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SUSTAINABILITY IN DIGITAL TRANSFORMATION: TOWARDS AN INTEGRATED FRAMEWORK

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ABSTRACT

This paper investigates how existing literature has approached the concept of sustainability in the context of digital transformation.

It adopts a three-step procedure for a systematic literature review (SLR), including planning, conducting, and reporting the review to synthesise current knowledge, classify key thematic areas, and establish a foundation for further empirical research. The findings emphasise the need for a structured and sustainable approach to digital transformation to enhance business resilience and effectiveness. Although this is a relatively new and emerging topic, and there is a lack of a solid conceptualisation of the role of sustainability in digital transformation, several important theoretical implications can still be identified.

By addressing the fragmented nature of the literature, this study contributes to the field by developing a structured framework for classifying key areas of sustainability in digital transformation. The systematic literature review revealed an absence of a unified conceptualisation and a lack of consistent understanding of sustainability in digital transformation across the analysed publications. Nevertheless, the study successfully identified 24 areas related to the sustainability of digital transformation, which were categorised into a framework comprising four fields: people, management, technology, and environment.

The study plays a crucial role in enhancing the understanding of the sustainability of the digital transformation process by using a classified set of sustainability areas within it. The study results provide practical information for managers leading digital transformation processes in companies.

KEY WORDS

sustainability, sustainable digital transformation, digital transformation, information systems, sustainable management, systematic literature review

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INTRODUCTION

Over the past decade, digital transformation has become a defining force in reshaping industries, economies, and societies (Kraus et al., 2021; Omol, 2024; Pappas et al., 2023; Verhoef et al., 2021). As

organisations invest heavily in technologies, such as artificial intelligence, cloud computing, and the Internet of Things (IoT) (Al-Sharafi et al., 2023; Babina et al., 2024; Lee & Lee, 2015), the scale and speed of transformation continue to accelerate (Chaudhuri et al., 2024). Global expenditure on digital transformation is expected to reach USD 2.8 trillion by 2025 -

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more than double the amount spent in 2020 (Pacolli, 2022). By 2030, nearly one trillion devices are projected to be connected to the Internet (Pinzaru et al., 2019), while an estimated 40 % of current market leaders may be displaced due to the lack of viable digital strategies (Hoa & Tuyen, 2021).

At the same time, this rapid evolution has raised critical concerns (Dąbrowska et al., 2022; Rowe, 2018; Soto-Acosta, 2024). When digital transformation initiatives are misaligned, underestimated, or implemented without foresight, they may become sources of disruption and harm socially, economically, and environmentally (Carnerud et al., 2020; Flyverbom et al., 2019; Ghobakhloo, 2020). These risks have catalysed growing interest in the concept of Sustainability of Digital Transformation (SDT) - a convergence of two major trends in contemporary management: digitalisation and sustainability (Kupilas et al., 2022; Lichtenthaler, 2021).

This paper addresses that gap by conducting a systematic literature review (SLR) on the sustainability of digital transformation. The review consolidates scattered insights, identifies key thematic dimensions, and offers a classification framework that may inform future empirical research. In doing so, the paper contributes to both the conceptual clarification and operationalisation of SDT.

In this study, digital transformation is defined according to Vial as “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication and connectivity technologies” (Vial, 2019). Sustainability is examined through the lens of the Triple Bottom Line (TBL) framework (Elkington, 1997), which considers economic, social, and environmental dimensions. While this framework provides a useful starting point, the review also explores whether these three pillars sufficiently capture the complexity of SDT, or whether additional dimensions, such as ethical, governance, or resilience aspects, should be included.

Accordingly, this paper seeks to answer the following research questions:

RQ1: How has scholarly research approached the topic of the sustainability of digital transformation?

RQ2: How are the dimensions of sustainable digital transformation understood and classified?

To address these questions, a systematic literature review was conducted, identifying key contributions at the intersection of digital transformation and sustainability, and evaluating their methodological and conceptual approaches. It aims to provide a clearer

understanding of the state of the art, propose an integrative classification of sustainability dimensions in SDT, and lay the groundwork for developing robust research models to guide future inquiry.

1. LITERATURE REVIEW

While the term sustainability is typically associated with long-term environmental, social, and economic development (Bai et al., 2020; Huang et al., 2024; Owusu & Asumadu-Sarkodie, 2016), sustainable digital transformation entails a more specific interpretation (Costa Melo et al., 2023; Nyagadza, 2022). In this context, sustainable refers to the ability of organisations to implement digital transformation in a way that maintains long-term value creation across multiple dimensions (Ciachorowski & Miranda, 2025). This is not limited to reducing environmental impact but includes ensuring that technological advancement is resilient (Garcia-Perez et al., 2023), ethically governed (Saarikko et al., 2020), inclusive (Di Vaio et al., 2021), and strategically integrated (Schwarz Müller et al., 2018).

