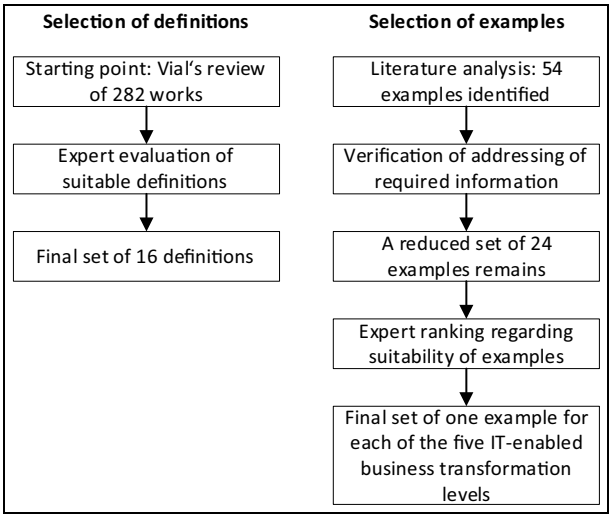


Fig. 2 Selection processes for definitions and examples

that focus on conceptually clarifying the DT concept (Verhoef et al. 2021; Wessel et al. 2021).

Regarding our candidate set of real-world DT examples, we analyzed all papers published between January 2015 and June 2020 that cited Venkatraman's (1994) framework and included real-world examples of DT.[4] We identified 54 examples distributed across the five levels specified by Venkatraman (1994): (i) localized exploitation: 17; (ii) internal integration: 10; (iii) business process redesign: 7; (iv) business network redesign: 12; and (v) business scope redefinition: 8. Mertens et al. (2017) indicate that levels three to five should be considered as DT, while levels one and two should not. However, because it is a major goal of our study to reveal possible discrepancies in the perception of the DT phenomenon between academia and practice, we included all five levels in our study.

We derived the final set of examples of DT through a structured two-stage process including a pre-study with DT research experts aiming to select a set of five examples of IT-induced change that (i) provided sufficient contextual information to allow for a clear integration into one of the five levels defined by Venkatraman (1994) and (ii) represented a clear example of each level. In the first stage, we checked each example for the inclusion of information about the context, technology used, and expected outcome. This process reduced the number of examples from 54 to 24. In the second stage, six DT experts from research and practice completed an online survey. After showing each expert the definition of each IT-enabled business transformation level (Venkatraman 1994), we tasked them with ranking the remaining

[4] We defined this five-year period to consider the most recent literature. Venkatraman (1994) was cited more than 2,000 times at the time we planned this empirical study, and it was not possible to analyze all of these papers. Therefore, we decided to systematically analyze papers from the last five years.

Table 3 Digital transformation definitions used in main survey study

ID	Definition	Source
Def_1	Leveraging of IT functionality to redesign focused high-value areas of business operations by deploying standard IT applications with minimal changes to the business process	Venkatraman (1994)
Def_2	Leveraging of IT capability to create a seamless organizational process, reflecting both technical interconnectivity and organizational interdependence	Venkatraman (1994)
Def_3	Leveraging IT functionality in redesigning an organization's key processes to derive organizational capabilities for competing in the future and utilizing IT capability as an enabler for future organizational capability	Venkatraman (1994)
Def_4	Effectively deploying IT capabilities to redesign the nature of exchange among multiple participants in a business network, thereby articulating the strategic logic to leverage related participants in the business network to provide products and services in the marketplace, and exploiting IT functionality for learning from the extended network as well as for coordination and control	Venkatraman (1994)
Def_5	A redefinition of the corporate scope that is enabled and facilitated by IT functionality	Venkatraman (1994)
Def_6	A process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies	Vial (2019)
Def_7	Using digital technology in order to (re)define a value proposition and to change the identity of the firm	Wessel et al. (2021)
Def_8	A change in how a firm employs digital technologies to develop a new digital business model that helps to create and appropriate more value for the firm	Verhoef et al. (2021)
Def_9	The use of technology to radically improve the performance or reach of enterprises	Westerman et al. (2011)
Def_10	The use of new digital technologies (social media, mobile, analytics, or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations, or creating new business models)	Fitzgerald et al. (2013)
Def_11	The profound and accelerating transformation of business activities, processes, competencies, and models to fully leverage the changes and opportunities brought by digital technologies and their impact across society in a strategic and prioritized way	Demirkan et al. (2016)
Def_12	The changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes	Hess et al. (2016)
Def_13	A planned digital shock to what may be a reasonably functioning system	Andriole (2017)
Def_14	Adopting business processes and practices to help the organization compete effectively in an increasingly digital world	Kane (2017)
Def_15	The changes imposed by IT as a means to (partly) automatize tasks	Legner et al. (2017)
Def_16	The impact of IT on organizational structure, routines, information flow, and organizational capabilities to accommodate and adapt to IT and to emphasize more the technological root of IT and the alignment between IT and businesses	Li et al. (2018)

Table 4 Examples of digital transformation scenarios in corporate practice used in main survey study and assigned level based on Venkatraman (1994)

ID	Example	Source	Assigned level
Ex_1	A port introduces new handling technologies, like automated guided vehicles equipped with sensor and laser technologies allowing for autonomous handling of cargo in dedicated terminal areas	Heilig et al. (2017)	Localized exploitation (1)
Ex_2	A machine-producing company introduces an integrated database linking CAD/CAM [Computer-Aided Design/Manufacturing] terminals with various organizational functions (purchasing, billing order handling, payroll, shop floor), enabling the placement of efficient purchase orders for materials based on an engineer's CAD/CAM drawings and reducing finished goods inventory	Venkatraman (1994)	Internal integration (2)
Ex_3	An insurance provider introduces a workstation-based information system capable of pulling data from all over the company, changing its insurance underwriting process from an assembly-line process stretching over several departments and individuals to a case-based process with dedicated case managers and expert roles, thereby increasing productivity by 40%	Davenport and Short (1990)	Business process redesign (3)
Ex_4	A port introduces an interconnected information system for directly scheduling the appointments for trucks of external organizations.	Heilig et al. (2017)	Business network redesign (4)
Ex_5	A machine manufacturer utilizes IT to change from a product to a service-based business model	Mertens et al. (2017)	Business scope redefinition (5)

examples of the candidate set in terms of how holistically and understandably they represented the respective level. This resulted in the final set of examples presented in Table 4.

