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## Developing a unified definition of digital transformation

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### ABSTRACT

Digital Transformation (DT) has become an imperative for most organizations in our world of emergent and continuous changes. The term DT has been so broadly used (and misused) that it becomes very confusing. Consequently, the need to provide some conceptual rigor to DT is urgently needed. The purpose of this article is to develop a unified definition of “digital transformation” based on a vastly rigorous/scientific review and analysis of 134 well-received, published definitions of DT that significantly differentiates from other related terms in the literature. The proposed unified definition will help researchers and practitioners to “advance the theory and practice” of the discipline.

### 1. Introduction

With a sharp increase in publications, Digital Transformation (DT) has surely injected new vigor into both conceptual and empirical research, but simultaneously, several issues surrounding its conceptualization and theorization remain ambivalent as it is being socially constructed on the basis of separate domains of knowledge. Without a solid understanding of digital transformation’s core elements and the logic of how these elements connect, the underlying structural impediments may impede dialog across the domains and devastate the consistency of research streams.

The motivation of this research effort is based on the observation that there are diverse definitions or descriptions of DT, leading to the emergence of a hype and buzzword in both academic and practitioner literatures. Conversely, not enough attention has been paid to the question of what DT actually is, and how we should conceptualize it. Without the adoption of a unified definition, researchers and practitioners will not be able, in the long run, to “advance the theory and practice” of the discipline (Stock and Boyer, 2009). Leaders in various industry circles use the term DT inconsistently to describe various strategizing and organizing activities (Warner and Wäger, 2019), triggering different disciplines in research and influencing practice (Hausberg et al., 2019). While existing literature demonstrates new levels of research interest in this area, there is evidence of lacking a universal and comprehensive understanding of this concept (Goerzig and Bauernhansl, 2018; Gray and Rumpe, 2017; Haffke et al., 2016; Matt et al., 2015; Morakanyane, Grace, & O’Reilly, 2017; Van Veldhoven and Vanthienen, 2019), its implications at multiple levels of analysis (Vial, 2019), as well as inconsistencies in the existing literature (Besson and

Rowe, 2012; Cha and Lee, 2013). The confusion and complexity of understanding such concepts, both in the academic and practitioner communities, as they do not have unified views of the fundamental attributes of DT (Morakanyane et al., 2017; Van Veldhoven and Vanthienen, 2019), leads to a misunderstanding of the essence of this phenomenon. Despite the complexity and diverse understanding of DT in the literature, “all scientific disciplines have to evolve over time to make scientific progress and build cumulative knowledge” (Riedl et al., 2017, p. 478), and more importantly, this scientific progress should be achieved by careful and systematic differentiation leading to an improved command of complexity (Mertens and Wiener, 2018), rather than merely reinventing the wheel.

In light of conceptual and theoretical advancement, this paper aims to provide insights into the core defining primitives and linguistic clarity of digital transformation to address the need to develop a unified definition. In this paper, we applied a mainly qualitative approach followed with a short expert survey embedded by using a rigorous eight-step theoretical approach with three-level analysis in an inductive way to answer two main research questions:

- What are the core attributes of the DT definition?
- To what extent are those attributes core to the DT definition?

We attempt to contribute to the literature by developing a unified definition of “digital transformation” that differentiates from other related terms (e.g., digitalization and digitization).

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## 2. Research background

It is generally accepted in the academic community that dictionary or commonly used definitions are not sufficient for scientific study (Bunge, 1967; Hunt, 1991; Teas and Palan, 1997; John G Wacker, 2004). The lack of a unified definition of DT is critical for several significant reasons. As for researchers, it is challenging to develop DT theory, define and test relationships between DT elements, and develop a consistent stream of research that builds on what has been done before. Ambiguity and complexity in understanding continue to hinder the study and further development of DT that is detrimental to the synergy in research. Furthermore, the vagueness in understanding demonstrates the lack of a coherent theoretical frame that reconciles all aspects of DT (Henriette et al., 2015). As for practitioners, the absence of a unified definition of DT creates difficulties for executives, especially CEO, CIO (Chief information officer), and CDO (Chief Digital Officers) (Haffke et al., 2016; Horlacher, 2016; Horlacher and Hess, 2016; Singh and Hess, 2017), to claim authority and responsibility for the strategy and implementation of the digital transformation of their organization. The broadness and complexity of this concept also make it more difficult to benchmark and benchmark against other companies and industries on DT metrics, job responsibilities, good practices, and other HR issues.

Furthermore, there is no explicit or unified definition used to address what these similar terms intend to imply, namely, “digital transformation,” “digitalization” or “digitization” (Demlechner and Laumer, 2019; Legner et al., 2017; Mertens and Wiener, 2018; Riedl et al., 2017), and they are often used interchangeably in existing research (Hausberg et al., 2019; Mergel et al., 2019). For example, Riedl et al. (2017) closely looked at the relationship between Digitalization and the well-established field of Information Management. By developing three major scenarios on the relationship between Information Management (IM) and Digitalization (D), and by collecting feedback from a panel of experts about these three different scenarios, they were able to make the point that digitalization was a part/subset of the field of IM, nevertheless, some new aspects were brought into play with digitalization that was not originally part of IM. This paper led to further discussions by Mertens and Wiener (2018), clarifying that Digitalization should not be considered as a new phenomenon but more like a building block on the shoulder of the previous IM discipline. Until this new building block is able to bring/demonstrate some new significant additions/complexity to the IM field, it should not be treated as a “new discipline” but more as a natural extension, allowing to avoid current hype surrounding it. We are currently experiencing similar issues with the concept of Digital Transformation.

Consequently, from a theoretical perspective, it is almost impossible to develop a sound DT theory until valid constructs and generally accepted definitions of concepts are developed and until the DT theory significantly differentiates itself enough from other pre-existing theories/concepts. To support such objectives, a unified definition of DT would significantly benefit researchers’ efforts to study the phenomenon of DT, allowing researchers to more precisely develop new theories surrounding it and for practitioners to identify DT’s scope and boundaries in order to implement DT better.

## 3. Literature review

The literature review in this research was divided into two parts: A systematic literature review (SLR) to collect existing DT definition; and a literature review to analyze the methodologies used to develop a unified definition, why it is needed, and how to develop it. We will discuss DT in general in this section to provide more background of how and what has been debated profusely in the literature, and elaborate DT definitions in detail in section 5.

### 3.1. Digital transformation

With the evident changes in some industries, a triggering number of DT-related research has surfaced in literature, yet a clear understanding of DT remains shrouded in considerable confusion and misconception. It is due in the diversity of the research stream without a solid foundation of shared understanding of the critical concept – digital transformation.

One confounding limitation of the extant literature is a failure to distinguish adequately between DT and its related terms as they are used interchangeably. In early definitions, the concept DT was used, or probably misused, synonymously with traditional definitions of digitization. Digitization essentially refers to “taking analog information and encoding it into zeroes and ones so that computers can store, process, and transmit such information” (Bloomberg, 2018) or “the technical process of converting analog signals into a digital form” (Legner et al., 2017). Digitalization refers to “the pace of change in a society driven by digital technological development, involving multiple technologies at different stages of maturity that will converge and create new technologies” (McAfee, 2009) and “a sociotechnical process of applying digitizing techniques to broader social and institutional contexts that render digital technologies infrastructural” (Tilson et al., 2010). According to Gartner’s IT Glossary, digitization is the process of changing from analog to digital form, whereas digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities. Indeed, digitization, digitalization, and DT are interconnected, but they should be kept distinct at the conceptual level. These three terms are associated with the use of digital technologies. The outcomes of digitization can feedback into the process of digitalization and DT. However, DT is not equivalent to digitalization, but they both can be the result or the effect of the action of “going digital.” The consensus today seems to be that DT encompasses more than digitization (Haffke et al., 2016; Iansiti and Lakhani, 2014; Yoo et al., 2012).

At the beginning, a strong emphasis was put on the use of digital technologies. Then, organizations and researchers gradually realized that DT was more than just a technological shift (Henriette et al., 2015), and that it requires not just technology but also the alignment of strategy and other factors, such as people, culture, mindset, talent development, and leadership (Goran et al., 2017). Some definitions concentrate on the impact of DT, such as operational efficiency improvement. Just to name a few: DT can improve decision-making (Heilig et al., 2017; Roedder et al., 2016) and create competitive advantage (Korhonen and Halen, 2017; Schwertner, 2017). Some authors include customer value creation, like optimizing customer needs and experiences (Rogers, 2016) in their definitions, while others exclude it. An enormous challenge remains in the lack of a reconciled definition and fundamental elements of the literature (Morakanyane et al., 2017). Many existing studies outview DT as totally different things. For instance, while some authors view DT as a slight technology-enabled change such as implementing a new ERP System (S. Chanias, 2017), others believe that DT is a more radical and evolutionary process that takes place over time (Janowski, 2015; Loebbecke and Picot, 2015; Wang et al., 2018). While some researchers associate DT with business models (Berman, 2012; Bharadwaj et al., 2013; Gassmann et al., 2014; Schallmo et al., 2017) and strategy (Bharadwaj et al., 2013; Henriette et al., 2015; Matt et al., 2015; Rogers, 2016; George. Westerman, 2018), others view DT as a paradigm or as a process (Berman, 2012; Janowski, 2015; Wang et al., 2018). Some researchers consider DT as the economic and societal effects of digitization and digitalization (OECD, 2018).

To better understand the dynamics of such a complicated phenomenon, some researchers have taken up the task of empirically examining its various elements and taking on the challenge of bringing clarity to the multiplicity of DT definitions. For instance, Morakanyane (2017) reviewed DT to categorize and synthesize them with a limitation of 53 definitions that were examined. There is nothing inherently incorrect about analysing a limited number of DT definitions. However, such

analysis is incomplete in the sense that there is the potential that key definitions or concepts may be omitted. We believe there is still room and value in further investigating and developing such an initial commendable effort.

### 3.2. Three frequently used methods for definition analysis

By screening the relevant articles on the topic of “unified definition,” we found three frequently used methods that are suitable to analyze the existing definitions in our case: content analysis, conceptual analysis, and conceptualization.