The literature on SDT, however, remains fragmented (Dang et al., 2024; Hanelt et al., 2021). Diverse conceptualisations coexist (Ayoubi et al., 2023; Guandalini, 2022; Matt et al., 2015), which often emphasise isolated dimensions, such as technological innovation (Romanello & Veglio, 2022), environmental impact (Liu et al., 2022), human-centred design (Brauner & Ziefle, 2022), or managerial approaches (Ionescu et al., 2022), without offering an integrated understanding of how these dimensions interrelate. The multidimensionality of SDT, combined with a lack of conceptual clarity, may lead to inconsistent interpretations and hinder effective implementation (Ayoubi et al., 2023; Gimpel et al., 2018; Guandalini, 2022). Moreover, the unprecedented pace of technological innovation, particularly in AI, further complicates the management of transformation processes (Caputo et al., 2021).

A number of models and frameworks have been proposed to guide digital transformation efforts (Bai et al., 2017; de Camargo Fiorini & Jabbour, 2017; Rachinger et al., 2019; Urbinati et al., 2020), yet they differ widely, especially when they attempt to incorporate sustainability principles. Most frameworks emphasise economic or technological aspects, with limited integration of social or environmental concerns (Frank et al., 2019). Few studies attempt a holistic perspective that acknowledges the full

spectrum of sustainability dimensions (Kamble et al., 2020). This conceptual gap necessitates a comprehensive synthesis of existing research.

2. RESEARCH METHODS

To clarify the current state of research on sustainable digital transformation, this paper adopts the three-step procedure for a systematic literature review (SLR), proposed by Tranfield (2003), which includes planning, conducting, and reporting the review. This approach offers a transparent process for carrying out the SLR, provides the flexibility to explore emerging scientific themes, and ensures the use of appropriate tools and methods.

2.1. PLANNING THE REVIEW

This review focused on papers published in the Scopus and Web of Science (WoS) databases. The two databases were selected because they are among the most comprehensive and representative sources of academic literature. Despite their individual features, there is substantial overlap between them, meaning that most high-quality research is indexed in both. Second, given the very rapid pace of development in digital technologies, this study covers the seven-year period from 2018 to 2024, corresponding to the time frame leading up to the start of this review. Third, the need for a systematic literature review on the sustainability of digital transformation arises from the fragmented nature of the literature. To identify potentially overlooked or under-researched areas, it is essential to adopt an interdisciplinary approach that integrates diverse perspectives, thereby laying a solid foundation for the design of future empirical research. For this reason, the authors did not impose additional selection criteria based on journal ranking or impact factor. The initial phase of the review process aimed to identify and summarise the literature on the subject, highlight research gaps, assess the suitability of the selected area for further research, and evaluate its relevance for practitioners. The work began with the selection of keywords, which were then used during the article screening phase across relevant databases. The literature review utilised combinations of Boolean operators and the following search strings:

(TITLE-ABS-KEY ("sustainable digital transformation") OR TITLE-ABS-KEY (sustainab* AND "digital transformation") OR TITLE-ABS-KEY (sustainab* AND digitisation) OR TITLE-ABS-KEY

(sustainab* AND digitization) OR TITLE-ABS-KEY (sustainab* AND digitalization) OR TITLE-ABS-KEY (sustainab* AND digitalisation) OR TITLE-ABS-KEY ("industry 4.0") OR TITLE-ABS-KEY ("industry 5.0"))

The first keyword combination, "sustainable digital transformation", captures the essence of the study. To explore this multidimensional concept in depth, this paper uses a set of interrelated keywords. The first of these is "sustainability," which, in the context of digital transformation, refers to technological advancement that reduces negative environmental impacts while enhancing social benefits. Sustainability combined with "digital transformation," a process of technological change that can transform business models, organisational processes and even the way societies function, forms the conceptual foundation of this study. Additionally, the keywords "Industry 4.0" and "Industry 5.0" were used to target research that emphasises a changing vision of digital transformation from automatisisation and efficiency-driven transformations to long-term development driven by human-centric values and organisational resilience. The combination of search terms was used to search titles, abstracts and keywords: "digital transformation" or "digitisation"/"digitization" or "digitalisation/digitization". The terms "digitisation" and "digitalisation" are also discussed in the literature, where they are often used interchangeably with the term "digital transformation", but more precisely represent an integral stage of the transformation process involving the implementation of digital technologies into traditional business processes. The combination of these keywords used created a comprehensive and targeted research framework, enabling a broad yet precise search across titles, abstracts and keywords of relevant scientific papers.