3.4 Main survey and sample

Using the definitions and examples presented in Tables 3 and 4, we developed our online survey, which consisted of three question blocks: (1) demographic data, (2) DT examples, and (3) DT definitions. In the *first block*, we prompted participants to provide information on their age, gender, highest level of education, industry of current employment, position within their organization, and number of years of professional experience. In the *second block*, we presented the examples to participants in a randomized order, each on a single page, and requested that they indicate via a radio button whether or not each could be classified as an instance of DT. Furthermore, in an open-text field, participants were prompted to provide the text snippets from each example that were most relevant to their decision. In the *third block*, we presented the definitions to the participants in randomized order, each on a single page. As in the second block, participants were first prompted to indicate via a radio button whether the presented description constituted an appropriate DT definition and were then asked to provide the text snippets from the definition that led to their decision. We deliberately presented the DT examples before the DT definitions to avoid any bias in respondents' categorization. Data were collected in English in the UK in 2021. We implemented the survey using the online platform SurveyMonkey. The provider allows the survey to be played out only to participants who meet certain criteria. Our chosen criteria were the following: range of age: 18–99; country: UK; professional position: business decision-maker (i.e., a position including managerial decision-making responsibilities); company size: more than ten employees. An incentive was paid to the participants. In Appendix 1, we show sample screenshots from the second and third block of the survey.

A total of 2156 participants participated in the survey, and 1253 questionnaires were completed in full. Of these, we discarded 724 after a screening process because of data quality issues. First, we excluded persons who filled the free-text fields with meaningless character strings. Second, we also excluded participants who had an unrealistically short completion time (<4 min).[5] A possible reason for the high number of participants who had to be excluded could be the relatively high effort involved in the completion of the survey because participants had to give responses via radio buttons *and* had to use drag and drop to indicate text snippets. Importantly, based on our strict exclusion criteria we secure the quality of our data. The following analyses are based on a final sample of $N = 529$ business decision-makers.[6]

[5] Based on a pre-test with an English-native speaker who was neither a member of the research team nor a participant of the study, we found that four minutes was the minimum realistic completion time.

[6] The median survey completion time of the N = 529 business decision-makers was 12 min and 48 s.

3.5 Data analysis

In our analysis of the survey data, we first focused on the DT definitions. We investigated the distribution of participants' categorizations of the presented definitions (i.e., whether each was a suitable DT definition) to obtain a clearer picture of participants' perceptions of the DT definitions. To analyze and group the decisive terms reported, we conducted an in-depth examination of the text snippets in the context of the primitives identified by Vial (2019) and Gong and Ribiere (2021) as presented in Table 2 and consequently the primitives' relevance for DT definitions from a business decision-making perspective. For that purpose, we coded each of the 16 DT definitions for the applied primitives in advance (Table 5). In the coding process, the second and third author of this paper independently analyzed each definition regarding the coverage of each particular primitive (Table 2). In 90 out of the 96 (16 definitions × 6 primitives) cases there was agreement among the two coders, and in the remaining six cases agreement was achieved through discussion with the first author of the paper. The final coding result is presented in Table 2. After receiving the responses, all text snippets that participants indicated as relevant to their assessment were analyzed with a fuzzy algorithm regarding the corresponding primitives, thus identifying their influence on the assessment. In the present research context, application of a fuzzy algorithm means to reduce the respective terms to their word stems.

Next, we focused on the examples for DT scenarios from corporate practice. As with the definitions, we analyzed the data on the distribution of participants' categorization of the examples as DT or not DT. We also analyzed the text snippets reported as decisive for the assessments. Various search operators such as "*" and "?" were applied for the search strings in the analysis to account for different spellings and typos.

4 Results

4.1 Demographic statistics

Respondents' gender distribution was almost balanced: 53% female ($n = 281$) and 47% male ($n = 246$). Two participants did not specify their gender. The age distribution is shown in Fig. 3 ($M = 40.15$ years, $SD = 12.13$ years).

The distribution of respondents' years of professional experience is illustrated in Fig. 4 ($M = 15.66$ years, $SD = 10.55$ years).

The vast majority of respondents (74%) had completed higher education; 45% reported a bachelor's degree as their highest degree, 25% a master's degree, and 4% a doctorate. Respondents' hierarchical positions within their organizations were as follows: 16% held a C-level position, 54% were employed in middle management, and the remaining employees had some other form of managerial decision-making responsibility (e.g., in teams).

4.2 Understanding of digital transformation based on definitions

Participants were prompted to indicate whether each of the 16 presented descriptions would constitute an appropriate DT definition. Figure 5 shows the results. Interestingly, although we carefully and deliberately selected the 16 DT definitions from the scientific literature for our main survey study (see Sect. 3.3), the share of respondents stating that a definition was *not* appropriate ranged from 12% (Def_10) to 48% (Def_13). Thus, we observe a significant discrepancy between the scientific literature (see the column "Source" in Table 3) and practice (i.e., business decision-makers' perceptions and corresponding survey responses).

Using this approach, we obtained further results regarding DT definitions. First, regarding the primitives' relevance for the overall assessment (i.e., suitable DT definition *and* no suitable DT definition), we found: the primitive *means* was relevant to 34% of all assessments of definitions addressing this primitive, whereas *impact* was relevant to only 15%. The remaining results within these maximum and minimum values were: *nature* (22%), *expected outcome* (22%), *target entity* (19%), and *scope* (18%). Second, regarding responses stating that a definition was suitable, *means* was the decisive primitive, relevant to 40%; *impact* was only relevant in 17% of cases. The remaining results within these maximum and minimum values were: *expected outcome* (24%), *nature* (23%), *scope* (20%), and *target entity* (20%). Third, regarding decisions that a definition was not suitable, *nature*, *means*, and *expected outcome* were relevant for 16% and *impact* for only 8%, and we observed 15% for *target entity* and 12% for *scope*. Appendix 2 summarizes the detailed results.

4.3 Understanding of digital transformation based on scenarios

Figure 6 illustrates the results of the assessment of whether each scenario describes an example of DT. As previously mentioned, the literature (e.g., Mertens et al. 2017) suggests distinguishing between evolutionary and revolutionary levels of DT based on Venkatraman's (1994) framework (Fig. 1). Thus, theoretically, one would expect that Ex_1 and Ex_2 (evolutionary levels) would be assessed predominantly as no DT and Ex_3, Ex_4, and Ex_5 (revolutionary levels) as DT. However, for the majority of respondents all five examples constituted DT scenarios. It is even more surprising that Ex_1 and Ex_2 were labeled DT by the largest shares of respondents (86% and 88%, respectively), when we expected that the three examples of the revolutionary levels (Ex_3: 83%, Ex_4: 83%, Ex_5: 73%) would have the largest proportion.