Content analysis is characterized as “a systematic, rigorous approach to analyze documents obtained or generated in the course of the research, and can be applied in qualitative, quantitative, and sometimes mixed modes of research frameworks and employed a wide range of analytical techniques to generate findings and put them into context” (M. D. White and Marsh, 2006, p. 41). Content Analysis is often used as a companion research instrument in multi-method studies employing diverse methods to enhance the validity of results by minimizing biases (Krippendorff, 2004), and the best content-analytic studies use both qualitative and quantitative operations (Weber, 1990). There is a debate as to how a content analysis should be undertaken, particularly about quantitative and qualitative techniques. The qualitative analysis deals with the forms and antecedent-consequent patterns of form, while quantitative analysis deals with duration and frequency of form (Smith, 1975). A gap exists between the qualitative scholars’ interest in substantively valid concepts and the quantitative scholars’ concern for proper numerical measures. Advocates of qualitative and quantitative content analysis often emphasize their differences, yet many similarities exist as well. The summary of both qualitative content analysis and quantitative content analysis is provided in Table 1. We should notice that the most recent controversial issue is not whether one approach is intrinsically better than another, but which combination of methods is best to meet the aims of a particular study. In the case of developing a unified definition, we believe both qualitative and quantitative content analysis is needed. They are not mutually exclusive and should be used in combination.

Hempel (1970) argued that concepts play an integral role in research and have been described as the “building blocks” of theory. A “good definition” was defined as “a concise, clear verbal expression of a unique concept that can be used for strict empirical testing (p. 654).” Wacker (2004) argued that definitions must be carefully designed to represent the abstract concept clearly, and clear definitions lead to better conceptual characteristics and, ultimately, meaningful, statistically valid measures. The procedure of developing a “good” theory is firstly defining concepts (who and what a conceptual definition is) and domain (the when and where the conceptual definitions apply); then defining causal relationships (how and why the conceptual definitions are related to measurements); and lastly making predictions (what should, could, and would happen when formal conceptual definitions are used for measurement). Following this procedure, Wacker came up with eight rules of formation for “good” formal conceptual definitions (see Table 2). Suddaby (2010) argued that it is problematic when authors use terms described as constructs and assume that the reader understands the intended meaning since any word has both a denotative and connotative meaning. Therefore, he proposed three characteristics of a good definition (see Table 3) that are intended to help fix the meaning of the theoretical term as offering definitions of key terms and constructs in research is a bare minimum standard of construct clarity. From a more philosophical perspective, Robinson (1950) argued that concepts are related to definitions. In fact, there is no real difference between defining a word and providing an analysis of a concept. Nevertheless, despite the primordial importance of concepts or the definition of a concept, social scientists have received relatively little attention over the years (Goertz, 2006). It is generally agreed that if a concept is not formally defined, statistical analyses of causal characteristics and

**Table 1**  
Comparison between qualitative and quantitative content analysis.

Category	Qualitative Content Analysis	Quantitative Content Analysis
Definition	“A method for systematic and rule-guided classification and description of text material considering latent contents and contexts.” (Mayring, 2014) “A research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns.” (Hsieh and Shannon, 2005)	“A research technique for the objective, systematic, and quantitative description of the manifest content of communication.” (Berelson, 1952)
Objective	“To search for multiple interpretations by considering diverse voices (readers), alternative perspectives (from different ideological positions), oppositional readings (critiques), or varied uses of the texts examined (by different groups).” (Krippendorff, 2004)	To make “replicable and valid inferences from texts ... to the contexts of their use.” (Krippendorff, 2004)
Purpose	Focuses on the characteristics of language as communication with attention to the content or contextual meaning of the text; Developing themes to capture the underlying meanings of data portions (latent meaning-based purpose). (Schreier, 2012)	Develop numerical data that can be studied statistically; Developing themes based on how many times the relevant information occurs in the data (frequency-based purpose). (Schreier, 2012)
Goal	To identify important themes or categories within a body of content, and to provide a rich description of the social reality created by those themes/categories as they are lived out in a particular setting.	To reliably code the presence or absence or frequency of occurrence of an element of content.
Type	Thematic	Referential
Result	Credible & context-bound results (Schreier, 2012)	Reliable & context-free results (Schreier, 2012)
Ontological roots	Interpretativist	Positivist in its orientation
Epistemological roots	Constructivist	Objectivist
Criticized for	Highly subjective character and difficulties with controlling the impact of the coder’s personality. (Oleinik, 2011)	The exclusive reliance on frequencies makes the humanities and social sciences a province of the natural sciences missing syntactical and semantic information embedded in the text. (Weber, 1990)

measures cannot lead to a good measurement instrument (Bollen, 2014).

Gerring (1999) argued that a concept consists of three elements: (a) the events or phenomena to be defined (the extension, denotation, or definiendum), (b) the properties or attributes that define them (the intension, connotation, definiens, or definition), and (c) a term covering both *a* and *b*. The goodness in concept formation could not be reduced to “clarity,” to empirical or theoretical relevance, to a set of rules, or to the methodology particular to a given study. Instead, the conceptual adequacy should be perceived as an attempt to respond to a standard set of criteria, whose demands are felt in the formation and use of all social science concepts. He provided a complete and reasonably concise framework for explaining the process of concept formation within the social sciences and proposed that concept formation is a highly variable

**Table 2**  
Rules for conceptual definitions (adapted from Wacker, 2004).

#	Rules
1	Definitions should be formally defined using primitive and derived terms.
2	Each concept should be uniquely defined. The formal conceptual definitions denotation matches as closely as possible match its connotation.
3	Definitions should include only unambiguous and clear terms.
4	Definitions should have as few as possible terms in the conceptual definition to avoid violating the parsimony virtue of “good” theory.
5	Definitions should be consistent within the field. Formal conceptual definitions should be similar as possible between studies.
6	Definitions should not make any term broader.
7	New hypotheses cannot be introduced in the definitions.
8	Statistical tests for content validity must be performed after the terms are formally defined.

**Table 3**  
Guidelines for conceptual clarity (adapted from Suddaby, 2010).

#	Guidelines
1	Offer definitions of key terms and constructs.
2	The definition should capture the essential properties and characteristics of the concept or phenomenon under consideration.
3	A good definition should avoid tautology or circularity.
4	A good definition should be parsimonious.

process involving trade-offs among these eight demands. The term “concept” refers to the end product of “conceptualization.” Gerring also argued that the process of conceptualization is moving from definition to measurement and back to the definition.

**4. Research design and methodology**

Research design is a central activity in organizing how to conduct

research. Only if researchers understand the design options and procedures that accompany their methodological choice, the research result would have great promise for addressing the proposed research questions. DT is constantly debated in the ontology. The best method is the one that solves the problem of not having a unified view of DT’s fundamental attributes. Hence, we applied a pragmatism paradigm to tackle the ambivalent issues of DT.

Taken together with the secondary data analysis and preliminary data collection, we used an embedded research design and proposed an eight-step approach that is mainly a qualitative analysis of the existing definitions followed by a short survey to collect feedback from experts in the field. Our proposed approach, based on the combination of existing approaches, was developed in order to strengthen as much as possible the scientific rigor of our approach and to address some of the limitations of using just one or a few of these distinctive approaches. The process of developing a unified definition consists of four stages: definition collection, definition analysis, unified definition creation, and unified definition evaluation (see Fig. 1).

**5. The unified definition development**

This section presents the process of DT unified definition development and discusses the issues that must be addressed in the existing definitions in detail.

**5.1. Definition collection**

Understanding how the concept has been previously discussed in the literature is vital to develop a unified definition. Therefore, the first step to develop a unified definition is obviously to collect existing definitions from the extant literature.

- Step 1: Collect definitions from extant literature

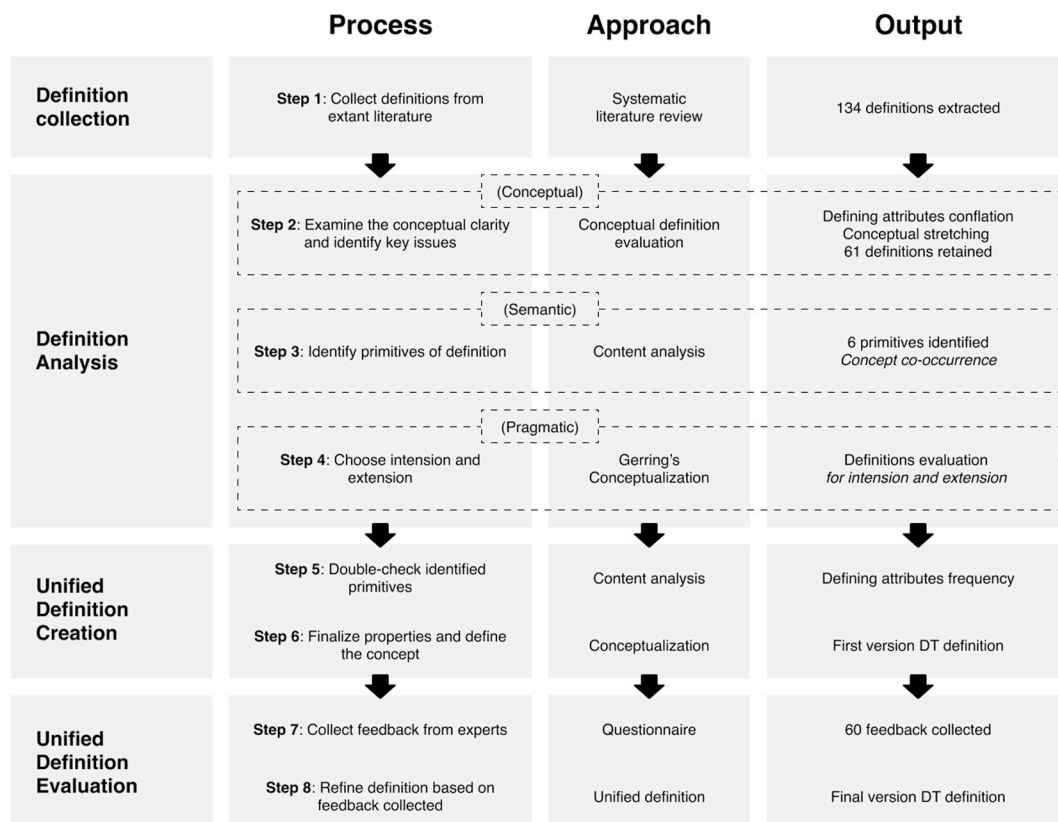


Fig. 1. Theoretical approach and process to develop a unified definition.

To reduce bias and random error that can occur in descriptive literature reviews (Cook et al., 1997; Fu et al., 2018) and cover an extensive range of datasets to collect as many definitions as possible, we adopted a systematic literature review (SLR) approach to search for the existing definition of DT in the SCOPUS and EBSCO databases. For clarification of the search criteria and the identification of the source, we applied an adapted PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines to identify the qualified articles (See Fig. 2). The extraction of the dataset was conducted at the end of the year 2019.

