

Conceptualizing digital transformation using semantic decomposition

Conceptualizando transformación digital por medio de descomposición semántica

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Abstract: Economic and social disruption generated by COVID-19 increased research on digital transformation processes; however, consensus about the formal conceptual definition of digital transformation is yet to be reached. A concise and clear concept built using existing definitions in literature is needed for empirical research in the business and management fields. Using semantic decomposition method to systematically decompose the extant definitions collected from the business literature, this study proposes the following formal conceptual definition of digital transformation: “a process that aims to improve society by triggering significant changes to the enterprise business model using digital technologies”. Consistent measurable properties caused by a formal conceptual definition support academic research and enable practitioners to exploit new knowledge essential when adapting the firm’s business model to the new digital reality.

Keywords: Digital transformation; definition; semantic decomposition.

Resumen: La disrupción económica y social generada por el COVID-19 incrementó la investigación y nuestro conocimiento sobre la transformación digital; sin embargo, carecemos de una definición formal conceptual de transformación digital. Un concepto claro y conciso, a partir de definiciones existentes en la literatura, es necesario para la investigación empírica en el campo de gerencia y negocios. Utilizar el método de descomposición semántica nos permite alcanzar el objetivo de investigación y construir una definición formal conceptual manejable y fácil de entender, donde se define la transformación digital como “un proceso que tiene como objetivo mejorar la sociedad desencadenando cambios significativos en el modelo de negocio de las empresas a través del uso de tecnologías digitales”. Los resultados consistentes y medibles que genera una definición formal conceptual apuntalan la investigación académica y permiten a los profesionales explotar nuevo conocimiento esencial al momento de adaptar el modelo de negocio a la nueva realidad digital.

Palabras clave: Transformación digital; definición; descomposición semántica.

1. Introduction

The world is facing a digital transformation (DT) triggered by the intensified prevalence and use of digital technologies that are fundamentally changing organizations and economies. Today's information age is dependent on different technologies based on the development of big data, algorithms, cloud computing, and social networks (Acs et al., 2022), and the market success of many businesses—whose competitive advantage mostly relies on digital technologies—is highly conditioned by their participation in digital platforms (Lafuente et al., 2022). However, the notion of DT is both theoretically and empirically underspecified (van Meeteren et al., 2022). Firms realize the potential of DT, but they can hardly tackle the challenges or achieve the maximum benefits of DT (Ellström et al., 2022). More literature is needed to uniformly define DT and help governments and private sectors develop the knowledge and abilities needed to rapidly adapt to the disruptive changes faced by businesses as a result of DT (Kraus, et al., 2021a). Although the term DT is frequently used in business research and marketing, scholars disagree on a common definition (Siachou et al., 2021). DT is not limited to particular innovative businesses such as digital start-ups and high-tech giants; it is rather a process that embraces companies of all sizes from diverse industries (Bresciani et al., 2021). For instance, for small and medium-sized enterprises (SMEs), an approach that reduce the underlying complexity of DT projects into manageable and easy-to-understand steps, rather than abstract frameworks, is highly demanded (Barann et al., 2019).

Casual everyday language is not precise enough for formal empirical research; a scientific field must develop artificial languages to increase the precision of empirical testing (Wacker, 2004). For example, Vial (2019) uses semantic analysis to build a conceptual definition of DT based on literatures on Information Systems and suggests it can be replicated in other disciplines where DT is relevant.

The discussion around DT in business and management is still open (Bresciani et al., 2021). According to Vial's (2019) call, this study aims at building a concise and clear concept of DT using existing definitions in the academic literature to provide appropriate and consistent measurable properties (Wacker, 2004), especially for the business and management domains.

A concise and clear concept of DT can help the consolidation of future applied research on business models and the design of structured frameworks for adapting business processes to digitalization. Moreover, conceptual clarity on DT is essential for equipping scholars and social planners with valid measurement instruments to strengthen research and policy action plans. For instance, governments should develop policies that facilitate the digitalization of society and economic activities (Lafuente et al., 2022), therefore, they have the responsibility of designing digital infrastructures and regulations that increase the efficiency of digital markets (Acs et al., 2022).