In sum, we observe a significant discrepancy between the scientific literature (see the column "Source" in Table 4) and business decision-makers' perceptions and their corresponding survey assessments.

To statistically test the significance of the differences between the five scenarios, each of which represents a particular level of IT-enabled business transformation (Venkatraman 1994), we carried out an ANOVA using the Brown-Forsythe method, which performs the ANOVA for the group medians instead of the group means to yield more robust results (Derrick et al. 2018). The results presented in Table 6

Table 5 Coverage of primitives by definitions

ID	Full text	Nature	Scope	Target entity	Means	Expected outcome	Impact
Def_1	Leveraging of IT functionality to redesign focused high-value areas of business operations by deploying standard IT applications with minimal changes to the business process	X	X	X	X	X	
Def_2	Leveraging of IT capability to create a seamless organizational process—reflecting both technical interconnectivity and organizational interdependence	X		X	X	X	X
Def_3	Leveraging IT functionality in redesigning an organization's key processes to derive organizational capabilities for competing in the future and utilizing IT capability as an enabler for future organizational capability	X	X	X	X	X	X
Def_4	Effectively deploying IT capabilities to redesign the nature of exchange among multiple participants in a business network, thereby articulating the strategic logic to leverage related participants in the business network to provide products and services	X	X	X	X	X	X
Def_5	A redefinition of the corporate scope that is enabled and facilitated by IT functionality	X		X	X	X	
Def_6	A process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies	X	X	X	X	X	
Def_7	Using digital technology in order to (re)define a value proposition and to change the identity of the firm		X	X	X	X	
Def_8	A change in how a firm employs digital technologies to develop a new digital business model that helps to create and appropriate more value for the firm	X	X	X	X	X	X
Def_9	The use of technology to radically improve performance or reach of enterprises	X	X	X	X	X	
Def_10	The use of new digital technologies (social media, mobile, analytics, or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations, or creating new business models)	X	X	X	X	X	
Def_11	The profound and accelerating transformation of business activities, processes, competencies, and models to fully leverage the changes and opportunities brought by digital technologies and their impact across society in a strategic and prioritized way	X	X	X	X	X	X
Def_12	The changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes		X		X	X	
Def_13	A planned digital shock to what may be a reasonably functioning system	X		X			

Table 5 (continued)

ID	Full text	Nature	Scope	Target entity	Means	Expected outcome	Impact
Def_14	Adopting business processes and practices to help the organization compete effectively in an increasingly digital world		X	X		X	X
Def_15	The changes imposed by IT as a means to (partly) automatize tasks	X	X		X	X	
Def_16	The impact of IT on organizational structure, routines, information flow, and organizational capabilities to accommodate and adapt to IT and to emphasize more the technological root of IT and the alignment between IT and businesses	X	X	X	X	X	X

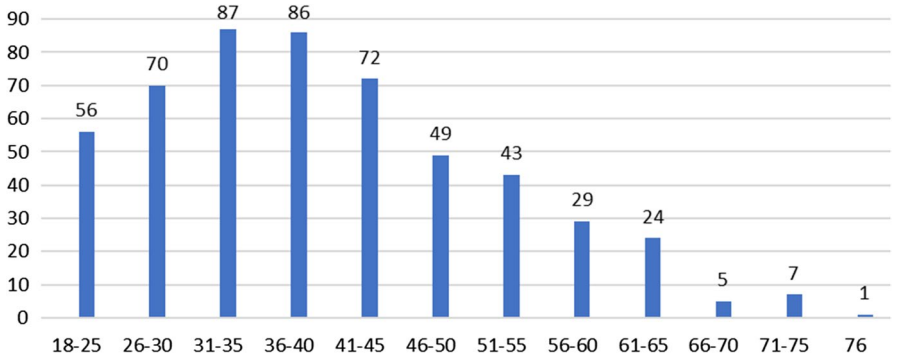
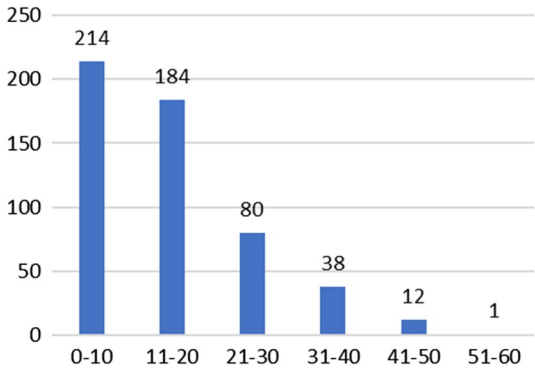


Fig. 3 Respondents' age distribution in years ($N = 529$)

Fig. 4 Distribution of respondents' professional experience in years ($N = 529$)



show a significant difference between the examples: $F(4, 2514) = 12.71$, $p < .001$. The corresponding statistics are presented in Tables 6 and 7.

Subsequently, we performed a post hoc test to show which examples were significantly different. The results presented in Table 8 illustrate significant differences in the assessment of examples 1 through 4 compared with example 5 (see the column "p_{bonf}" in which we present the Bonferroni-corrected p-values for pairwise comparisons).

A *t*-test also showed a significant difference ($p < 0.001$) between the two categories of examples, namely the evolutionary levels (Ex_1 and Ex_2) and the revolutionary levels (Ex_3, Ex_4, and Ex_5).

The results of our analysis of the text snippets participants reported as decisive or relevant for their assessments of the examples are illustrated in Fig. 7, which shows their frequency and the corresponding outcome of the assessment. Note that only the terms with the highest frequency of mentions are shown in Fig. 7; in the total bar, all votes are included. In the following, we describe the results, structured along the five examples.