An initial search for “digital transformation” yielded to 2520 peer-reviewed documents on SCOPUS and 4361 on EBSCO. We focused on peer-reviewed journal articles and conference papers to ensure a higher degree of quality control can be reached and to generate DT definitions from both academia and practice. The document search timeframe was limited from 2000 to 2019 since the first use of the term DT was attributed to the year 2000. The selected documents were written in English to avoid wrong interpretation. With the exclusion and inclusion criteria in Table 4, the search process resulted in a total of 1744 articles from SCOPUS and EBSCO databases after duplicates were removed.

For the second search, we used additional criteria to narrow down the articles containing “digital transformation” in the topic (title, keywords) and the subject term. With the criteria shown in Table 5, the search resulted in a total of 371 articles from the SCOPUS and EBSCO databases after duplicates were removed. Out of the 371 articles, only 305 were reviewed to extract DT definition. Since the full text of 66 articles were not available as the library of the authors has no access in full-text format, or the holdings are unclear for these articles, or the articles are not published in open access journals indexed by SCOPUS. Hence, to avoid taking the potential risk of missing any key definitions in the papers (without full-text access) from the SCOPUS and EBSCO databases, we extended the search query in Google Scholar through a backward and forward reference search up to 354 articles while reading the downloaded full-text papers in PDF format. At this time, apart from conference materials and journal papers, the articles also included highly cited professional papers (e.g., industrial reports) and government reports as we were interested in both academic and practitioner opinions. We found 146 DT definitions in the literature, excluded the definitions that are just citations to other authors, and extracted 134 definitions to be analyzed. Definitions extracted from these papers have reached a saturation point in our analysis, which means the potential definitions in some articles that we have no access to the full-text can be considered as neglectable for developing the unified definition. It is interesting to point out that only 37% of papers (134 definitions out of 354 articles) provided a definition of DT, even though it is one of the

keywords in the paper.

## 5.2. Definition analysis

### 5.2.1. First level – the conceptual analysis

The first level of analysis underlines the conceptual aspect of definitions. Following the rules for conceptual definitions proposed by Wacker (2004) and the guidelines for conceptual clarity recommended by Suddaby (2010), we analyzed definitions on a conceptual level and evaluated existing definitions against the conceptual clarity challenges.

- Step 2: Examine the conceptual clarity and identify key issues

We carefully read through all definitions and scrutinized them closely to identify conceptual clarity and essential aspects of each definition. Two significant issues that must be addressed were identified at this stage: both the academic and practitioner’s research on DT, to some extent, run the risk of defining attributes conflation and conceptual stretching.

### 5.2.2. Issue 1: Defining attributes conflation

When the attribute is conjoined with attributes that are manifestations of a different overarching attribute, it will give rise to the problem of conflation, which is contrary to the basic rules of conceptual logic (Munck and Verkuilen, 2002). For example, based on the definitions extracted from the extant literature, we found two highly cited groups of similar definitions with a conflation problem between the concept of DT and its outcome. The first group (See Table 6) defined DT as “the use of technology to radically improve the performance or reach of enterprise” (George Westerman, Calm ejane, Bonnet, Ferraris and McAfee, 2011, p. 5), and the second group (See Table 7) defined DT as “the use of new digital technologies to enable major business improvement” (Fitzgerald et al., 2014, p. 2) with modified examples of what kind of digital technologies to use and business improvements to achieve. These two groups of definitions are somehow connected as they both emphasized the use of technologies and the improvement. Other related definitions such as “adopting business processes and practices to help the organization compete effectively in an increasingly digital world” (Kane, 2017, p. 2), “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, p. 124) have conflated the concept and its impacts. We noticed that these definitions shared co-authors and mainly published in MIT Sloan Management Review or MIS Quarterly, which more or less indicated that they are working in the same domain.

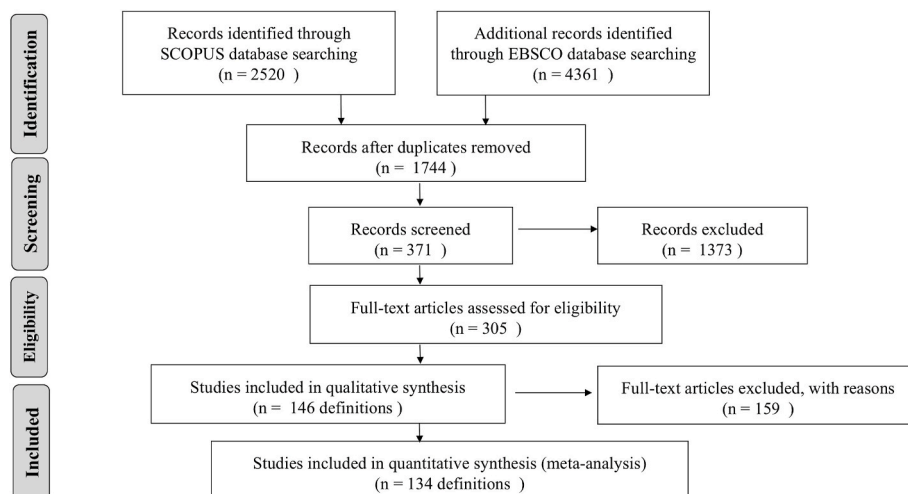


Fig. 2. PRISMA process and output.

**Table 4**

The 1st search exclusion and inclusion criteria and results.

SCOPUS database			EBSCO database		
Criteria	Filters	Documents	Criteria	Filters	Documents
Keyword	"digital transformation"		Keyword	"digital transformation"	
Restriction	None	2520	Restriction	Peer-reviewed	4361
Year	2000–2019	2397	Year	2000–2019	4335
Document type	conference paper, article, conference review	2038	Source type	academic journals, conference materials	4108
Source type	conference proceedings, journals	1738	Subject	"digital transformation"	1133
Language	English	1603	Language	English	504
			Duplicates removed (in EBSCO)		396
Duplicates removed (in Endnote)		1576	Duplicates removed (in Endnote)		168
Total documents					1744
Overlap in SCOPUS and EBSCO database					255

**Table 5**

The 2nd search exclusion and inclusion criteria and results.

SCOPUS database			EBSCO database		
Criteria	Filters	Documents	Criteria	Filters	Documents
Keyword	"digital transformation"		Keyword	"digital transformation"	
Restriction	Title, author's keywords	460	Restriction	Title, subject terms, peer-reviewed	374
Year	2000–2019	442	Year	2000–2019	372
Document type	conference paper, article	420	Source type	academic journals, conference materials	353
Source type	conference proceedings, journals	359	Subject	"digital transformation"	302
Language	English	338	Language	English	114
Duplicates removed		336	Duplicates removed		35
Total documents					371
Overlap in SCOPUS and EBSCO database					81

**Table 6**

The first group definition with conflation problems.

Authors	Definition of Digital Transformation
George Westerman et al. (2011)	The use of technology to radically improve the performance or reach of enterprise.
(Westerman, Bonnet and McAfee, 2014)	The implementation of innovation and new digital technologies to effect business improvements in an organization.
Bekkhuis (2016)	The use of digital technologies to radically improve the company's performance.
Gruman (2016)	The application of digital technologies to fundamentally impact all aspects of business and society.

Another important issue refers to conceptual stretching, the distortion that occurs when a concept does not fit the new cases (Collier and Mahon, 1993; Sartori, 1970). Using terms to broaden the definition's connotations to include unspecified properties, while leaving the denotation unchanged is called "concept stretching" (Chimezie and Osigweh, 1989). Concepts are routinely stretched to cover instances that lie quite a bit outside their normal range of use (Gerring, 1999). It can occur as individual researchers try to "enrich" a concept (John G Wacker, 2004), and it is a practice where authors choose a strategy of least resistance by adapting existing terms to new situations for which they were not designed or suited (Buller and Gamble, 2002). However, whatever the exact reasons, a lack of thought concerning why we need new terms and a lack of precision concerning the language we employ, can lead to more of our concepts becoming "essentially contested" than is necessary (Connolly and Bruner, 1974). Academics working on the same subject may talk past each other as they employ different words to study the same phenomena. As a result, theoretical knowledge in this area will fail to accumulate (Gerring, 1999) since the concept begins to mean everything and, therefore, nothing if it is stretched too far (Steiner, 2008).

Thus, 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

**Table 7**

The second group definition with conflation problems. Issue 2: Conceptual stretching.

Authors	Definition of Digital Transformation
Fitzgerald et al. (2014)	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).
Brown et al. (2014)	DT encompassing everything from the cultural and organizational changes required to the related use of new digital technologies in order to enable major improvements – such as enhancing user services, streamlining operations or creating entirely new services.
Piccinini et al. (2015)	DT involves leveraging digital technologies to enable major business improvements, such as enhancing customer experience or creating new business models.
Horlacher & Hess (2016)	The use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models.
Paavola et al. (2017)	The use of digital technology, in order to enable major business improvements in operations and markets such as enhancing customer experience, streamlining operations or creating new business models.
(Chanias, 2017)	The extended use of advanced IT, such as analytics, mobile computing, social media, or smart embedded devices, and the improved use of traditional technologies, such as enterprise resource planning (ERP), to enable major business improvements.

theoretical vacuity and practical confusion. For example, DT is supposed to explain the process of change as it covers the use of digital technologies to achieve something. It affects an individual organization, the business network, the industry, the society, even the wider world in an integrated way. However, using modernization to define DT is stretching it to mean any societal modernization that is taken to be associated with "the evolutionary social change toward increasing differentiation of structure and increasing specialization of function (Levy, 1966; Smelser, 2013)", "the emergence of new forms of integration, evolutionary

‘upgrading,’ and an increasingly generalized adaptive capacity of societies (Marsh, 1967)”, or “the extensive use of inanimate sources of power for economic production, and all that entails by way of organization, transportation, communication and so on (Moore, 1963).” Other examples, such as using consumerization, evolution, automation, or investment as a central category to define DT, would stretch the concept by adding a series of attributes to make it broadly applicable. This kind of definition might be driven by many reasons, such as the shifting focus of interpretation, the association of buzzword, or desire of parsimony, etc.

Apart from these two big issues, we also took into consideration other criteria provided by Wacker (2004) and Suddaby (2010) and removed inadequate definitions (examples see Table 8) that went against conceptual clarity. We believe that some definitions challenge more or less conceptual clarity, but they still add value to understand DT better; consequently, they were not crossed out. The minor discrepancies between the two authors were resolved by evaluating definitions together again. As a result of this process, 42 academic definitions and 19 practitioner definitions (total 61) were retained out of the 134 identified in the previous step.

The second level of textual analysis emphasizes on a semantic aspect of definitions. We began with qualitative content analysis and in-depth exploration of the definitions using semantic decomposition (Akmajian et al., 2017), a process that aims at breaking down groups of words, single words or even morphemes into series of primitives, to familiarize ourselves with the central rhetorical figures and bring rhetoric’s taxonomy to bear in the construction of coding schemes. Then, we used quantitative content analysis to find the co-occurrence of the codes to better understand the interrelationship among key concepts of definitions, instead of only looking at every single word.