2.2. CONDUCTING THE REVIEW

The combination of keywords appeared in 114,313 items overall, but only 13,373 from the Scopus database (under the category "Business, Management and Accounting") and 6,044 from the Web of Science database (under the category "Management and Business") were related to management science. Further filtering was applied to the set of publications using broad search parameters, excluding articles that did not meet the established criteria. Fig. 1 presents a graphical representation of the process, detailing the filtering criteria applied at each screening phase. The selection process was divided into three screen-

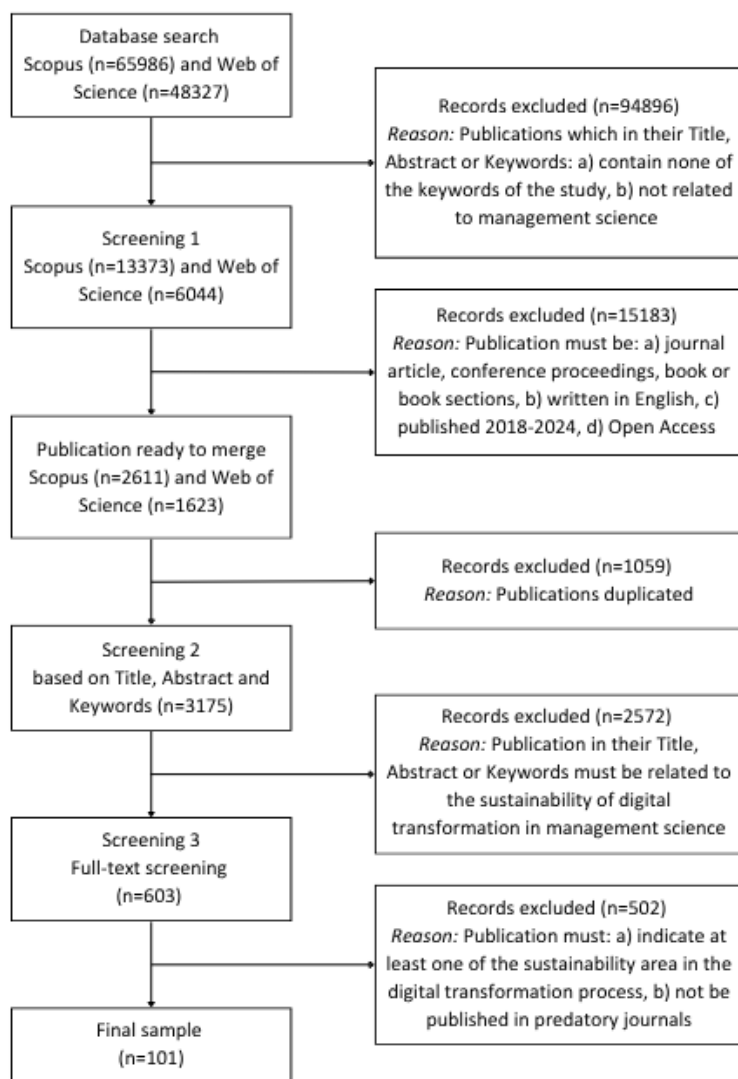


Fig. 1. Systematic literature review process

ing phases, each disqualifying articles that failed to meet certain specific criteria for further analysis.

In the first phase, the selection criteria focused on compliance with the types of publication specified in the initial analysis phase. The literature had to be in one of four forms: journal articles, conference proceedings, books or book chapters. Compliance with both the key terms and publication types was defined to ensure that selected items addressed broadly understood management in organisations, with a particular emphasis on the sustainability of digital transformation. The second criterion was the language of publication (English), and the third was the publication date; only articles published between 2018 and 2024 were included to ensure relevance to

current management trends. The final criterion concerned accessibility; articles without available full-text access were excluded.

Applying these filters resulted in 2611 publications from the Scopus database and 1623 from the Web of Science database qualifying for further analysis. After merging both databases and removing duplicates, 3175 unique articles remained for analysis, which were subjected to further selection criteria.

The second phase of selection focused on publications specifically addressing the sustainability of digital transformation in organisational management. Each publication was evaluated based on its abstract, title and keywords. Only those clearly related to the sustainability of digital transformation within the

context of management science were selected for further analysis. This phase resulted in 603 articles being accepted for the next stage of selection.

The final selection phase involved a full analysis of the articles to assess their alignment with the concept of sustainability of the digital transformation process. It was essential that the publications either identified sustainability-related areas relevant to ongoing digital transformation or that the authors highlighted the unique impact of a specific aspect of organisational development on the transformation process.