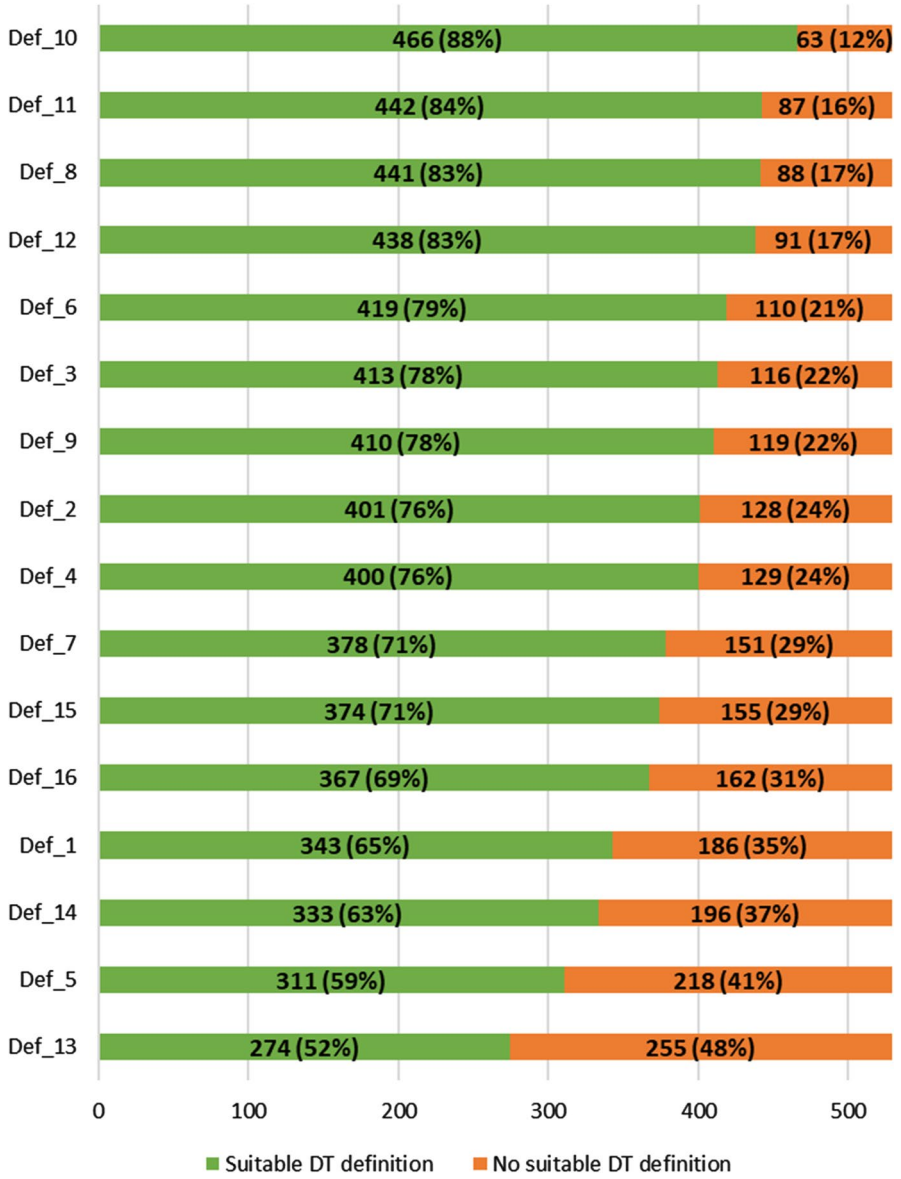


Fig. 5 Results of assessment of presented digital transformation definitions ($N = 529$)

For Ex_1, the terms reported as most relevant for the assessments were *automat* (automated, automation), *autonomous*, *laser*, *sensor*, *handling technolog* (technology, technologies), and *guided vehicle*. Interestingly, all terms except sensor (indicator for DT) and guided vehicle (indicator for no DT) were relevant for both answer decisions.

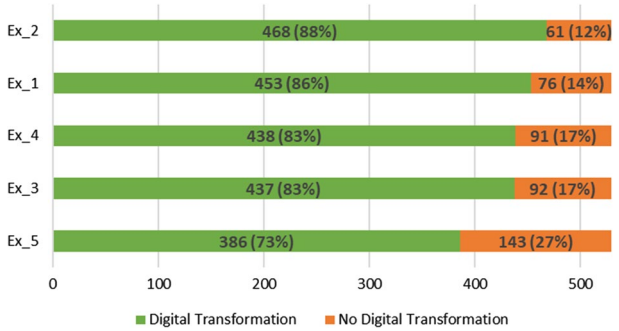


Fig. 6 Results of assessment of presented examples for digital transformation scenarios (N = 529)

Table 6 ANOVA

Homogeneity correction	Cases	Sum of squares	*df*	Mean square	*F*	*p*
Brown-Forsythe	Level	7.216	4.000	1.804	12.71	< 0.001
	Residuals	374.737	2514.396	0.149		

Type III sum of squares

For Ex_2, the decisive terms for the assessments were *integrated database*, *CAD?CAM* (combined), *linking*, *CAD*, *CAM*, and *efficient*. The only term which was relevant for both answer decisions was *integrated database*. All other terms show a strict separation. However, the combined mention of CAD and CAM was an indication of DT for a large group of respondents, while the separated terms indicated the opposite for a small share.

For Ex_3, the relevant terms were *information?system*, *pulling data*, *workstation?based*, *increase*productivity*, *process, assembly?line*, *dedicated case?manager*, and *case?based?process*. Again, there was a small overlap for the terms *workstation?based* and *increase*productivity.*

For Ex_4, the most relevant terms were *interconnected information system*, *directly scheduling*, *external organi?ation* (organization, organisation), *trucks of external organi?ations* (organizations, organisations), *port*, and *scheduling*appointment*.

Finally, for Ex_5, the most relevant terms were *utili?es IT* (utilises, utilizes), *change*, *service?based*, *business?model*, and *machine?manufacturer*. All terms except the latter were indicated for both decisions (i.e., DT and not DT).

Regarding the outcome and impact perceived as necessary for an instance of technology-induced change to be classified as DT, our results provide an interesting picture: Terms from Ex_5 representing the extent of business scope redefinition, which constitute core elements of the DT concept (e.g., change, service-based, business model, utilize IT), led participants to decide that Ex_5 was *not* an example of DT.

Our results also contradict the argument that a certain degree of innovativeness in the technologies used can be considered a precondition for DT (see the list of the

Table 7 Descriptive statistics

Level	Mean	*SD*
Ex_1	0.856	0.351
Ex_2	0.885	0.320
Ex_3	0.826	0.379
Ex_4	0.828	0.378
Ex_5	0.730	0.445

Table 8 Post Hoc comparisons

Levels		Mean difference	SE	*t*	Cohen's *d*	p_{bonf}
Ex_1	Ex_2	−0.028	0.023	−1.224	−0.084	1.000
	Ex_3	0.030	0.023	1.306	0.083	1.000
	Ex_4	0.028	0.023	1.224	0.078	1.000
	Ex_5	0.127	0.023	5.467	0.316	< 0.001
Ex_2	Ex_3	0.059	0.023	2.530	0.167	0.115
	Ex_4	0.057	0.023	2.448	0.162	0.144
	Ex_5	0.155	0.023	6.691	0.400	< 0.001
Ex_3	Ex_4	−0.002	0.023	−0.082	−0.005	1.000
	Ex_5	0.096	0.023	4.162	0.233	< 0.001
Ex_4	Ex_5	0.098	0.023	4.243	0.238	< 0.001

Cohen's *d* does not correct for multiple comparisons; *p*-value adjusted for comparing a family of 5

most relevant terms in Fig. 7). The mere mention of technology terms (e.g., automation, autonomous, laser, sensor, integrated database, CAD/CAM) frequently led participants to classify an example scenario as DT, independent from the fact whether they are novel or not. More specifically, although the technologies included in Ex_1 and Ex_2 reflect established IT that is not commonly understood as novel, respondents commonly described these technologies as key reasons why they categorized the examples as DT.