• Step 3: Identify primitives of definition

We took extant DT definitions and broke them down into their constituting parts based on grammatical analysis principles. In other words, by separating verbs from nouns and adjectives. Each part was then assessed based on its semantic purpose within the definition at hand. The primitives that represent the main overarching features of DT definitions were coded. The coding scheme emerges in the process of analysing existing definitions, instead of pre-defined ones. Each coding scheme should have clear explanations, easy-to-follow instructions, and unambiguous examples. Note that to increase the accuracy and confidence in the coding process’s reliability, co-authors independently evaluated each definition and compared their results. The minor discrepancies that existed between the coders were resolved by evaluating definitions together until coming to a consensus. All of these features mentioned above promote the reliability of the coding, ensuring all coders will code the same item in a uniform way or that a coder will code the same item the same way at different points in time (M. D. White and Marsh, 2006). In this sense, we identified six primitives: (1) nature, i.e., the reality of DT; (2) scope, i.e., the extent of the changes taking place within the target entity in terms of its nature, outcome, and impact; (3) target entity, i.e., the unit of analysis affected by DT; (4) means, i.e., the methods involved in creating the change within the target entity; (5) expected outcome, i.e., the consequence of DT that relate to processes, offerings, changes in processes, and the quality of the entity’s relationship with others such as competitiveness, advantages, efficiency; and (6) impact, i.e., the non-quantifiable long-term effects that the change may have, for example, value creation. We believe these six primitives have reached the saturation point to cover all aspects of the DT definitions.

5.2.3. Third level – the pragmatic analysis

Finally, the last level of definition analysis focused on the pragmatic aspect of the definition. The first two levels of analysis helped us get familiar with the existing definitions. However, the third level was the most challenging task to illustrate the definitional diversity clearly and

**Table 8**

Definitions with conceptual clarity challenges. Second level – the semantic analysis.

Authors	Digital Transformation Definition	Conceptual Clarity Challenge (s)
Stolterman & Fors (2004)	The changes that the digital technology causes or influences in all aspects of human life.	• Vague term: or • Conflation between the concept and its impacts
(White, 2012)	The arises from the blending of personal and corporate IT environments, often referred to as the consumerization of IT.	Conceptual stretching to consumerization
McDonald & Rowsell-Jones (2012)	DT goes beyond merely digitizing resources and results in value and revenues being created from digital assets.	A vague definition with comparative words: goes beyond
Mazzone (2014)	The deliberate and ongoing digital evolution of a company, business model, idea process, or methodology, both strategically and tactically.	• Conceptual stretching to evolution • No means and outcome
Iansiti & Lakhani (2014)	The digitization of previously analog machine and service operations, organizational tasks, and managerial processes. It changes a business model is in two ways: how the organization creates value for its customers (the customer value proposition) and how it captures that value (how it makes money).	• Unclear term: digitization • Comparative definition: previously
Betz et al. (2016)	The increasing automation of business undertakings, practices, procedures, and models in response to the increasing influence and opportunities of information and computing technologies.	Conceptual stretching to automation
Herbert (2017)	A company’s ability to react and successfully utilize new technologies and procedures – now and in the future.	A vague definition to capture the essential characteristics of the phenomenon by defining it as an ability
Gaivoronskii et al. (2017)	DT refers not only to evolutionary but revolutionary changes in industries and technologies.	Ambiguously defined using opposite attributes
Rowe (2017)	The investment in people and technology to drive a business that is prepared to grow, adapt, scale, and change into the foreseeable future.	• Vague definition to capture the essential characteristics of the phenomenon by defining it as investment • Conceptual stretching to investment
Legner et al. (2017)	DT is evident in numerous societal areas, such as substantial IT-induced changes in political decision-making, judicial frameworks, and related to supply and demand in labor markets.	• Reality statement than a definition • Conflation between the concept and its expected outcome
Leodolter (2017)	DT is defined as a societal meta-development.	A parsimonious definition
Andriole (2017)	DT is a planned digital shock to what may be a reasonably functioning system.	A vague definition to capture the essential characteristics of the phenomenon by defining it as digital shock
Ismail et al. (2017)	The process through which companies converge multiple new digital technologies, enhanced with ubiquitous connectivity,	• Unclear term “new digital technologies” and “ubiquitous connectivity” • Conflation between means and the expected outcome

(continued on next page)

Table 8 (continued)

Authors	Digital Transformation Definition	Conceptual Clarity Challenge (s)
	with the intention of reaching superior performance and sustained competitive advantage, by transforming multiple business dimensions, including the business model, the customer experience (comprising digitally enabled products and services) and operations (comprising processes and decision-making), and simultaneously impacting people (including skills talent and culture) and networks (including the entire value system).	<ul style="list-style-type: none"> <li>• Lack of parsimony</li> <li>• Defining with examples</li> </ul>
Hartl & Hess (2017)	The IT-enabled change in organizations through digitalization of products, services, core processes, customer touch points and business models. It distinguishes itself from previous IT-enabled business transformations in terms of velocity and its holistic nature.	<ul style="list-style-type: none"> <li>• Unclear term: digitalization</li> <li>• Tautology: transformation</li> <li>• Comparative definition: previous IT-enabled business transformations</li> </ul>
Solis (2017)	The investment in and development of new technologies, mindsets, and business and operational models to improve work and competitiveness and deliver new and relevant value for customers and employees in an ever-evolving digital economy.	<ul style="list-style-type: none"> <li>• Unclear term: new technologies</li> <li>• Conflation between the concept and its expected outcome</li> </ul>
Mićić (2017)	The integration of digital technology into business that results in, sometimes fundamental, changes in business operation and delivery of value to customers.	<ul style="list-style-type: none"> <li>• Vague term: sometimes</li> <li>• Conflation between the concept and its impacts</li> </ul>
Al-Ruithe et al. (2018)	DT enables enterprises to improve operational efficiencies and organizational performance, and blend digital and physical business and customer experiences.	Conflation between the concept and its expected outcome
Bloomberg (2018)	The customer-driven strategic business transformation that requires cross-cutting organizational change as well as the implementation of digital technologies. DT requires the organization to deal better with change overall, essentially making change a core competency as the enterprise becomes customer-driven end-to-end.	<ul style="list-style-type: none"> <li>• Tautology: transformation</li> <li>• Conflation between the concept and its prerequisite</li> </ul>
Kempegowda & Chaczko (2019)	The adoption of technologies, and its capabilities to digitize organizational assets.	An ambiguous definition refers to digitization
Van Veldhoven & Vanthienen (2019)	The continuously increasing interaction between digital technologies, business, and society, which has transformational effects and	Defined circularly between the concept effects and its impact

Table 8 (continued)

Authors	Digital Transformation Definition	Conceptual Clarity Challenge (s)
NCMM (2020)	increases the change process's velocity, scope, and impact. DT involves integrating digitalized processes to achieve enterprise-wide automation, modernization, and previously unattainable outcomes.	Conceptual stretching to modernization

to make a systematic evaluation of the concept that helps to decide the intension and extension for a unified definition. Gerring (1999) set up eight criteria for conceptual goodness, namely: familiarity, resonance, parsimony, coherence, differentiation, depth, theoretical utility, and field utility.

- Step 4: Choose intension and extension

In this step, we carefully applied Gerring's eight criteria to the remaining definitions and certain problems become immediately apparent. The first criterion, *familiarity*, refers to the degree to which a new definition, "makes sense" or is intuitively "clear," to which it conforms or clashes with established usage. A high degree of familiarity is obtained by adhering to words and phrases that make sense and by not changing the meaning of these words and phrases to avoid misunderstandings when other relevant academic communities use the concept. The second criterion, *resonance*, requires a concept to include a term that creates a "cognitive click" and is easy to remember. The third criterion, *parsimony*, refers to the length of the definition. It requires the formal definition of a concept to be as concise and straightforward as possible. The first three criteria can be said to affect whether or not a new concept will become popular, and whether or not other scholars will use the concept because it is clear and easy to use. As shown in Table 8, many definitions use unclear terms to define DT at the moment, and the parsimony of extant definitions varies. Nevertheless, DT still creates cognitive clicks for most people. The most easily apparent argument in favor of DT is that nowadays, most people can find elements of the DT concept that align intuitively with situations in their everyday life and work environment. Thus, DT meets these criteria, which appears to be the main reason it gained immense popularity quickly. The fourth criterion, *coherence*, refers to the extent to which the properties of a concept (intension) and the phenomena it covers (extension), "belong to one another" or are logically related. It refers to the degree of internal coherence between the different attributes and the actual, observable components of the concept. The fifth criterion, external *differentiation*, which can be contrasted with the concept's internal coherence, refers to the degree of boundedness from other neighboring concepts. It is about establishing the boundaries or limits beyond which a concept should not be extended. A highly differentiated concept is easily recognizable and easy to separate from other concepts. Attention to this variable is essential if we are to avoid the problem of concept stretching outlined in the second level of analysis in this paper. The concept of DT is reasonably coherent as it dovetails with connotations of "transformation," but fail to attain a high degree of differentiation as it has been used interchangeably with some other concepts. The sixth criterion is *depth*. Concept formation is somewhat about grouping characteristics that are normally found under one heading. A deep concept has several attributes that need not be part of the definition but are attributes that are associated with the concept. We need to judge the utility of a concept based on the number of properties it can "bundle together," meaning the higher the number of properties shared by the phenomena in the extension, the higher the "depth" of a concept is. The higher the depth, the better. DT is indeed a deep concept, as it has been used to explain a



vast number of phenomena, and most people, therefore, associate several outcomes to the concept. However, this depth is probably mainly a consequence of the undifferentiated nature of this concept, which allows many phenomena covered by other fields to be appropriated by a DT agenda. The seventh criterion, *theoretical utility*, refers to the concept's usefulness in theory formulation: does the concept help formulate new theories or refine existing? How well does the concept add new knowledge to an existing field? The eighth criterion, *field utility*, refers to the disruption that concept formation can do to the rest of the "semantic field" in which academics are working. Defining a concept is somewhat about establishing relations with other terms. A concept with a high field utility does not damage the field it enters; it does not diminish the conceptual quality of existing concepts in the field. Regardless of conceptualization, DT has a very high theoretical utility in certain aspects since it has been used in many disciplines in the extant literature. However, if DT really is either change, process, strategy, or technology, the concept has low field utility as it destroys the differentiation of existing concepts. On the contrary, if DT is an integrated amalgam of change, process, strategy, and technology, and these components form an internally coherent concept, it would be something different from existing concepts and would not destroy existing concepts. Moreover, it would constitute a concept that fulfills most criteria quite well. Thus, in a strict sense, only the broad conceptualization meets the criterion of field utility. A different and unified DT definition from the existing ones is needed if the broad conceptualization is to be differentiated from neighboring concepts and retain its field utility. In short, several conclusions emerge from this lengthy evaluation. It is noteworthy that the concept of DT performs quite well on several criteria: It is familiar and resonant and seems to sufficiently parsimonious in some cases and high theoretical utility. As noted above, it is, therefore, no wonder that the concept gained popularity so quickly, although the popularity may be unwarranted. In particular, problems identified in terms of differentiation are potentially devastating. And such conclusions provide valuable insights on the trade-offs while developing the unified definition.