The study did not exclude publications from lower-ranking journals, as the goal was to gather a broad range of sustainability-related areas within the digital transformation process. At this stage, the collected literature serves as a basis for classifying these areas. The evaluation of the relevance and impact of individual areas will be the subject of further empirical research, during which areas of negligible relevance will be excluded from future modelling of a framework for sustainable digital transformation. Additional selection criteria involved excluding all articles from predatory journals, as they are considered less reliable sources of knowledge. The remaining 101 articles formed the basis for further work

2.3. REPORTING

After all the screening phases were completed, the selected articles were subjected to descriptive and thematic analyses. The descriptive analysis focused on examining publications in terms of recognition and citation metrics, research approaches and methods used, and industrial scope. The detailed data collected and analysed during this phase are presented in Appendix 1. The thematic analysis, in turn, identified the most important thematic threads addressed in the selected publications. Additionally, it served as the foundation for identifying the key areas that constitute the sustainability of digital transformation and for developing its preliminary framework.

3. RESEARCH RESULTS

3.1. DESCRIPTIVE ANALYSIS

The descriptive analysis closely aligned with RQ1, which focused on determining how existing research has approached the topic of the sustainability of digital transformation. Prior to the COVID-19

pandemic (Abilova & Aliyeva, 2022), digital transformation in enterprise management was not a leading topic in the literature, especially in the context of sustainability. Since 2020, however, there has been a clear upward trend in the number of publications advocating for a broader perspective on digital transformation that goes beyond financial optimisation and technological enterprise growth. Entrepreneurs and researchers studying the implementations of new technologies are increasingly seeking more effective methods of technology adaptation that lead to lasting organisational change. These approaches emphasise long-term outcomes, even if they come at the cost of short-term profitability.

The growing interest in the sustainability of digital transformation is also reflected in the increasing number of citations of the analysed publications, although the overall citation count remains relatively average. From the pool of 101 selected articles, the median number of citations is 38, while the 10 most cited articles (Casciani et al., 2022; Liu et al., 2022; Ching et al., 2022; George & Schillebeeckx, 2022; Del Giudice et al., 2021; Guandalini, 2022; Ghobakhloo et al., 2021; Kamble et al., 2020; Gil-Gomez et al., 2020) received at least 237 citations, with the most frequently cited article by Carayannis and Morawska-Jancelewicz (2022). In the sample of articles included in the study, 11 out of 350 authors appeared more than once; most frequently, these were Iranmanesh and Ghobakhloo (three times) (Ching et al., 2022; Ghobakhloo et al., 2021, 2024). This suggests that there is no dominant author in the field of sustainable digital transformation.

Similarly, the analysis did not reveal the existence of a single journal that consistently published articles on sustainable digital transformation. On the contrary, sustainable development in digital transformation seems to be of interest to a wide range of editors and, consequently, to the wider academic community. However, the journal *Business Strategy and the Environment* deserves attention, with as many as five articles appearing in the sample for this study. Among the 81 journals and conference proceedings, 14 published at least two articles.

The high diversity of scientific journals is also reflected in the diverse origins of the authors. As shown in the table (Table 1), the authors contributing to the presented systematic literature review (SLR) come from all continents. However, the concept of digital transformation sustainability within management is predominantly explored by scholars affiliated with European institutions, who represent over 60 %

Tab. 1. Global distribution of authors by continent

CONTINENT	ALL AUTHORS		PRIMARY AUTHOR	
	NUMBER OF COUNTRIES	NUMBER OF AUTHORS	NUMBER OF COUNTRIES	NUMBER OF AUTHORS
Europe	22	224	19	63
Asia	12	86	9	26
Africa	4	13	3	4
North America	3	14	2	4
South America	1	12	1	2
Australia	1	9	1	2
sum	43	358	35	101

of all contributing authors. This trend remains consistent even when considering only primary authors. Asia ranks second in terms of author representation, accounting for 24 % of the total. In contrast, the concept of sustainable digital transformation appears to be more popular among authors from other continents, though their representation ranges only from 2 % to 4 %. Among the 43 countries included in the study, authors affiliated with German institutions dominate, contributing about 12 % of the publications, followed by those with Spanish, Italian and British affiliations, each representing between 7 % and 8 % of publications. The first Asian country affiliation in the list is Indonesia, with 6 % representation. North America and Africa account for only 4 % each, while countries from other continents each contribute less than 2 %.

The next stage analysed the research approaches and methods used in the selected set of papers. The early phase of research on sustainable digital transformation is evidenced by the predominance of conceptual (54 %) and exploratory (47 %) studies. Most of the selected papers focus on identifying and understanding the emerging phenomenon of sustainability of digital transformation, along with related challenges that were previously unknown or poorly understood.

This is further supported by the employed research methods. Most studies (approx. 68 %) used qualitative methods, while only 14 % were based on quantitative data. The reliance on qualitative approaches reflects the need for in-depth analysis of this relatively new phenomenon of sustainable digital transformation. In the initial stages of research, it is essential to understand the context and gain a deep insight into the phenomenon from the participants' perspectives. The chosen methods enable more effective analysis of cases involving a novel or unexpected result in this area. Qualitative methods are especially

valuable in interdisciplinary research, as they facilitate a comprehensive understanding of complex and evolving phenomena. They support exploration through a holistic, participatory approach to learning.