5 Discussion

Based on the results of our analysis of related literature, we were especially interested in how the major characteristics of DT currently discussed in the scientific community are reflected in practitioners' perceptions of the DT concept. The main finding of our study is that there is a significant discrepancy between the scientific literature and practice in terms of the conceptual understanding of DT.

Overall, 12–48% of respondents classified the DT definitions included in our survey as unsuitable (Fig. 5). We asked participants to indicate the text snippets that led to their classification decision (shown in detail for all 16 definitions in Appendix 3).

Fig. 7 Most relevant terms for assessment of five examples ($N = 529$)

Terms closely linked to the concept of DT—such as redefinition or redesign (Def_1, Def_3, Def_4, Def_5, Def_7), corporate scope (Def_5), business processes (Def_2,

Def_3, Def_6, Def_12, Def_14), and change (Def_1, Def_6, Def_7, Def_8, Def_12, Def_15)—led participants to *reject* a phrase as a suitable definition of DT in a considerable number of responses.

Moreover, and this is also a notable result, participants identified several terms *without* a direct link to DT—such as improve (Def_6, Def_9, Def_10), performance (Def_9), radically (Def_9), and digital world (Def_14)—or technology-focused terms—such as digital technology (Def_7, Def_8, Def_10, Def_11 Def_12), IT (Def_1, Def_2, Def_3, Def_4, Def_5, Def_16), and automation (Def_12, Def_15)—as strong indicators that a phrase was a suitable definition of DT. Altogether, the buzzword "digital technology" led the survey participants to classify a definition as instance for DT most often.

Taking these results into account, we conclude that practitioners' decisions regarding whether a DT definition is suitable:

- is in a remarkably large number of cases hardly related to the conceptualizations of DT in the scientific literature and
- is evidently influenced by mentions of buzzwords related to digital technologies.

In line with Steininger et al. (2009), we define a buzzword as a term or concept which "dwells on recent developments [… and hence] is also subject to a greater risk of placing too much emphasis on fads" (p. 411). In particular, the term *digital technology* triggers practitioners to assume a definition is related to the DT concept, whereas more abstract terms (which are typically not directly related to the technology itself) (e.g., business model, business processes, change, redefinition) are hardly associated with it.

According to the scientific literature (Heilig et al. 2017; Mertens et al. 2017; Venkatraman 1994), Ex_1 and Ex_2 reflect evolutionary IT-induced changes and therefore should not be understood as DT scenarios, considering the expected extent of the required outcome and impact of DT. However, only 12% (Ex_2) and 14% (Ex_1) of respondents assessed them as not DT. This result sharply contrasts how existing literature would understand DT scenarios. Ex_1 and Ex_2 were originally assigned to the evolutionary levels of IT-enabled business transformation (Venkatraman 1994), which lack the necessary scope of change in outcome and impact and should therefore not be considered DT. The remaining three examples were assigned to the revolutionary levels (Venkatraman 1994), which—according to the necessity for fundamental (Gong and Ribiere 2021), profound (Demirkan et al. 2016), or significant (Vial 2019) scope of change—should be considered instances of DT. However, these three examples were assessed most frequently as not DT (17–27%). This suggests that participants considered evolutionary-level examples to be DT more often than revolutionary-level examples. This finding corresponds to the study results reported in Mergel et al. (2019), in which the higher levels also played only a minor role regarding DT in organizations of the public sector.

Our results clearly indicate that practitioners understanding of DT is strongly diverging from existing conceptualizations within literature (e.g., Gong and Ribiere 2021; Verhoef 2021; Vial 2019). What follows is that research in the DT domain should abstain from presuming common conceptualization of the DT term and

instead emphasize the utilization of more concrete terms and practical examples. Furthermore, research communication focused on DT should provide concise definitions to provide a clearer depiction of the scientific concept to practitioners.

Another important implication of our research findings is that in the future, scientists should proactively engage with practitioners more than they have in the past to elucidate the significance of the inherent characteristics of DT for the success of digitalization initiatives. In particular, it should be ensured that DT is not merely viewed as the introduction of digital technologies into organizations, regardless of how innovative a digital technology may appear (e.g., as in the case of AI or blockchain). Rather, science should convey to practice that DT should be understood as much more strategic and conceptually broader, especially in terms of its disruptive potential, changes in value creation paths, and organizational changes, including potential organizational resistance and measures for their management (e.g., Vial 2019). It can be assumed that such a more actively oriented communication from science to practice can effectively contribute to changing perspectives in practice, so that in the future, the views of practitioners will align more closely with those of scientists.

For decision-makers we could not observe a necessity of conceptualizing DT beyond technology utilization. Neither a differentiation based on the degree of organizational change nor alongside the novelty or innovativeness of the applied technology could be identified as a central factor based on which decision-makers distinguish DT from no DT. For researchers in the field of DT, such results are, at least to some extent, counterintuitive and irritating. Yet, these results open up a promising research avenue. Evaluating if and which added benefits of a more complex and literature-based understanding of DT arise for organizational decision-makers could foster our understanding of how employees shape and are shaped by organizational digital transformation endeavours.

For the economy to benefit as directly as possible from the scientific findings on the phenomenon of DT, it is essential for academic researchers to identify and cope with tensions that might arise from different understandings of the phenomenon. As the results of our study show, we have not yet reached a shared understanding on the topic since there are discrepancies in both concrete categorizations of examples and the aspects relevant for differentiation. To this end, future research seeking to clarify (1) how practitioners' understanding of DT is formed and (2) how decision-makers are affected by current conceptual confusion could investigate combining buzzwords that practitioners associate with DT with the most relevant primitives. This would likely establish a scientifically sound, yet broadly accepted, definition of DT.