We then analyzed the identified primitives deeply based on their frequency and Gerring's conceptualization theory to choose the appropriate intension and extension. To clearly define digital transformation, we illustrate some core attributes in detail here as an example of how we understand the properties needed to construct our definition by analyzing these two terms "digital" and "transformation" separately.

The term "digital" refers to digital technologies that defined as the combinations of information, computing, communication, and technologies (Bharadwaj et al., 2013). Except for any new upcoming digital technology, to be specific, the extant digital technologies can be classified as primary digital technologies (e.g., mobile, social, cloud, Big Data, and IoT) and secondary or emerging (e.g., 3D printing, wearables, virtual and augmented reality, artificial intelligence, drones and robotics, and deep learning algorithms) as incumbent digital technologies can be observed according to the strength of affiliation with the traditional corporate IT (Spremic, 2017); or novel IT delivery models (e.g., cloud/fog computing), pervasive computing (e.g., internet of things, cyber-physical systems), mobile computing, blockchain, and tools to support (real-time) data science (e.g., big data, machine learning) and so on (Heilig et al., 2017). The term "transformation" has become a popular, overused, and misunderstood word in the 21st century, and people often confuse transformation with any kind of change, technology breakthrough, innovation, process improvement, or transition (Daszko and Sheinberg, 2005). However, etymologically, transformation means "change in shape." To transform means to change in form, appearance, or structure or to create something new that has never existed before. While all transformation is change, not all change is transformation. Transformation needs to meet the criteria of the three "Bs" — it must be Big, must be Bold (i.e., the intensity and degree of change involved), and lead to Better outcomes. Only if it affects a large number of people and has a significant impact on the industrial, social, and economic level, it will merit the term. Transformation is about making things better for the

majority of people, which connotes a relentless, competitive focus on excellence (Krishnadadas, 2017). DT in the organizational context can relate to another concept in the scope of change, "organizational metamorphosis," which is expected to occur at varying intervals, was defined as "transformations which sharply distinguish one period of organizational history from another" (Starbuck, 1967). A well-known analogy, in this case, would be transforming from a caterpillar to a butterfly. An entity evolves through convergent periods punctuated by reorientations (or recreations), which demarcate and set bearings for the next convergent period (Tushman and Romanelli, 1985).

To recapitulate, making a good concept of digital transformation requires differentiating it from related concepts, which is one of the devastating issues identified above. We can tackle this issue by emphasizing several peripheral defining attributes beyond the core attribute of the change process. The essential attribute of DT is the change. The nature of change can help to evaluate and characterize the key attributes of DT, including whether or not the change amount to fundamental transformation underway in "going digital" based on judging if a transformation has indeed taken place or not. Several peripheral attributes concerning the scope (e.g., the nature of change with the expected outcome, and the extent of the impact) of DT add depth to the unified definition and allow its differentiation from related concepts. We carefully and precisely chose the defining attributes that best explain the notion while involving trade-offs. To better understand what DT is and is not, it is indispensable to differentiate it from other similar concepts.

Hence, defining DT as a fundamental change is significant since it allows for differentiation from other non-fundamental changes, such as digitization and digitalization. The corresponding verbs "digitize" and "digitalize" share the same etymological root "digit," which refers to convert into a sequence of digits. Aligning with what has been discussed in section 1, 2, 3.1, and 5.2, and to avoid the inconsistent and ambiguous use of similar terms, the authors have chosen to use the following definitions: We refer digitization to highlight the transition from analog to digital services with a 1:1 change in the delivery more and the addition of a technological channel of delivery (Mergel et al., 2019); and digitalization to emphasize the use of digital technologies and data (digitized and natively digital) in order to create revenue, improve business, replace business processes (not simply digitizing them) and create an environment for digital business (i-scoop, 2016) in this paper. Digitization reduces paper clutter and improves efficiency by making information easier to store, search, and find, whereas digitalization involves using digital technologies to automate processes for better outcomes and to optimize value (NCMM, 2020). Therefore, although the scope of a fundamental change like DT is found to have affected its dynamics, the essential attribute of the change process remains constant.

Another differentiation we may draw attention to is the scope of improvement and the different end-results that digitalization and DT would create. There are many ways to understand the concept of improvement in different domains. However, we acknowledge two types of improvement as an expected outcome of the change process: incremental and radical improvement. They have been extensively discussed from an innovation perspective concerning a continuous or discontinuous improvement aspect; and widely considered from a reengineering perspective such as business process reengineering (BPR), the Japanese Kaizen and Kaikaku models in the business management domain. The basic characteristics of incremental improvement imply small-step improvements and continuous process-oriented modification, whereas radical improvement is characterized by an episodic occurrence, intending dramatic results (Yamamoto, 2010). Incremental improvement focuses on smaller solutions and actions that allow for completion via small steps, not leaps and bounds—such as automation, streamlining, optimization, reengineering, and cost reduction, which is achievable by digitalizing business activities and operations. In other words, digitalization is mainly focused on the work at the operational level, whereas DT emphasizes the results at the strategic level. An entity

might undertake a series of digitalization projects, ranging from retraining workers to use digital technologies to automate processes and work routines. Conversely, DT is not something that an entity can implement as a project. It entails frame-breaking and the destruction of some elements of the system in different entities (e.g., organization, business network, industry, society) through simultaneous initiatives on many fronts, and often in a relatively short space of time. It requires the use of digital technologies to radically align silos to produce dramatic changes in offerings and performances. Therefore, aligning with the nature of transformation, we would define DT as a fundamental change to a process utilizing digital technologies that result in an improvement to all stakeholders so dramatic that demand for the new way of working or thinking, such as new digital platforms, new methods, new cultures, new strategies, and new structures. Note that digital technologies play a critical role in radical improvement, but overlooking it could result in failure in DT as they are the means or an enabling part of the whole change process.

The last differentiation is that the impact of digitalization and DT varies, even though there might be an overlap of the target entity between them as the unit of analysis affected could both refer to the change in the organization. A similar example is that an invention does not become an innovation until it has processed through production and marketing tasks and is diffused and accepted into the marketplace (Freeman, 1989; Garcia and Calantone, 2002; Layton, 1977; Schumpeter, 1934). It is critical to elucidate that a non-fundamental change does not become a transformation until it has processed through the adoption of digital technologies and generated non-quantifiable long-term effects that create entirely new value for stakeholders or lead to an entirely new market. The change enabled by digital technologies only in a small scale setting that makes no direct economic contribution, meaning adding values to the entity in a quantifiable way for the entity itself, should be considered as digitalization. In other words, notwithstanding its target entity is organizational, industrial, or societal, the core attributes of DT do not change.

5.3. Unified definition creation

Bearing all issues mentioned earlier, we argue that digital transformation is a rather complex concept, but it should be used with care. We believe a universal and comprehensive understanding of DT would help academics to develop DT theory, define and test relationships, and help practitioners to describe various strategizing and organizing activities on DT metrics consistently. Wacker (1998) argued that all theory (both good and bad) has four essential earmark properties: formal conceptual definitions, theory domain, explained relationships, and predictions. Gerring (1999) argued that standards in differentiating good concepts from bad ones are assessable in terms of the goals achieved by a given concept relative to that which the concept might otherwise attain with a different choice of words, properties, or phenomena. That is to say, choices concerning the definition, intension, and extension of a concept will involve trade-offs, which may very well result in less than perfect outcomes (Buller and Gamble, 2002).

- Step 5: Double-check identified primitives

Before defining DT, we laid stress on screening the remained definitions again, going deeply to each coding scheme qualitatively, double-checked the primitives regarding intension and extension of DT, and then identified the core and peripheral defining attributes based on the frequency of codes quantitatively (see Table 9). Different research domains (e.g., change management, innovation management, strategic management, Information Systems Management, process management, and organizational change) that provide necessary and sufficient conditions for locating examples of DT were also identified. This reminds us that as DT falls into an interdisciplinary subject, we should ground our work in the established knowledge bases, rather than simply to frame it

**Table 9**  
Six primitives including core and peripheral defining attributes.

Primitives	Core attributes	Peripheral defining attributes	Frequency	
Nature	Change		45	
	Process		25	
	transformation		23	
Scope		Fundamental (nature)	14	
		Radical (outcome)	10	
		Significant (impact)	6	
Target entity	Organization		30	
	Business network		15	
	Industry		9	
	Society		7	
Means	Resources	Digital technologies	45	
	Capabilities	Human resources/people	20	
		Financial resources	5	
		Strategy	21	
		Digital capabilities	8	
	Expected outcome	Improvement	Offerings	20
		Change in	Customer experience	19
Innovation		Performance	18	
		Efficiency	13	
		Competitive advantage	6	
		Ubiquitous connectivity	5	
		Business model	39	
		Processes	21	
		Operations	19	
		Structure	7	
		Culture	6	
		Mindset	4	
		Management	4	
Impact	Value	Governance	3	
	Stakeholders (customers, employees, partners, etc.)	Business model	9	
		innovation		
		Innovative and agile	5	
		Digital innovation	4	
			29	
			24	

within contemporary fads and fashion (Tidd and Bessant, 2018).

- Step 6: Finalize properties and define the concept

To reconceptualize digital transformation, we used the identified core attributes to construct our definition and define DT as “A fundamental change process enabled by digital technologies that aims to bring radical improvement and innovation to an entity [e.g., an organization, a business network, an industry, or society] to create value for its stakeholders by strategically leveraging its key resources and capabilities.” Note that some peripheral attributes are used in conjunction with core attributes to discriminate DT with digitalization, as mentioned in step 4 in detail.

Our definition warrants four critical observations. Firstly, it can be used in a broader context, including organizational, industrial, societal contexts, as we found the target entity primitive refers to an individual organization, business network, industry, and society. Secondly, it defines DT against related concepts by depicting what DT is and what DT is not to differentiate the boundaries of DT externally. We carefully choose the combination of adjective and noun to balance the semantic space (the degree to which a concept’s definitional borders are clear) and the physical space (the degree to which a concept’s borders in time and space are clearly demarcated), without sacrificing to meet the parsimony criterion too much. Thirdly, it defines DT without using the term “transformation” to avoid tautology, which challenges the conceptual clarity. Lastly, it not only provides the core and peripheral attributes of DT but also identifies the research domains related to each level that would help to clarify the research stream for both academics and practitioners.