It is noteworthy that more than 62 % of the analysed publications base their research on secondary data. This may suggest the use of a wide range of available sources, including publications, reports, studies, and statistical data, which allow for deeper contextualisation of the researched problem. Only 12 % of the analysed publications rely on primary data, indicating that the authors pursued a specific research objective that required original, previously unpublished data. Around 26 % of the analysed publications use a mix of primary and secondary data, which may reflect an effort to strengthen research findings through triangulation.

Deepening the methodological analysis, it was observed that although the authors of the analysed publications employed various data collection methods, 45 % relied on a single method, typically a literature review or the use of existing data. In the remaining publications, two (45 %) or three (11 %) data collection methods were used. The use of surveys (20 %), interviews (19 %), and case studies (11 %) reflects the authors' efforts to identify research gaps and analyse previously observed patterns.

The final step of the descriptive analysis focused on the industrial scope. Of all the publications analysed, nearly 52 % addressed multiple industries, while about 48 % focused on a single, specific industry. Most of the publications referred to the broadly defined business sector without specifying company size or the nature of the activity. The most frequently mentioned sector was the manufacturing industry (including manufacturing, steel, food and fashion), followed by the logistics and supply chain management, and agriculture and natural resources.

3.2. THEMATIC ANALYSIS

The thematic analysis aimed to answer RQ2, which concerns “how areas of sustainability of digital transformation are identified and understood in the literature”.

The SLR-based analysis shows that the sustainability of digital transformation, considered a key element in the evolution of contemporary organisations (Ananyin et al., 2018), is a multidimensional concept (Andriushchenko et al., 2020) subject to various interpretations in scientific literature (Braukmann et al., 2023) and business practice (Beier et al., 2022; Branca et al., 2020). A comparison of different definitions of this phenomenon (Guandalini, 2022; Haryanti et al., 2023; Lammers et al., 2018) reveals a wide range of perspectives (Camarinha-Matos et al., 2024), highlighting the technological (Schuh et al., 2021), organisational (Broo & Schooling, 2023) and socio-cultural (Casciani et al., 2022) dimensions of the digitisation process. These discrepancies reflect not only technological evolution, but also the shifting expectations and needs of stakeholders (Abdallah et al., 2022), which directly influence how organisations undertake and implement digital transformation strategies (Alfarizi & Widiastuti, 2023).

All of the analysed articles aimed to optimise enterprise activities in the context of digital transformation through actions related to sustainability. The sustainability areas addressed varied across enterprises, regardless of the industry covered in each publication. Based on the analysis, the authors of this article identified 24 distinct areas of sustainability within digital transformation. The table (Table 2) presents these areas along with the meanings as derived from the selected publications.

The most frequently addressed areas were environmental (81 % of publications), technological (75 %), social (73 %), and economic (72 %). The authors of these publications highlighted connections to the sustainability framework known as the Triple Bottom Line (Loviscek, 2021), a concept introduced by John Elkington in 1994 (Elkington, 1997). This marked a pivotal shift in strategic thinking about the role of enterprises in relation to sustainability. The areas of sustainability are defined as follows: the social dimension emphasises a collective approach to transformation, aiming to ensure that change positively impacts communities by democratising processes, improving access to technology, and investing in human capital; the environmental dimension focuses on actions that result from environmental transformation such as

changes in energy used for production, waste management, and carbon footprint reduction; the technological dimension relates to technological innovation, digital inclusion, and the development of sustainable digital technologies. The economic dimension involves cost optimisation through the use of technology, as well as consideration of non-financial aspects of business operations.

On average, the emerging areas include organisational agility (26 % of publications), which focuses on adaptability, speed, and customer orientation. The human dimension (22 %), which considers individuals and their roles and impacts; culture (21 %), referring to the creation of values within the company along with interpersonal norms and rules; governance (19 %), which pertains to the principles of management and control within the organisation; and ethics (11 %), which involves adherence to rules and laws throughout the product life cycle; knowledge and support (11 %), which involves knowledge sharing and training; process (11 %), which focuses on the design of workflows and the interrelations between people and tasks within the organisation. These areas appeared most frequently in articles discussing digital transformation driven by algorithms and artificial intelligence tools.

The next set of sustainability areas in digital transformation processes identified by the authors of this article are those that appeared infrequently in the reviewed publications. However, given the very rapid development of artificial intelligence, these areas may grow in importance in the coming months and years. These include areas focused on implementing digital business development strategies (business sophistication - 9 %); operational (8 %), which concerns the optimisation and implementation of organisational processes; developing appropriate infrastructure to support technology (infrastructural - 8 %); ensuring integration with the external environment in a digital context (external - 6 %) and fostering innovation and creativity (creative outcomes - 5 %).