Another important focus of future research is whether different understandings of the concept of DT are influenced by demographic factors (e.g., age, gender), organizational factors (e.g., position in the corporate hierarchy, focus on technical or managerial tasks), or by the personality of the respondents. In future personality research, for example, the Big Five personality model could be used, which conceptualizes openness, conscientiousness, extraversion, agreeableness, and neuroticism as the determinants of human personality (McCrae and Costa 1997, 1999). Current research findings indicate that the perception

and acceptance of digital technologies are influenced by personality (e.g., Riedl 2022).

6 Conclusion

The analysis of the literature indicates that empirical investigation of business decision-makers' perceptions and opinions on the DT phenomenon is largely missing, while a significant number of theoretical papers exist, conceptualizing and defining DT. Against this paucity of investigation of business practice, we conducted a survey study based on data from N = 529 business decision-makers in the UK. The results of our study show a significant discrepancy between the scientific literature (i.e., conceptualizations and definitions of DT in academia) and practice (i.e., business decision-makers' perceptions and corresponding survey responses). A large proportion of respondents did not classify concrete examples as DT or not DT based on degree of organizational change, as proposed in the scientific literature (e.g., Venkatraman 1994, Mertens et al. 2017). Moreover, many participants also did not classify DT based on abstract definitions. Rather, the key finding of our study is that practitioners classify a scenario or example as DT and consider a definition of DT to be suitable based on the occurrence of specific terms related to digital technologies, which are typically considered as buzzwords (e.g., Steininger et al. 2009). Therefore, the core characteristics of DT as outlined in the scientific literature (e.g., Chen and King 2022; Vial 2019; Wessel et al. 2021) are often irrelevant to practitioners' perceptions of DT. The primitives used in the definitions created by researchers show mixed levels of relevance to practitioners, at best. Thus, with reference to our research question we conclude that the understanding of DT as elaborated in the academic literature is hardly reflected in the understanding of business decision-makers. As outlined in Sect. 4, our study revealed major discrepancies.

This research also has some limitations that indicate opportunities for future research. Although we followed a well-defined process to decide which definitions and examples we included in our empirical study, other options are available in the literature, and additional definitions or examples could be developed over time. Based on the results of differentiating between terms, future studies could be designed to more clearly determine when and which terms make an impact—for example, by describing the same scenarios with different technologies. Thus, while the present study is of a correlational nature, we foresee experimental studies which deliberately manipulate definitions and observe corresponding effects on the classification as DT or no DT. Due to the survey design, our study did not include contextual information regarding the participants organizational context. Future work could investigate whether the understanding of DT differs between decision-makers in organizations that have experienced large scale DT initiatives and organizations that still show low levels of digital maturity. It will be rewarding to see what insights future research will reveal.

Appendix 1

Below we show sample screenshots from the second and third block of the main survey. See Figs. 8, 9

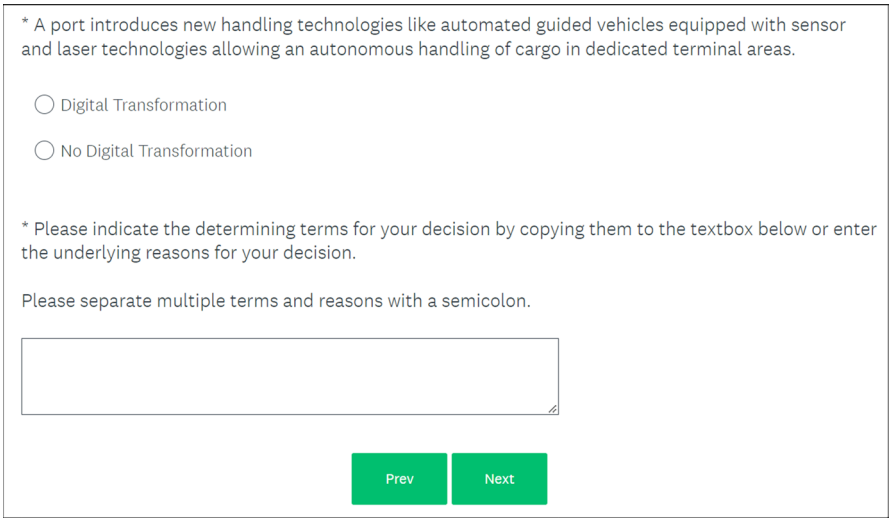


Fig. 8 Sample screenshot of survey block 2 (Examples)

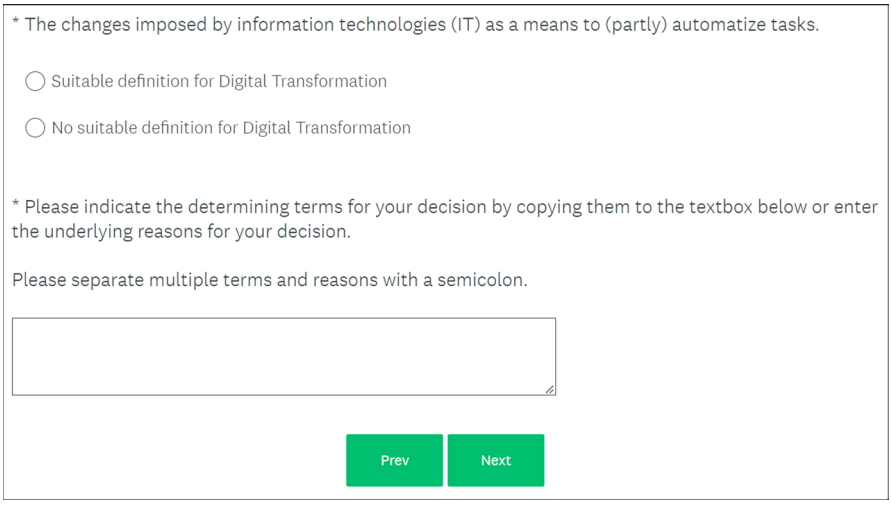


Fig. 9 Sample screenshot of survey block 3 (Definitions)

Appendix 2

In Figs. 10, 11, 12, higher values for definitions are indicated by more darkly colored backgrounds (note that the coloring refers to two blocks: columns 1 to 16 and the column "overall"). Because participants could name several primitives as reasons for each decision, the percentages do not add up to 100.