#### 5.4. Unified definition evaluation

Before finalizing our definition, we wanted to get some feedback from experts in the field, not as a validation mechanism, but much more to get a feeling on how this definition will resonate with them and uncover potential holes we may have missed.

- Step 7: Collect feedback from experts

Consequently, we invited 70 DT international experts based on their LinkedIn profiles, and 60 accepted our invitation to answer a quick feedback survey about our unified DT definition (response rate = 85%) (Table 10: The list of survey questions). These 60 experts came from both academia and business (14 academics, 25 practitioners, 21 pracademics), and the self-reported average expertise level was 4.5 out of 6 (See Fig. 3: Expert's average rating of the unified definition of DT). Once again, getting some constructive feedback is prioritized, rather than a significant/representative sample size here.

A post-hoc one-way ANOVA test was performed to compare the difference of the work domain groups' average scores on the feedback of the unified DT definition. Respondents were divided into three groups based upon their domain (Group 1: academics; Group 2: practitioners; Group 3: Pracademics). There was no statistically significant difference in the extent of whether the unified definition is clear ( $F(2, 57) = 1.331$ ,  $p = .272$ ), complete ( $F(2, 57) = 0.763$ ,  $p = .471$ ), relevant ( $F(2, 57) = 0.952$ ,  $p = .392$ ), useful ( $F(2, 57) = 1.428$ ,  $p = .248$ ), abstract ( $F(2, 57) = 0.901$ ,  $p = .412$ ), helpful ( $F(2, 57) = 0.642$ ,  $p = .530$ ), and differentiable DT from related concepts ( $F(2, 57) = 0.707$ ,  $p = .497$ ) for the three working domain groups as well as whether the unified definition fits the respondents' perception of DT ( $F(2, 57) = 0.780$ ,  $p = .463$ ). The result of One-way ANOVA indicated that this definition is quite unified.

- Step 8: Refine the definition based on feedback collected

Feedback from 45 respondents we collected on the open-ended questions can be divided into three categories: wording, criteria, and other perspectives.

Concerning wording, some experts suggested adding "network," "social capital," "people," "culture," and "human behavioral" in the definition. We agree that those are vital factors that lead to success in DT, but as for a unified definition, we believe it is better to keep it condensed in an abstract level by using "resources and capabilities" to include all these factors mentioned above and leave the space to develop operational definition case by case. Another critical comment refers to innovation and radical improvement. Different understandings of

innovation indicators can be found in the literature (Dziallas and Blind, 2019). Some experts argued that although DT involves innovation, they are not convinced DT has to bring innovation; or one suggested to concentrate on the radical innovation. As shown in Table 9, we mainly refer "innovation" to business model innovation, innovative and agile business, and digital innovation, which genuinely does not cover all target entities. Therefore, we agreed to modify innovation accordingly in a more precise way to describe how it involves in the change process. Some experts agreed that DT leads to a radical improvement, whereas some experts are not sure if DT should necessarily be characterized as "radical" improvement. As discussed in step 6, we believe that whether the expected outcome is "radical" should be considered as one of the key attributes to differentiate DT from digitalization. The concept of "transformation" itself has indicated the nature and scope of the fundamental change. Hence, the two processes differ according to the patterns by which the nature of change relates to the outcome produced. In essence, the improvement can either be radical (DT) or incremental (digitalization), implying either the emergence of redefining value proposition (DT) by capability-driven outcome (business model innovation, new revenue streams, radical changes in offerings, and game-changing restructure), or reinforcing an existing value proposition (digitalization) by economic-driven outcome (efficiency, cost reduction, errors elimination, and productivity) (See Fig. 4). There were several comments that refer to "stakeholders." Experts suggested emphasizing the "customer" aspect or those who are part of the operation, however, it is not the case in practice to incorporate "all" stakeholders. Acknowledging all stakeholders or a particular group of people will only cause DT to fail and never be understood or trusted. We agree with it, but we believe different stakeholders on the value chain may benefit more or less from any change, especially when taking the scope and impact of DT into consideration. Indeed, customers are an indispensable part of stakeholders, but it does not mean to create new values only for customers. It should create value for both internal stakeholders (i.e., employees, managers, owners, etc.) and external stakeholders (i.e., customers, partners, suppliers, etc.). One expert's feedback, "the biggest success factor is the ability of the human involved (internal and external stakeholders) to adapt to the new digital stimulated transformations," partially supported our views. To make it clearer, we decided to revise the unified definition into "redefine its value proposition to its stakeholders" as the value proposition is already customer-oriented. However, the top priority regarding stakeholders, in this case, should be on customers (or citizens in the case of government as the target entity), followed by employees and partners, etc.

Regarding the criteria, two things have drawn our attention: parsimony and differentiation. As for parsimony, some suggested shortening this definition by removing the last part "by strategically leveraging its key resources and capabilities," because it seems out of place or the transformation requires very often to use different methodologies, and the entity does not necessarily have this capability. Nevertheless, we believe this part is necessary to explain the second means that enable DT to happen in an entity as it included three important factors: strategy, resources, and capabilities. Apart from the use of digital technologies, we believe human resources and financial resources are also vital. DT is not only a technological shift, but a more complicated process to fully utilize all resources in the process. Moreover, many definitions ignored the financial support to make it happen. Some feedback also supported the view by stating "it captures the focus on change and improvement rather than the technology as some magical unicorn;" "transformation of any kind is metamorphosis, and that implies a reordering if the dynamics in systems in terms of second and third-order change," and the entity that truly embraces DT would "precisely go through the acquisition of dynamic capabilities and with people's support." We believe the nature of DT, as a fundamental change process, creates an impetus for the entity to implement responses to develop agility and maintain competitive advantages. Dynamic capabilities surely contribute to DT, but the role of dynamic capabilities and how it contributes to DT should

**Table 10**  
The list of survey questions.

#	Questions
1	Are you an Academic, a Practitioner or a Pracademic?
2	How would you rate your personal level of knowledge/expertise about Digital Transformation (DT)?
3	To which extent do you think that this unified definition of DT is clear:
4	To which extent do you think that this unified definition of DT is complete:
5	If incomplete, what aspect(s) might be missing?
6	To which extent do you think that this unified definition of DT is relevant:
7	To which extent do you think that this unified definition of DT is useful:
8	To which extent do you think that this unified definition of DT is abstract:
9	To which extent do you think that this unified definition is helpful in better understanding what DT really is?
10	To which extent does this definition fit your perception of DT?
11	To which extent does this definition uniquely differentiate DT from related concepts like "digitization" and "digitalization"?
12	Compared to previous DT definitions you have seen before, how will you rank this one?
13	Additional feedback/comments about the given unified DT definition?
14	If you are interested in receiving a copy of the results of this survey, please enter your e-mail address (optional).

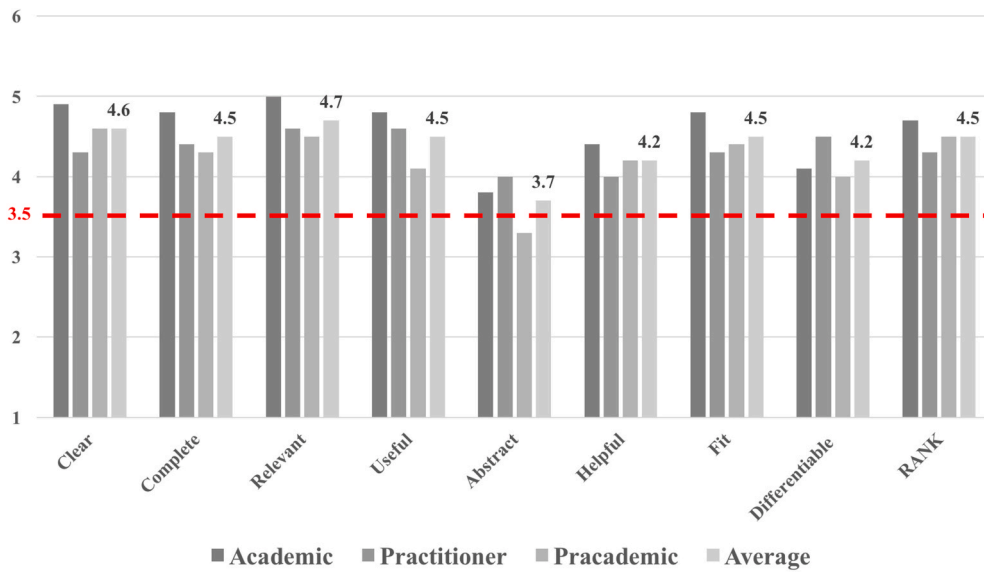


Fig. 3. Expert's average rating of the unified definition of DT.

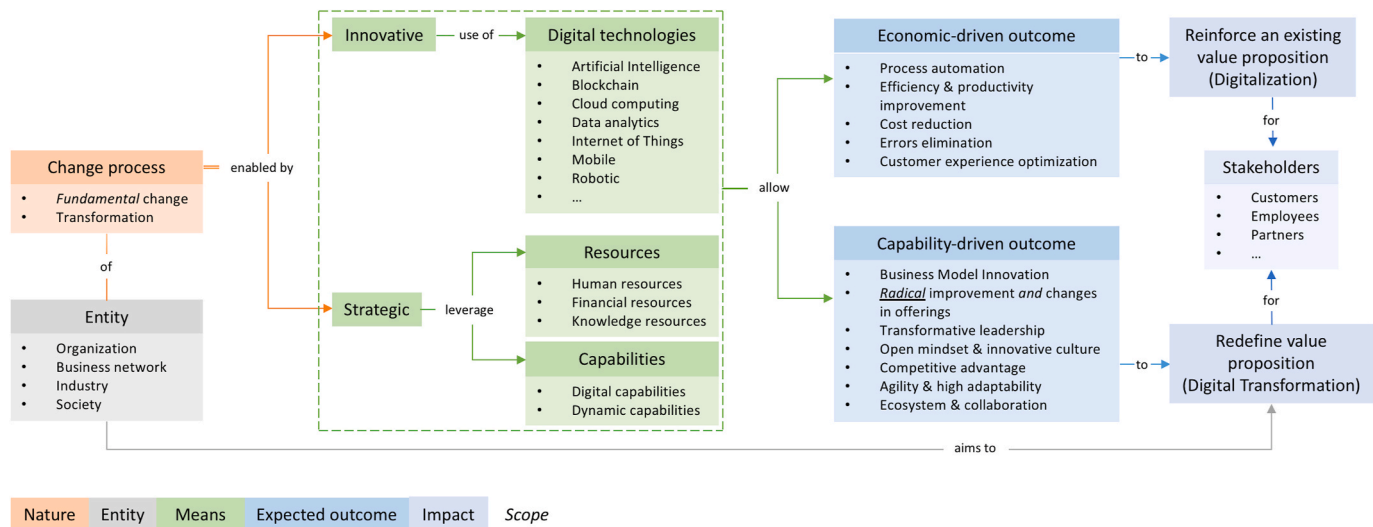


Fig. 4. Digital transformation conceptual diagram.

be examined deeply or measured in an operational definition. As a result, we think a unified definition should keep the higher abstract level of defining attributes to construct the content and logic of the definition, and sacrifice parsimony a bit, if necessary, to comprehend all core aspects. However, we agreed to put two “means” together to make it easier to read. As for differentiation, we are not repeating it again here, as we have discussed in detail above. Other perspectives such as the tension between a definition that is pitched at a sufficiently high level to embrace all aspects of the concept, and one that provides sufficient detail to deliver a clear understanding of the concept, we have been more or less discussed in the paper.