The least frequent areas were those that appeared only several times, each constituting 4 % of the analysed publications. These areas include structural which focuses on the materials used in construction; legal, which addresses legal considerations; individual, which refers to the personal impact of digital transformation on individual stakeholders; adapting to rapidly changing market conditions (market sophistication); promoting collaboration across all parts of the organisation (organisational ecosystem), and enhancing customer interaction through tech-

Tab. 2. Sustainability areas of digital transformation

NO.	NAME OF THE SUSTAINABILITY AREA	ADOPTED MEANING OF THE AREA FOR THE PURPOSE OF IDENTIFICATION	REFERENCES (EXAMPLES)	NUMBER OF PUBLICATIONS (N=101)
1.	Environmental	Minimising the environmental impact of technology.	(Calafat-Marzal et al., 2023; Cali et al., 2023; Ching et al., 2022; Ghobakhloo et al., 2021; Guandalini, 2022; Pérez Perales et al., 2019; Pinzaru et al., 2022; Popovs & Drinke, 2022; Weber-Lewerenz, 2021)	82
2.	Technological	Implementing new technologies.	(Abiodun et al., 2023; Chatzistamoulou, 2023; Chavez et al., 2022; Del Giudice et al., 2021; Fareed et al., 2024; Gil-Gomez et al., 2020; Ionascu et al., 2022; Li et al., 2024; Liu et al., 2022; Luo & Liu, 2024)	76
3.	Social	Building responsible digital practices for society.	(Kamble et al., 2020; Singh & Maheswaran, 2023; Spaltini et al., 2021; Straková et al., 2022; Trstenjak et al., 2023; Tyagi et al., 2024; Zaychenko et al., 2021)	74
4.	Economic	Increasing efficiency and generating economic value.	(Barmuta et al., 2020; Beier et al., 2022; Bhagat et al., 2022; Branca et al., 2020; Braukmann et al., 2023; Camarinha-Matos et al., 2024; Ghobakhloo et al., 2024; Margherita & Braccini, 2023)	73
5.	Organisational agility	Increasing the company's flexibility to respond to change.	(Broo & Schooling, 2023; George & Schillebeeckx, 2022; Jayashree et al., 2022; Kupilas et al., 2023; Otero Mateo et al., 2018; Pinzaru et al., 2019; Walter Colombo et al., 2021)	26
6.	Human	Improving working conditions through technology.	(Carayannis & Morawska-Jancelewicz, 2022; J. Chen et al., 2023; Gerhátová et al., 2021; Kupilas et al., 2022; Pacolli, 2022; Pappas et al., 2023)	22
7.	Cultural	Shaping a technology-friendly organisational culture.	(Abdallah et al., 2022; Abilova & Aliyeva, 2022; Alfarizi & Widias-tuti, 2023; Casciani et al., 2022; Haryanti et al., 2023; Schuh et al., 2021; Shang & Zhang, 2022)	21
8.	Governance	Implementing effective digital management strategies.	(Ananyin et al., 2018; Andriushchenko et al., 2020; Caraveo Gomez Llanos et al., 2023; L. Chen et al., 2023; Chipangamate et al., 2023; Grishunin et al., 2022)	19
9.	Ethical	Ensuring ethical standards in digital operations.	(Appiah-Nimo & Chovancová, 2020; Brauner & Ziefle, 2022; Jimenez et al., 2022)	11
10.	Knowledge and support	Development of competence and availability of technical support.	(Gatell & Avella, 2024; Keefe et al., 2024)	11
11.	Process	Digitisation and automation of business processes.	(Narkhede et al., 2024; Sezer et al., 2024; Valdez-Juárez et al., 2024; Nyagadza, 2022)	11
12.	Business sophistication	Implementing digital strategies for business development.	(Ionescu et al., 2022; Siswanti et al., 2024a, 2024b)	9
13.	Operational	Optimising operational processes with digital tools.	(Abad-Segura et al., 2024; Arranz et al., 2023; Ayoubi et al., 2023)	8
14.	Infrastructural	Building appropriate infrastructure to support technology.	(Arroyabe et al., 2024; Phiet, 2023)	8
15.	External	Integrating with the external environment in a digital context.	(Y. Chen et al., 2024; Leberruyer et al., 2024; Oubrahim & Sefiani, 2023)	6
16.	Creative outcomes	Stimulating innovation and creativity in the organisation.	(Arroyabe et al., 2024)	5
17.	Structural	Modifying organisational structures in response to technology.	(Lammers et al., 2018; Romanello & Veglio, 2022)	4
18.	Legal	Alignment with technology regulations.	(Ferrari et al., 2022; Ionescu et al., 2022)	4
19.	Individual	Personalisation of technology for individual user needs.	(Christmann et al., 2024; Dash et al., 2023)	4
20.	Market sophistication	Adapting to rapidly changing market conditions.	(Bezerra et al., 2024; Rodriguez Santiago, 2024)	4
21.	Customer experience	Improving customer interaction through technology.	(Mihardjo et al., 2019; Sezer et al., 2024; Valdez-Juárez et al., 2024)	4
22.	Organisational ecosystem	Creating collaboration between all parts of the organisation.	(Arroyabe et al., 2024; Carlos et al., 2024; Parmiggiani & Mikalef, 2022; Sun et al., 2024)	4
23.	Psychological	Nurturing the impact of technology on psychological wellbeing.	(Bezerra et al., 2024; Keefe et al., 2024)	3
24.	Political	Establishing relationships with political and regulatory stakeholders.	(Peretz-Andersson & Torkar, 2022)	1