Definition no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	overall
NATURE	15%	18%	16%	21%	24%	7%	N/A	16%	25%	20%	32%	N/A	49%	N/A	17%	20%	22%
SCOPE	21%	N/A	0%	12%	N/A	20%	12%	22%	32%	20%	11%	7%	N/A	26%	36%	20%	18%
TARGET ENTITY	17%	17%	14%	14%	21%	11%	14%	37%	12%	31%	23%	N/A	20%	24%	N/A	13%	19%
MEANS	30%	25%	32%	26%	32%	35%	33%	30%	40%	49%	37%	31%	N/A	N/A	19%	59%	34%
EXPECTED OUTCOME	5%	14%	13%	5%	10%	16%	35%	25%	41%	36%	22%	40%	N/A	19%	37%	18%	22%
IMPACT	N/A	18%	7%	12%	N/A	N/A	N/A	21%	N/A	N/A	9%	N/A	N/A	21%	N/A	13%	15%

Fig. 10 Primitives' relevance for overall assessment (i.e., suitable DT definition and no suitable DT definition)

NATURE	21%	20%	19%	25%	20%	7%	N/A	16%	28%	21%	33%	N/A	53%	N/A	18%	19%	23%
SCOPE	12%	N/A	0%	14%	N/A	22%	14%	25%	38%	22%	11%	8%	N/A	24%	40%	23%	20%
TARGET ENTITY	15%	19%	17%	18%	20%	10%	13%	41%	13%	33%	24%	N/A	24%	21%	N/A	15%	20%
MEANS	38%	28%	37%	31%	48%	40%	45%	33%	45%	52%	42%	35%	N/A	N/A	25%	65%	40%
EXPECTED OUTCOME	6%	17%	16%	6%	10%	16%	33%	28%	47%	38%	23%	44%	N/A	17%	41%	21%	24%
IMPACT	N/A	20%	8%	15%	N/A	N/A	N/A	22%	N/A	N/A	10%	N/A	N/A	26%	N/A	16%	17%

Fig. 11 Primitives' relevance for positive assessments (i.e., suitable DT definition)

NATURE	4%	12%	6%	9%	30%	10%	N/A	16%	13%	6%	25%	N/A	45%	N/A	15%	22%	16%
SCOPE	37%	N/A	0%	5%	N/A	10%	9%	5%	13%	5%	9%	2%	N/A	28%	25%	14%	12%
TARGET ENTITY	20%	9%	4%	5%	23%	15%	18%	16%	9%	16%	17%	N/A	15%	30%	N/A	10%	15%
MEANS	16%	13%	16%	10%	10%	15%	4%	16%	24%	27%	11%	11%	N/A	N/A	7%	46%	16%
EXPECTED OUTCOME	2%	7%	4%	4%	11%	18%	38%	8%	23%	22%	16%	21%	N/A	22%	28%	11%	16%
IMPACT	N/A	12%	1%	5%	N/A	N/A	N/A	19%	N/A	N/A	2%	N/A	N/A	11%	N/A	7%	8%

Fig. 12 Primitives' relevance for negative assessments (i.e., no suitable DT definition)

Appendix 3

This appendix shows the detailed results of the respondents' classification of the 16 DT definitions. We asked participants to indicate the text snippets that led to their classification decision (See Figs. 13, 14, 15, 16).

Fig. 13 Most relevant terms for decision-making, definitions 1–4 (N = 529)

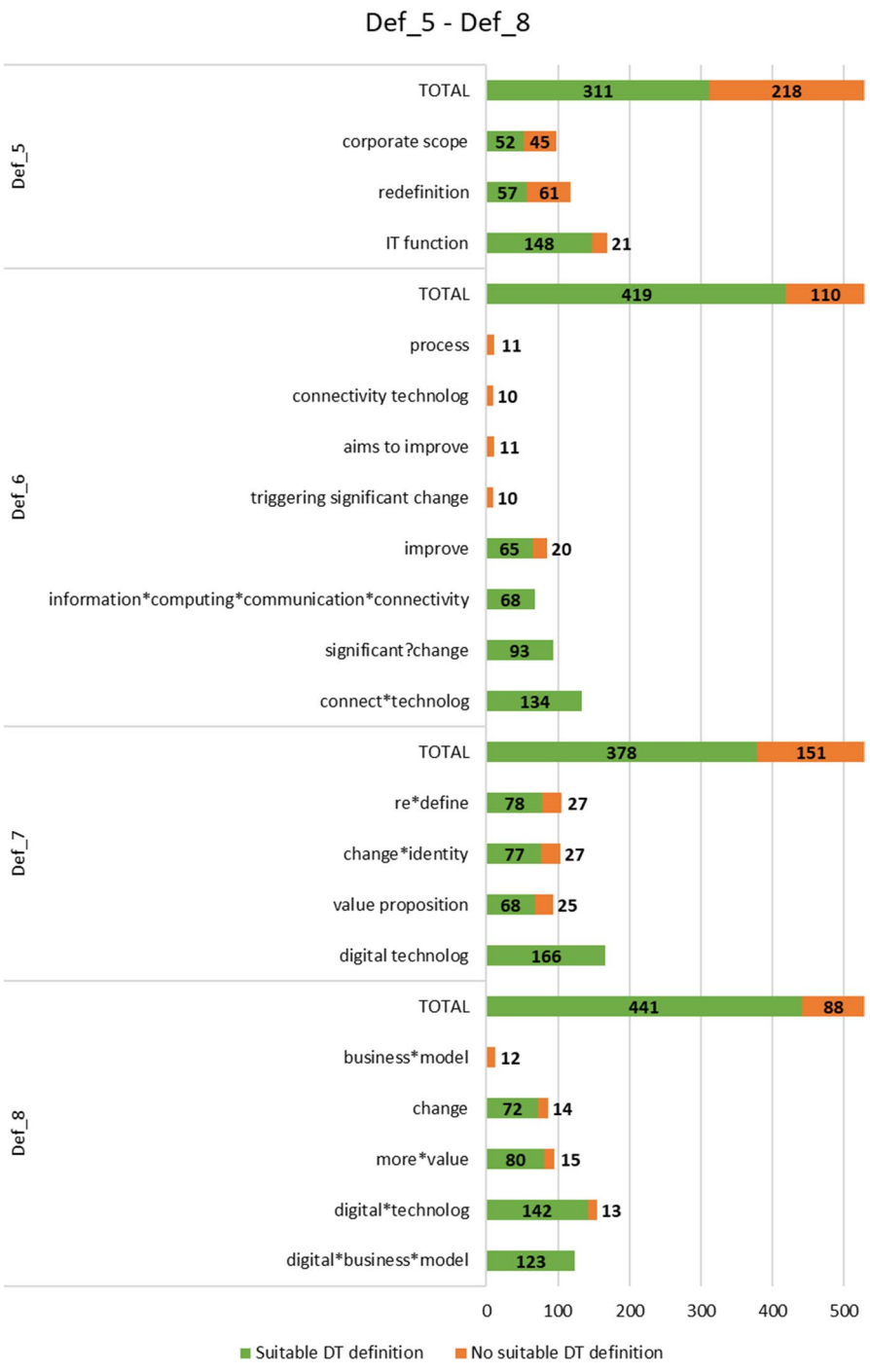


Fig. 14 Most relevant terms for decision-making, definitions 5–8 (N = 529)