The research question of this proposal is the following: is the business literature sufficient to develop a conceptual definition of DT based on previous definitions?

2. Theoretical framework

The rise of smart devices and social media platforms has led to drastic changes in the way customers communicate with businesses, and in customers' expectations to businesses' response times and multi-channel availability (Schallmo et al., 2017). In 2005, just 500 million devices were connected to the Internet; 10 years later there were 8 billion; by 2030, it's estimated that 1 trillion devices will be connected (WEF, 2016). Digital technologies are becoming an integral part of individuals' lives and organizations' work routines, and digitalization is continuously impacting the economy and

society (Gimpel *et al.*, 2018). Digitalization is the cause of large-scale transformations across multiple aspects of business, providing unparalleled opportunities for value creation (Weinelt, 2016). Research has shown that technology itself is only a part of the complex puzzle organizations need to solve to remain competitive in a digital world (Vial, 2019). The journey to digital maturity requires a whole-hearted commitment from a company's leadership and sustained investment in people, capabilities, technology, and cultural change (Catlin *et al.*, 2015).

According to Matarazzo *et al.* (2021), research focused on DT in SMEs and how digitalization may change the entire process of consumer value creation is still limited, but they identify digitalization as a prerequisite for DT. Autio *et al.* (2018) associate transformative effects and business model (BM) innovation with digitalization; Verhoef *et al.* (2021) reserve these characteristics for DT. Kane *et al.* (2015) find the advantages of digitalization strategic, and not merely technological.

In general, there is frequent interchangeability between terms associated to DT (e.g., DT, digitalization, and business process reengineering) as well as a variety of variables, characteristics, and constructs affecting the conceptualization of DT (e.g., type of organization, industry, areas where digital information applies, organizations' legacy and capabilities, organizations' BM, and organizations' experience with information technology and systems) (Siachou *et al.*, 2021). Although digital changes have been thoroughly investigated by academics, DT, digitalization, and digitization are terms that are often used interchangeably by management scholars (Caputo *et al.*, 2021).

Amongst other definitions, the term DT is used today to signify the transformational or disruptive implications of digital technologies for businesses (Jafari-Sadeghi *et al.*, 2021). For Legner *et al.* (2017), DT describes the changes brought about by information technologies as a means to automatize tasks. However, Andriole (2017) said that DT is not a software upgrade or a supply chain improvement project, but a planned digital shock to what there may be a reasonably functioning system.

There is currently no commonly accepted definition for the term DT (Schallmo *et al.*, 2017). Vial (2019) reveals that circularity, unclear terminology, and the conflation of concepts and their impacts—among other challenges—hinder the conceptual clarity of DT. Proposing a novel definition is only the first step toward developing a better understanding of the phenomenon (Trischler & Li-Ying, 2022). The challenges of DT have gained attention from both academics and practitioners (Favoretto *et al.*, 2021).

DT initiatives have been thoroughly investigated in this recent period (Gregurec *et al.*, 2021) even though a formal concept remains undefined. Although definitions are never complete, unequivocal, or fully formalized, that does not mean that any or all definitions should be equally acceptable (Wacker, 2004). It is often the case that satisfying definitions cannot be found about words or concepts that are rarely used or have been newly created (Li *et al.*, 2020). The meanings of those expressions are usually consulted from the immediate local context, on dictionaries, research documents, or the web to support interpretations and compare them to more global contexts (Ishiwatari *et al.*, 2019).

In the case of formal conceptual definitions, few terms are preferred to convey the *essence* of the concept (Wacker, 2004). Li *et al.* (2020) propose to explicitly decompose the meaning of words into semantic components for definition generation. Wierzbicka (1996) proposes that different languages share a set of atomic concepts that cannot be further decomposed, i.e., semantic primitives by which all complex concepts can be semantically composed. Primitive terms have also been described in academic circles as terms that are not defined but are assumed to be understood by the academic field (Wacker, 2004).