Tab. 3. Framework of the areas of the sustainability of digital transformation

NO.	FIELD NAME	SUBGROUP NAME	DIGITAL TRANSFORMATION SUSTAINABILITY AREA NAME	REFERENCES (EXAMPLES)
1.	Technology	Tools	• Technological • Infrastructural • Structural	(Broo & Schooling, 2023; Cali et al., 2023; Del Giudice et al., 2021; Guandalini, 2022; Winarsih et al., 2021)
		Actions	• Operational • Process	(Abad-Segura et al., 2024; Arranz et al., 2023; Ayoubi et al., 2023; Narkhede et al., 2024; Nyagadza, 2022; Sezer et al., 2024; Valdez-Juárez et al., 2024)
2.	Management	Organisational	• Governance • Organisational agility • Organisational ecosystem	(Arroyabe et al., 2024; Carlos et al., 2024; Parmiggiani & Mikalef, 2022; Popovs & Drinke, 2022; Sun et al., 2024)
		Strategic	• Business sophistication • Economical • Market sophistication • External • Legal • Ethical	(Chernova et al., 2023; Ferrari et al., 2022; Gil-Gomez et al., 2020; Klungseth et al., 2023; Pérez Perales et al., 2019)
3.	People	Single	• Customer experience • Individual • Knowledge and support • Creative outcomes	(Narkhede et al., 2024; Pacolli, 2022; Phiet, 2023; Sezer et al., 2024)
		Multiple	• Social • Human • Psychological • Cultural • Political	(Carayannis & Morawska-Jancelewicz, 2022; Ghobakhloo et al., 2021; Kürpick et al., 2023; Münnich et al., 2023)
4.	Environment	Environment	• Environmental	(Calafat-Marzal et al., 2023; Grishunin et al., 2022; Junge & Straube, 2020; Kamble et al., 2020; Lichtenthaler, 2021; Ogrea, 2023)

nology (customer experience). Additional areas include areas focused on managing the impact of technology on psychological wellbeing (psychological - 3 %) and political (1 %), which encompasses policy-related influence.

Due to the large number of sustainability areas, it was necessary to classify them in order to simplify the structure and illustrate how the areas relate to one another. From the authors' perspective, it was important and fundamental to determine whether each sustainability area concerned technology-related or people-related areas. To support this classification, the following question was posed for each area: Does the sustainability area relate to technology, people, both technology and people, or neither?

Based on the responses to the question, four groups of sustainability areas were identified.

If the answer to the question was either "technology" or "people", it corresponded to the respective sections in the table (Table 3). If the answer was "technology and people", then it corresponded to the "management" section of the table. If the answer was neither "technology" nor "people", then it was classified under the "environment" section, as this was the only sustainability area that did not fit into the previous categories.

The division into four groups of areas helped simplify the understanding of the identified areas of digital transformation sustainability, but it was not sufficient to clearly structure the entire network of connections. Therefore, the authors introduced a further subdivision within each group to better assign the areas based on their functionality and importance. This refined classification is presented in the table (Table 3).

The proposed division breaks down the "technology" field into two subgroups: "tools" refers to various tools, machines, equipment, and other products used in the digital transformation process; and "action" encompasses all the activities and operations carried out during this process. The "people" field is divided into two subgroups based on the number of individuals involved: "single", for activities performed by and for one person, and "multiple", for activities involving more than one person. The field that combines technology and people, "management", is further divided into two subgroups: "organisational", which relates to the implementation of activities at the operational level, and "strategic", which pertains to the higher-level strategic planning. "Environment" contains only one area of sustainability and, as such, retains the same subgroup name.