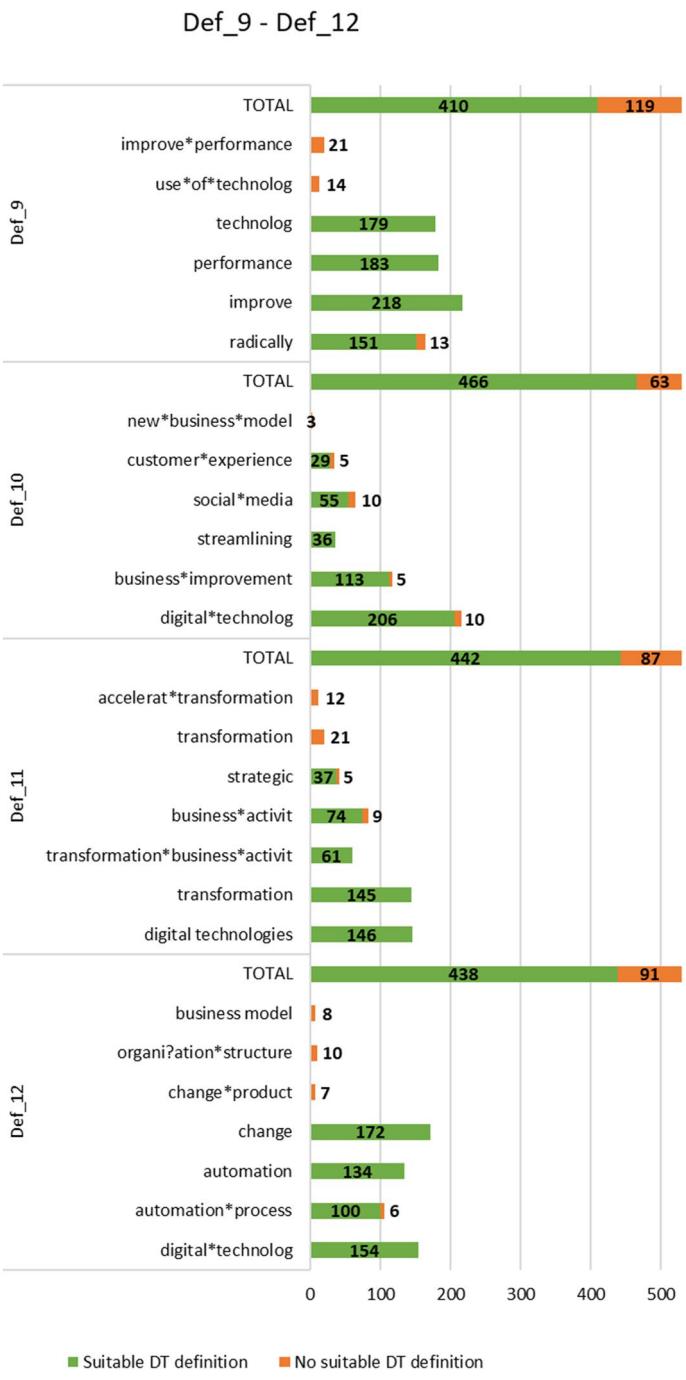


Fig. 15 Most relevant terms for decision-making, definitions 9–12 (N = 529)

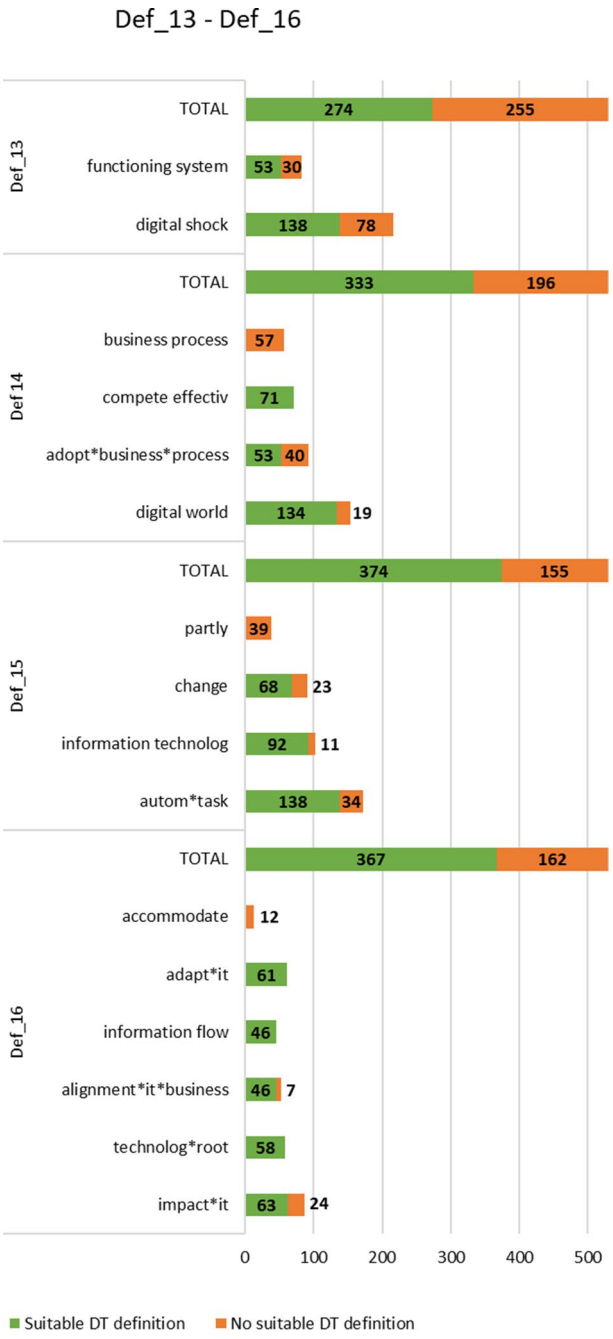


Fig. 16 Most relevant terms for decision-making, definitions 13–16 (N = 529)

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