3. Methodology

To build a manageable, easy-to-understand formal conceptual definition of digital transformation, [Wolfswinkel et al.'s \(2013\)](#) five-stage process is proposed to conduct a rigorous literature review. This process allows to (1) define the scope of the review; (2) search the literature; (3) select the final sample; (4) analyze the corpus; and (5) present the findings ([Vial, 2019](#)). Web of Science and Scopus databases are used for the initial queries as recommended by [Tijjani et al. \(2020\)](#). To confirm the inclusion of all the relevant studies, the results were also cross-validated ([Fakhar Manesh et al., 2021](#)) in Google Scholar. The analysis consisted of the collection of definitions of DT and other related concepts.

After analyzing the existing definitions of DT in the academic literature, 17 unique definitions were selected. Since academic journals are not the only sources of knowledge ([Mohammed et al., 2015](#)), other professional sources such as [SAP Insights \(2021\)](#) and [PwC \(2013\)](#) were also accessed which provided an integrative view of the state of the art on DT ([Kraus, et al., 2021b](#)). Exploring those sources allowed to obtain the practitioners' point of view.

Following [Ishiwatari et al. \(2019\)](#), whose experiment is intended to describe unfamiliar words, phrases, polysemous words, rarely used idioms, or emerging entities (such as DT) through the Oxford dictionary, a "dataset newly created" from Wikipedia was also used. Finally, following [Gadetsky et al. \(2018\)](#), who collects a dataset of definitions using [OxfordDictionaries.com](#) API, definitions in the [Oxford Dictionary \(n.d.\)](#), [Wikipedia \(n.d.\)](#), and [Cambridge Dictionary \(n.d.\)](#) were also collected by relating term searches to digital transformation.

A clear, concise definition of DT was derived using semantic decomposition ([Akmajian et al., 2017](#)), a process that aims at breaking down groups of words, single words or even morphemes into a series of primitives ([Vial, 2019](#)). Rules for formal conceptual definitions imply that a concept must be defined using primitive and derived terms to assure that terms are assumed to be known by individuals ([Wacker, 2004](#)).

4. Results

After following the five-stage process for a rigorous literature review, 19 unique definitions of DT were found. Although, this relatively small number reflects an overall enthusiasm toward the phenomenon of DT at the expense of conceptual clarity. Some of these definitions were created by research groups while others considered parts of previously published definitions. The definition by [Barann et al. \(2019\)](#), considers DT "as the continuous digitalization process of a company, which uses digital and data-driven innovation to improve existing processes, change distinct BM elements, or reinvent its BM entirely". Other definitions were built by combining existing pieces of knowledge ([Wang et al., 2017](#)), since "the term DT is used today to signify the transformational or disruptive implications of digital technologies for businesses and society" ([Jafari-Sadeghi et al., 2021](#); [Matt et al., 2016](#); [Nambisan et al., 2018](#)).

Academic journals are not the only sources of knowledge ([Mohammed et al., 2015](#)). Two definitions were retrieved from professional sources; [PwC \(2013\)](#) describes DT "as the fundamental transformation of the entire business world through the establishment of new technologies based on the internet with a fundamental impact on society as a whole". [SAP Insights \(2021\)](#) indicates that DT "involves integrating digital technologies and solutions into every area of a business. This is as much a cultural change as a technological one as it requires organizations to make fundamental shifts in the ways they operate and how they deliver customer experiences and benefits. Digital solutions also help increase the workforce and can lead to business process and business model transformation".

The [Oxford Dictionary \(n.d.\)](#) search retrieved no exact match for “digital transformation” in Academic English. The [Cambridge Dictionary \(n.d.\)](#) search suggested “digitalisation” for digital transformation, among other words, while the [Wikipedia \(n.d.\)](#) dataset referred the result to “digitization”.

The 19 definitions of DT retrieved for this research were analyzed to determine the essence of DT concepts by following the [Wacker \(2004\)](#) guidelines for conceptual definitions ([Table 1](#)).