To sum up, DT encompasses many defining attributes as this notion is being socially constructed based on separate domains of knowledge as such we mentioned in section 5.3. Therefore, we broke them down and identified six primitives (e.g., nature, entity, means, expected outcome, impact, scope) that emerged from the most frequent defining attributes in each primitive. Finally, we need to connect them logically to define DT while aiming to give a systemic analysis of the term and discriminating it with similar ones. The finalized unified definition of Digital Transformation is as follows:

“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\* and redefine its value proposition for its stakeholders.” (\*An entity could be: an organization, a business network, an industry, or society.)

We drew a digital transformation conceptual diagram shown in Fig. 4 to depict the logic of six identified primitives with their defining attributes. It also pictures the building blocks of DT and key elements involved in the process of DT. We purposefully included two types of expected outcomes (e.g., economic-driven and capability-driven outcomes) associated with digitalization and DT correspondingly in Fig. 4. Because some organizations may implement digitalization projects first before achieving DT, others may manage to reach DT directly depending on the organization’s strategies and the industries they are operating in.

## 6. Discussion

Many allege the concept of “digital” and “transformation” has occurred recently in a wide variety of literature. However, what is remarkable is if such widespread alleged DT existed during the last

decade in various contexts. Is the extent of transformation, in fact, occurring? How might we distinguish “transformation” from “non-fundamental change,” and are there different types of DT? What is the true nature of change and transformation? How to explore genuinely alternative approaches to the understanding of digital change, renewal, and transformation? Indeed, transformation means different things to different people or groups, and it is not always clear what exactly needs to be transformed and why, whose interest these transformations serve, and what the consequences will be (O’Brien, 2012).

### 6.1. Theoretical discussion

“Selling” DT as something entirely new creates the risk that current research fails to build on the existing body of knowledge (Mertens and Wiener, 2018). Without taking the risk of reinventing the wheel, we would like to point out that DT comprises objectives and tasks, some of which have already been included in how information and communication technologies (ICTs) affect business concepts such as process, services, and products, how the transformative implication of ICTs across various domains, as well as business-IT-alignment in existing Information Management frameworks that subsumed under the prefix “digital,” as well as methods and contents under the suffix “transformation.” Therefore, digital transformation is accused of being the “old wine in new bottles” with topics such as ERP (Enterprise Resource Planning), which refers to the adoption of standard software packages or IT-enabled organizational change from the 1990s; BPR (Business Process Reengineering), which refers to business management initiatives striving for process efficiency supported by IT. ERP and BPR put the effort on the exploitation of IT software to improve the organization itself with a focus of internal improvement regarding effectiveness and efficiency, whereas DT refers to the innovative use of various advanced digital technologies to create value for stakeholders with both internal and external focus at a larger scale. There are overlaps between digital transformation and these well-established topic areas. However, DT also differs significantly from them in terms of the scope and other organizational change initiatives or philosophies, such as BPC (Business Process Change) and ISOT (Information Systems-enabled Organizational Change), in terms of content and order. Regarding the classification of the content of organizational change along with six categories: culture, configuration, coordination, people, information, and technology (Vollmann, 1996), as well as the three different orders of schematic change (Bartunek and Moch, 1987), BPC and BPR, represent a deterministic, exploitative type of first-order and second-order organizational change that is primarily focused on the transformation of business processes within the organizations. ISOT is more concerned about exploring second-order change through IT, but DT clearly goes beyond organizational boundaries and largely influences the whole value network of an organization (Riasanow et al., 2018). Note that technology can either (re)define value propositions to achieve the emergence of a new organizational identity in DT, or support value proposition to reinforce an existing organizational identity in ISOT. Organizations undergoing ISOT intended to increase efficiency and make work more effective or digital, but their identity claims and value propositions remain the same (Wessel et al., 2020). Besides, we also identified other newly emerging research topics in research domains such as innovation management and strategic management in section 5.3 as DT may occur across multiple dimensions and scales, and in different contexts and settings. Another critical observation mentioned in step 7 found that DT can be used in a broader context, including organizational, industrial, and societal contexts. It describes the process which leads the society from the postindustrial information society into all aspects of the “digital society” (Sikora et al., 2016). Therefore, the scope of DT is definitely different from the terms mentioned above in this section.

The challenge and need to strive for developing a sustainable nomenclature of digital-related terms and concepts mentioned in sections 2 and 3.1 is an urgent and important problem to tackle, in

particular, the difference between “digitalization” and “digital transformation.” Moreover, this problem has to be tackled scientifically and systematically based on cumulative knowledge in the literature. We will not repeat it here as we have discussed this issue throughout the paper. However, it is worth mentioning the suffix “ization” regarding digitalization to make it clearer. The creation of a concept which results in new “ization” contains its own particular hazards. Constructing a noun out of a verb in the English language by adding the suffix “ization” to the base word can have the effect of creating a double meaning (Taylor, 2000). The new term will denote the process described by the original verb and the end-state that results from the culmination of such a process (Buller and Gamble, 2002). In this sense, digitalization would come to depict a state of being digitalized and the process whereby the entities are affected by the action of “going digital.” It would be dangerous to keep the process and end-state of a phenomenon separate for such term as the suffix “ization” creates the possibility of the conflation of meaning. Therefore, it would be logical to delimit the focus of digitalization on the outcome of the implementation of digital technologies, describing the consequences the implementation may have on offerings (products and services) and the quality of the entity’s relationships with others, such as increased simplicity, efficiency, speed, competitiveness, etc. Conversely, the end-result of digital transformation is totally different. We think transformation in the context of the digital transformation which refers to a fundamental change of a whole new form, function, or structure with the adoption of digital technologies that create new value. It involves a series of rapid and discontinuous change in the entity that fundamentally alters its character and fabric, and changes in strategies, processes, operations, cultures, structures, and mindset. The punctuated equilibrium paradigm proposes that fundamental change cannot be accomplished piecemeal, slowly, gradually, and comfortably (Gersick, 1991). The continuous improvement should be viewed as “the evolution and aggregation of a set of key behavioral routines within the firm,” and not as a short-term activity only (Bessant et al., 2001). In organizational science, reorientations are relatively short periods of discontinuous change where strategies, power, structure, and systems are fundamentally transformed toward a new basis of alignment (Tushman and Romanelli, 1985).

Lastly, both definitions from academics and practitioners indicate the importance of human resources (i.e., people factor) for DT. Not only the mindset of executives (CEO, CDO, CIO) but also the commitment, skills, or innovative ideas of employees matter. The leadership teams are not necessarily made up of top managers, echoing the thought of radical improvement but is being driven by top-down initiatives and bottom-up acceptance in the organization (Stoddard et al., 1996).

### 6.2. Empirical examples discussion

To better illustrate the empirical validity of our unified definition, we selected several empirical cases across different entities (organization, business network, industry, society) to see how these real-world examples resonate with our definition. Note that DT has different levels of maturity as a changing process, considering what the entity has already achieved in terms of performing transformation efforts to adapt to an increasingly digital environment (Chanias and Hess, 2016). The cases in this section are in different maturity levels, but it does not affect us to discuss the validity of our unified definition in various businesses and industries.

Nowadays, lines defining industries are blurring (i.e., one of the impacts of DT at the industrial level). For example, Alibaba and Google look like a portfolio of businesses. Alibaba is not just an e-commerce company, but also a financial services and technology company, glued with data and analytics. Google is a multinational organization built around its hugely popular search engine, including Internet analytics, cloud computing, Web app, and browser. If you think about them on an abstract level, what they are doing resonances with our unified definition regarding how they strategically leverage their resources (e.g., align

new and enriching existing products, people, platforms) and capabilities (e.g., explore and exploit digital technologies and knowledge) to create new values and push digital transformation in the business landscape. These companies are going through DT at the organizational level to improve themselves while creating changes in the market to drive DT at higher levels. In other words, the identified target entities (*i.e.*, the unit of analysis affected by DT) are interconnected. Organizations that go through DT at the organizational level to improve themselves can affect their associated business network, pushing changes in the market to drive DT at the industrial and societal levels.

The change in business models, especially business model innovation as one of DT's critical outcomes shown in Table 9, can well explain how the use of digital technologies allows different outcomes and impacts. Disruptive digital business models (e.g., in the automobile industry being affected by Google/Alphabet, Tesla, and Apple; or new business models coming out from Amazon in the online retail industry) are good examples in this regard. Leaders in the digital economy are emerging seemingly from out of nowhere (e.g., Uber, Airbnb) (Oswald and Kleimeier, 2017). Netflix pivoted from DVD delivery to a streaming service. Large technology companies like Apple and Amazon have created new businesses to move quickly. They achieved this by strategically leveraging their resources and capabilities (means) to recreate value (impact), which allows them to adapt to changes in customer preference and marketplace dynamics.