Each definition was, then, broken down into its constituents in order to identify their primitives, following the semantic decomposition process described by [Vial \(2019\)](#). Those primitives were (1) the target entity, i.e., the unit of analysis affected by DT; (2) the scope, i.e., the extent of the changes taking place within the target entity’s properties; (3) the means, i.e., the elements involved in creating the change within the target entity (4) the expected outcome, i.e., innovation of the BM (see [Table 2](#)). A conceptual definition of DT was finally derived from the resulting properties. DT is defined “as a process that aims to improve society by triggering significant changes to the enterprise business model using digital technologies”.

Table 1: Guidelines for conceptual definitions.

Rule 1	Definitions should be formally defined using primitives and derived terms.
Rule 2	Each concept should be uniquely defined.
Rule 3	Definitions should include only unambiguous and clear terms.
Rule 4	Definitions should have as few as possible terms.
Rule 5	Definitions should be consistent within their field.
Rule 6	Definitions should not make any term broader.
Rule 7	New hypotheses cannot be introduced in the definitions.
Rule 8	Statistical test for content validity must be performed after the terms are formally defined.

Source: Adapted from [Wacker, J. G. \(2004\)](#). A theory of formal conceptual definitions: Developing theory-building measurement instruments. *Journal of Operations Management*, 22(6), 629–650. <https://doi.org/10.1016/j.jom.2004.08.002>

Table 2: Extracting primitives for the concept of digital transformation.

#	Definition	Source(s)	Primitive #1:	Primitive #2:	Primitive #3: Means	Primitive #4:
			Target entity	Scope		Expected outcome
			Unit of analysis affected by DT	The extent of the changes taking place within the target entity's	The element involved in creating the change within the target entity	The outcome of DT
1	DT describes the fundamental transformation of the entire business world through the establishment of new technologies based on the internet with a fundamental impact on society as a whole.	(PwC, 2013)	Society	Transformation	New technologies base on the internet	N/A
2	We define digital transformation as the use of new digital technologies (social media, mobile, analytics or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations or creating new Business Models)	(Fitzgerald et al., 2014)	Business (implicit)	Use	New digital technologies (social media, mobile, analytics or embedded devices)	Major business improvements (customer experience, creating new Business Model)
3	Digital transformation involves leveraging digital technologies to enable major business improvements, such as enhancing customer experience or creating new business models.	(Piccinini et al., 2015)	Business	N/A	Digital Technologies	Enhancing customer experience or creating new business models
4	Digital transformation is the profound and accelerating transformation of business activities, processes, competencies, and models to fully leverage the changes and opportunities brought by digital technologies and their impact across society in a strategic and prioritized way	(Demirkan et al., 2016)	Business & Society	Changes	Digital Technologies	Business Model, activities, processes and competencies
5	The changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or automation of processes.	(Clohessy et al., 2017)	Company	Changes	Digital Technologies	Business Model.
6	An evolutionary process that leverages digital capabilities and technologies to enable business models, operational processes and customer experiences to create value.	(Morakanyane et al., 2017)	Business (implicit)	Leverage (use)	Digital capabilities and digital technologies	Business Model, create value
7	The use of new digital technologies, in order to enable major business improvements in operations and markets such as enhancing customer experience, streamlining operations or creating new business models.	(Paavola et al., 2017)	Business	Use	Digital Technologies	Business Model, customer experience, operations
8	The DT framework includes the networking of actors such as businesses and customers across all value-added chain segments, and the application of new technologies. As such, DT requires skills that involve the extraction and exchange of data as well as the analysis and conversion of that data into actionable information. This information should be used to calculate and evaluate options, in order to enable decisions and/or initiate activities. In order to increase the performance and reach of a company, DT involves companies, business models, processes, relationships, products, etc.	(Schallmo et al., 2017)	Company	Application (use)	New Technologies, skills	Business Model, processes, relationships, products
9	Digital transformation is a process of reinventing and re-engineering a business to digitize a company. This transformation is the deliberate and ongoing digital evolution of a company's business model, strategically, tactically, and operationally	(Bowersox et al., 2005; Mazzone, 2014; Saul & Gebauer, 2018)	Business	Reinventing and re-engineering	Digital Technologies (implicit in digitize)	Business Model

Table 2: Extracting primitives for the concept of digital transformation (Continued).