The World Economic Forum (2017) has analyzed the impact of DT across 13 industries and five cross-industry topics. Besides, thinking about DT in the content business, we can take the transformation digital technologies had brought into the music industry at the industrial level as an example concerning how music is stored and distributed. The fact that music is not stored on physical units anymore changed the whole system regarding the distribution of recorded music. This is a radical and fundamental change as we discussed. Coming from vinyl discs made out of shellac over cassettes to CDs, the technology of compressed digital audio, known as MP3, made it possible to send audio files digitally in an approximated quality to CDs (Tschmuck, 2012). Digital technologies have forced the music industry to adopt new possibilities and reinvent itself at a high pace. However, people who know how to use digital technologies wisely and the capabilities of leveraging resources (means) to achieve business models innovation (expected outcome) are what make the changes essentially. For example, Apple managed to get the licenses of the four big major labels (Warner Music Group, Sony BMG, EMI, and Universal Music Group) in 2003 and established iTunes, an online MP3 store to download tracks and albums. This does not only radically change or digitize the way people listen to music and allow Apple to diversify its offering by launching Apple Music in 2015 but also create opportunities for streaming services, where listening and having access is more important than ownership. It enabled Deezer and Spotify to start their business by offering a large range of music to customers while minimizing the costs for exploring new music. Knopper (2009) describes the new possibilities as a "shocking, liberating new world" in which artists can reach listeners all around the world by creating a buzz via Social Media channels, e.g., Facebook or Twitter, after uploading their songs on YouTube or Soundcloud. Similarly, Amazon has a clear vision (True Customer Obsession) to be the most customer-centric company in the world. While most people thought going digital is just using digital technologies to set up a digital platform, Amazon is really leveraging the service aspect of it to differentiate itself, and has been doing remarkable in their service innovation. Another example is the media industry. Digitized paper documentation archives and publications of newspapers and magazines are in the process of life-changing transformation. Readers, who used to buy newspapers in kiosks, shops, or receive them by post, may get access to them either for free or after authorization and registration of their subscription on websites. Aggregated statistical data about every user of news services, publishing houses websites, social networks are collected and analyzed to regulate the subject of content and the order of sending (Alekseevna et al., 2017).

The nature of DT as a fundamental change resides in the subtly changing way of life, where no one goes to shops to buy newspapers anymore. DT is penetrating other industries too. For example, the Digital Capability Center (DCC) Aachen introduced a smart wristband that includes various human-to-machine communication functions to boost the textile industry. It demonstrates how to digitize the entire textile production chain from order intake to product development, production, and service in an interactive way. The learning and demonstration environment with direct access to textile production conditions and processes at DCC Aachen enable action and problem-oriented learning. The condition monitoring offers comprehensive information on the production processes to minimize machine downtimes by 50% and minimizing scrap by 80% (Prass and Niemeyer, 2020). The logistics are achieved with the help of Augmented Reality (AR) using Google Glass smart glasses. This increased the logistics processes' productivity and the quality of the process in an innovative way. Real-time data displayed on the employees' tablet computers or smartphones and visualized by an IoT platform has radically improved the decision-making at different stages and the connectivity of the entire textile supply chain. The fundamental challenge for many fashion brands that they lag increasingly behind consumers' expectations is pushing the fashion industry to embark on the DT journey. In an uncertain and complex environment, the fashion industry is undergoing large-scale transformations due to the use of digital technologies and its impact on customer behavior. The availability of big data and analytics allow the fashion industry to tailor the customer experience strategically. DT for a fashion brand or the fashion industry generally means re-imagining how shopping in a digital world should play out and how to use digital technologies to close the gaps between customer's expectations and the real experience they receive than merely digitizing the shopping process for a physical world (Lay, 2018).

An empirical example of DT on the societal level is the digital lifestyle in China. Living or traveling in China, there is no need to use any cash or credit card. Each and every payment can be made via a mobile phone, even buy street food. Due to the fierce competition in China, all services provided by Alibaba, Wechat, Tencent, JD.com, etc. underpin the fast-moving Chinese digital lifestyle to purchase various items online frequently, typically from a smartphone. In the past four years, about 600 million users accessed urban services through Alipay, a Chinese third-party payment platform, to check their social insurance, pay for electricity, search for public transport and handle other affairs (Yan, 2019) without going out of your house. In a nutshell, Alipay is evolving from a platform offering inclusive financial services to an open digital ecosystem that provides users a gateway into a comprehensive digital lifestyle. Alibaba's strategic imperative is to make sure that its platform provided all the resources, or access to the resources, which online business would need to succeed to support its ecosystem to accommodate innovations in advanced technologies and create new types of online businesses, completely reinventing China's retail sector. Alibaba is creating value for all stakeholders when taking all functions associated with retail and coordinating them online into a sprawling, data-driven network of sellers, marketers, service providers, logistics companies, and manufacturers (Zeng, 2018). However, the reason why Alibaba and Tencent have so much value and market power emerging in China is the new capabilities in network coordination and data intelligence that they use. The ecosystems they steward are vastly more economically efficient and customer-centric than traditional industries. Their business model innovations allow them to adapt dynamically and rapidly to changing market conditions and customer preferences, gaining a tremendous competitive advantage over traditional businesses. Arguably, digital-native companies like Alibaba may have the advantage of being born online and data-ready, so their transformation is quite natural, but note that not all companies mentioned above were born digital. Organizations have taken off on the journey of digital transformation to reinvent themselves sustainably. Another example is the Swedish furniture giant IKEA. It has taken the first step to transform into a tech

company by launching the IKEA Place app, an augmented reality tool that allows users to visualize how furniture will look in their own home in 2017, providing innovative and highly valuable experiences both online and offline customers (Zigurat, 2019).

Some businesses have already reaped the benefits of DT, while others are still struggling with how to channel their digital ambition and create desired transformative business outcomes due to the unclear understanding of the essence of digital transformation and the mechanisms of change realization. The agility with which businesses can leverage and recompose their proprietary capabilities for a different purpose is critical in the era of DT. Furthermore, the COVID-19 pandemic has been a proving ground where the most agile and dynamic businesses have reacted fastest to the “new normal” of the lockdown economy and the rise in remote working (Laycock, 2020), and is likely to accelerate the pace of the DT. Many industries are expediting their transformation process to offer digital solutions. The healthcare providers have moved rapidly into telehealth, insurers into self-service claims assessment, and retailers into contactless shopping and delivery (Blackburn, LaBerge, O’Toole and Schneider, 2020).

In a nutshell, all entities (organization, business network, industry, society) have valuable digital assets, whether data or functionality, but the resources (i.e., human resources, financial resources, and knowledge resources) and capabilities (i.e., digital capabilities and dynamic capabilities) are the strategic assets to start or speed up the DT journey when they can be securely leveraged, reused, combined, and shared with stakeholders. DT is not only about the use of digital technologies per se, launching more mobile apps or migrating to the cloud or leveraging machine learning or most of the other finite things people associate with it (Zavery, 2020), but also about the strategic leverage of resources and capabilities to radically improve an entity and redefine its value proposition for its stakeholders.

## 7. Conclusion

The current hype surrounding the concept of “Digital transformation” is seriously affecting its credibility, and it is creating much confusion in both research and academic fields. By developing a unified definition of DT, we tried to bring some clarity about this concept and its associated core primitives and defining attributes. Consistent definitions provide clearer means for researchers to communicate with practitioners and to provide them with better prescriptions (McKnight and Chervany, 2001) to understand and develop digital transformation.

Consequently, we believe that our unified DT definition contribution is two-fold. On the one hand, it provides a conceptual definition for researchers to develop a consistent stream of research that builds on a systematic analysis of what has been done before and the source to come up with operational definitions to test relationships between various DT elements. On the other hand, it provides a clear description for practitioners to consistently differentiate various strategizing and organizing activities regarding DT and digitalization. Our findings highlight the need for a solid theoretical foundation of DT from a holistic perspective and a systematic analysis of existing definitions. In this regard, our rigorous approach allowed us to extract and validate the key/core attributes that support DT from numerous existing definitions. Through the various stage of our unified definition creation, we made sure that only the key attributes will remain and that our resulting definition will meet all the quality requirements defined by many conceptualization researchers. Identifying the fundamental attributes of DT sheds light on clarifying the confusion and complexity of understanding such concepts. It helps to bridge the common ground of interest across different knowledge domains regarding DT and points out the importance of embracing potential research directions. DT is not merely about technology, but rather a set of strategic renewal and transformation to recreate value at different levels in different entities. The resources and capabilities attribute in our definition suggest the human and leadership aspects are also essential components. The “entity” attribute also

reminds us that DT is not just an organizational issue, but it is becoming more and more an ecosystem and societal challenge and necessity. Nevertheless, attention should be paid to differentiate DT from its related terms to set up clear research streams. Defining DT as a fundamental change was significant since it allows for differentiation from other non-fundamental changes, such as digitization and digitalization. Transformation in the context of the digital transformation refers to a fundamental change of a whole new form, function, or structure with the adoption of digital technologies that create new value. On the practical front, the clear implication of our unified definition is that practitioners can consider the relevant activities and expected outcomes in their practices before they start to implement DT or digitalization-related projects. This might provide great insight for them to use DT consistently. Moreover, despite the notable growing numbers of papers using DT as one of the keywords in both academic and practitioner research, what we find in the definition collection stage in this research is that only 37% of papers defined DT. This would destroy the basic understanding of the entire research from the beginning, as we cannot ensure whether our perceptions are aligned. Having a unified definition of DT and presenting it clearly in the paper may partially help to solve this problem.

There are three limitations in our work. Firstly, although this research contributes to the body of knowledge on DT conceptualization, qualitative research’s limitations need to be considered too, such as the lack of preliminary qualitative observation or interview data collection. We tried to counteract this limitation by embedded quantitative expert feedback collection to evaluate the proposed unified definition. Although we collected 60 experts’ feedback in the field to explore how our unified definition resonances with their perception of DT, the empirical evidence is still limited. Analyzing a combination of definitions extracted from both conceptual and empirical papers inevitably increases the number of defining attributes. The conceptual paper (e.g., literature review of DT) doesn’t present original data and may increase the risk of over-interpreting the phenomenon. However, it synthesizes what has been known in the literature and knowledge from previous work. Nonetheless, we still believe a holistic and systematic analysis of current knowledge on DT enriched with secondary qualitative data is necessary to provide an overall understanding of this notion and help to sort and review inconsistency of the extant DT-related literature. Secondly, even though care was taken to ensure the design of the eight-step approach with relevant analysis, the process to develop a unified definition is still at its infancy stage. Future research attempts could evaluate our unified definition in additional qualitative observation and a quantitative survey design with a larger sample size to triangulate the methodological rigor and validity of the findings. Lastly, the systematic literature review’s exclusion and inclusion criteria may eliminate some useful contributions in other languages. As mentioned in section 5.1, we only included papers written in English while prioritizing an accurate interpretation of the papers. Multilingual researchers may attempt to synthesize the findings from papers written in different languages and investigate the understanding of DT from a cross-cultural perspective. As far as future related research, the synthesis of our unified definition can be further utilized in developing DT taxonomy and typology, operational definitions to construct and test hypotheses in various domains, as well as the digital transformation maturity model development. Moreover, identified attributes of DT in this paper reveal the changes driven by both top-down initiatives and bottom-up acceptance in a target entity that can be more thoroughly investigated in future studies.

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