10	Digital Transformation (DT) considers the continuous digitalization process of a company, which uses digital and data-driven innovation to improve existing processes, change distinct business model (BM) elements, or reinvent its BM entirely	(Barann et al., 2019)	Company	Use	Digital (technologies implicit) and data-driven innovation	Business Model
11	The digitization or Digital Transformation of product firms is the transition process companies are facing when moving from previous industrial stages to an interconnected smart enterprise of the Industry 4.0 era supported by these base technologies	(Frank et al., 2019; Kagermann et al., 2013)	Firms	Transition	Technologies	N/A
12	Digital transformation encompasses an organization's ability to adapt, respond, and position itself for success in the face of rapid technology evolution	(Guinan et al., 2019)	Organization	Adapt	N/A	Success
13	Digital transformation is an ongoing process of strategic renewal that uses advances in digital technologies to build capabilities that refresh or replace an organization's business model, collaborative approach, and culture.	(Warner & Wäger, 2019)	Organization	Use	Digital Technologies	Business Model
14	This phenomenon, also known as digitalization, refers to a business model driven by the changes associated with the application of digital technology in all aspects of human society	(Crupi et al., 2020; Stolterman & Fors, 2004)	Society	Changes	Digital Technologies	Business Model
15	Digital transformation is, therefore, defined as the pursuit of innovation, agile business, and operation models driven by technological evolution, processes, analytics, and talent capabilities to modernize customers' touchpoints, enabling infrastructures and creating new values for employees and stakeholders	(Haaker et al., 2021)	Business	Pursuit	Technologies and talent	Creating new values and infrastructure
16	The term digital transformation is used today to signify the transformational or disruptive implications of digital technologies for businesses and society	(Jafari-Sadeghi et al., 2021; Matt et al., 2016; Nambisan et al., 2018)	Business & Society	Transformations	Digital Technologies	N/A
17	Digital transformation is the most pervasive phase, and describes a company-wide change that leads to the development of new business models, which may be new to the focal firm or industry	(Iansiti & Lakhani, 2014; Kane et al., 2015; Pagani & Pardo, 2017; Verhoef et al., 2021)	Company	Develop	N/A	Business model
18	Digital transformation involves integrating digital technologies and solutions into every area of a business. This is as much a cultural change as a technological one as it requires organizations to make fundamental shifts in the ways they operate and how they deliver customer experiences and benefits. Digital solutions also help to augment the workforce and can lead to business process and business model transformation.	(SAP Insights, 2021)	Business	Integrate	Digital Technologies	Business Model, customer experience, benefits
19	Digital transformation in turn can be defined as the integration of digital technology into all aspects and operations of an organization, which in turn leads to infrastructural changes in how the organization is operated and delivers value to its customers	(Kraus et al., 2022)	Organization	Integrate	Digital Technologies	Delivers value to its customers, infrastructure, operations

5. Discussion and conclusions

To answer our research question: is the business literature sufficient to develop a conceptual definition of DT based on previous definitions?

Research on DT has raised vast interest among academics in recent decades (Kraus et al., 2022), but a clear definition of DT is still unaccounted for (Schallmo et al., 2017). The literature shows a growing number of publications dedicated to DT in the fields of business and management (Kraus et al., 2022), offering several DT definitions, without common concurrences (Chawla & Goyal, 2022). An introduction to a concise and clear DT concept, built using extant definitions in the literature, is highly desired. We experienced limitations when searching for DT definitions in sources different from journals, such as dictionaries.

Although in most of the definitions of the sample the target-primitive entity refers to businesses or enterprises, the resulting definition suggested by this article is not focused on businesses only. Given the increasing importance of DT and its effects on companies and societies, as well (Kraus et al., 2022), the definition proposed focuses on society as a whole. DT is shaping profound changes in societies (Matarazzo et al., 2021); Kraus et al. (2022) consider that relevant future research should move beyond the benefits of DT on individual companies and focus on its societal impacts.

The definition proposed recognizes *improvement* as an expected result of DT, without guaranteeing its realization. For DT to be successful, DT should become a strategic priority in the organization (Chawla & Goyal, 2022).

A final characteristic of the proposed definition is intended to reinforce its conceptual clarity and make it applicable to the business world; it includes the term BM into its structure. DT calls for the renewing and readjustment of BM to challenge conventional ways of doing business (Hadjielias et al., 2021).

Five of the definitions used to construct this formal conceptual definition are part of the most highly cited DT articles in Web of Science (see Table 3). Those papers are: Verhoef et al. (2021), Warner & Wäger (2019), Jafari-Sadeghi et al. (2021), Kraus et al. (2022) and Frank et al. (2019). As of July/August 2022, those highly cited papers received enough citations in Web of Science Core Collection to place them in the top 1% of the academic field of Economics & Business or Social Sciences based on a highly cited threshold for the field and publication year (Clarivate, 2022). Verhoef et al. (2021) is a “hot paper”, which means it was published in the past two years and received enough citations in Web of Science Core Collection in July/August 2022 to place it in the top 0.1% of papers in the academic field of Economics & Business (Clarivate, 2022). Although it seems that the number of definitions retrieved is low, they mostly come from highly cited articles from good indexing and ranking journals, which allows a good definition, which, according to Wacker (2004), should be a concise, clear verbal expression of a unique concept that can be used for strict empirical testing.

Kraus et al. (2022) call for more research aimed at developing a universal definition of the term DT from the perspective of business and management. This article answers that call, contributing to scholars and practitioners. According to Wacker (2004) having a formal conceptual definition is the prior step for developing measurement instruments since clear definitions lead to better conceptual characteristics and, ultimately, to meaningful statistically valid measures. A DT definition that supports measurement instruments will benefit scholars with better tools for better research in the emergent field of DT. There is also a need for research aimed at developing qualitative and quantitative measures that companies could use to assess the success of their DT efforts. These could be crucial for smaller companies. Despite all the talk about DT in developed and emerging economies and across all industries, the reality is that DT is only as useful if its implementation results in return on investment, benefits in terms of efficiency, effectiveness, cost-savings, competitive advantage, and decision-making (Marks et al., 2020). Future research may use this formal conceptual definition to create measurement instruments to develop empirical studies on DT and on Organizational Impact (Chawla & Goyal, 2022), addressed especially to SMEs’ business model transformation. To measure DT’s impact on society is also highly recommended.

Table 3: DT definitions from highly cited articles in Web of Science.

Definition	Authors	Citations	Journal	JIF 2021 - JCR Quartile	SSCI Category	CiteScore - Rank
Digital transformation is the most pervasive phase, and describes a company-wide change that leads to the development of new business models, which may be new to the focal firm or industry	Verhoef et al. (2021)	383	Journal of Business Research	10.969 Q1	Business	11.2Q1
Digital transformation is an ongoing process of strategic renewal that uses advances in digital technologies to build capabilities that refresh or replace an organization's business model, collaborative approach, and culture.	Warner & Wäger (2019)	339	Long Range Planning	7.825Q1	Business, Management	14.4 Q1
The term digital transformation is used today to signify the transformational or disruptive implications of digital technologies for businesses and society	Jafari-Sadeghi et al. (2021)	59	Journal of Business Research	10.969Q1	Business	11.2 Q1
Digital transformation in turn can be defined as the integration of digital technology into all aspects and operations of an organization, which in turn leads to infrastructural changes in how the organization is operated and delivers value to its customers	Kraus et al. (2022)	16	International Journal of Information Management	18.958 Q1	Information Science	28.8 Q1
The digitization or Digital Transformation of product firms is the transition process companies are facing when moving from previous industrial stages to an interconnected smart enterprise of the Industry 4.0 era supported by these base technologies	Frank et al. (2019)	275	Technological Forecasting and Social Change	10.884 Q1	Business	13.7 Q1

Note. JIF = Journal Impact Factor; JCR = Journal Citation Reports; SSCI = Social Sciences Citation Index; CiteScore = Citation recorded in Scopus data base.

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