4. DISCUSSION OF THE RESULTS

This study primarily aimed to review articles in the field of Sustainable Digital Transformation (SDT) to understand how the topic of sustainability in digital transformation is addressed. The review identified 101 publications providing insights into how the concept is currently understood. Despite the large number of publications on digital transformation studies that specifically focus on the sustainability aspect and that define specific areas of sustainability, the interest is rather limited. Most of the articles focus on the dominant dimensions of social, economic, and environmental sustainability. Although this is a relatively new and emerging topic, and there is a lack of a solid conceptualisation regarding the role of sustainability in digital transformation in transformational processes, several important theoretical implications can still be identified.

First, building on the foundational work of Vial (2019) and Elkington (1997), the authors identified a significant relationship between sustainability and digital transformation, both of which are key to long-term corporate strategy.

Second, the systematic review highlights a lack of consensus and consistent understanding regarding sustainable digital transformation across the analysed literature. In response to the identified problems occurring both in the scientific environment and among entrepreneurs, the authors of this SRL tried to conceptualise the approach to the sustainability of digital transformation by indicating the main fields of this concept.

Third, as the current study has shown, interest in sustainable digital transformation is observed in most industries, regardless of the size and technological sophistication of companies. Digital transformation is no longer the domain of only large companies or high-tech sectors. Even smaller and less advanced companies are seeing the value in such activities, and consequently, sustainability is becoming a key criterion in digital transformation, changing the way we think about technological development. What is more, the topic is attracting the interest of more and more researchers every year, as evidenced by the 100 % year-on-year increase in the number of publications addressing the sustainability of digital transformation. Interest in sustainable digital transformation has been noted on all continents, but the narrative in ongoing research is dominated by European authors.

Fourth, the development of the sustainability of digital transformation involves multiple interactions between the identified areas, which can create possible challenges and threats. The identified areas of the sustainability of digital transformation are associated with the novelty of the subject, and exploring this topic will provide a better understanding of the interrelationships between areas in order to create an optimal strategy for implementing a sustainable digital transformation.

Fifth, it is worth mentioning some methodological strengths of the current study. The present review, applying a systematic review methodology, scopes the whole field of the sustainability of digital transformation, not limited only to the most popular sustainability concepts, thanks to which it is more robust. It is worth noting that the inclusion of articles describing the sustainability of the digital transformation process from different types of academic journals adds value to this study, as we map the different areas of the sustainability of digital implementations, uncovering their key findings as well as their main concepts. Omitting perspectives presented in weaker journals could be to the detriment of further quantitative research, as this systematic literature review aims to identify all areas of sustainability of the digital transformation process from articles meeting the defined rigorous selection criteria. Further empirical research will select the identified areas of digital transformation sustainability in relation to their relevance and importance.

Last, by developing a framework that systematises the fragmented literature, it shows all the dimensions of sustainable digital transformation and groups them together. In this way, it provides a comprehensive approach to the topic, which is a good starting point for defining sustainable digital transformation, which is difficult but becomes easier if defined areas are used. This study enables future researchers to explore the different possible implications regarding the areas of sustainable digital transformation and increase their understanding with regard to the underlying mechanisms and conditions under which digitalisation will bring certain outcomes.

CONCLUSIONS

This study highlights the importance of a more robust and more effective business transformation by adopting a structured and sustainable approach to digital transformation. It plays a crucial role in

enhancing the understanding of the sustainability of the digital transformation process by using a classified set of sustainability areas in the transformation process. The results of this study provide practical information for managers leading digital transformation processes in companies.

First, the study highlights the need to integrate sustainability principles into the digital transformation process, supporting long-term value creation beyond immediate technological advances.

Second, managers carrying out a digital transformation process should take a multidimensional and inclusive approach to such a process, considering not only the technological aspects of implementations, but also focusing on the human, managerial and environmental aspects.

Third, the proposed breakdown structure supports practitioners in mapping and categorising the various aspects related to the sustainability of digital transformation. This will make the management of the digital transformation process more structured and harmonised.

Fourth, the findings of this study are also applicable to policymakers, highlighting a gap in the institutional mechanisms developed that do not consider the sustainability of digital transformation. Regulatory frameworks should encourage companies to adopt responsible digitalisation practices based on human-environment-technology synergies.

Fifth, the identified fields and areas of digital transformation sustainability provide the basis for a diagnostic tool to assess an organisation's readiness for sustainable digital transformation to help organisations to prioritise long-term digital transformation planning.

Last, the proposed framework can be applied to companies regardless of their size or sector, making it a versatile tool for organisations seeking a structured and sustainable way to carry out digital transformation. By adopting this approach, companies can increase their competitiveness, ensure compliance and drive efficiency through the synergy of humans, the environment and technology.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The conducted SLR has several limitations: an empirical research limitation, database sources, keywords, open access articles, and the exclusion of predatory journals. These restrictions were used as part of

a deliberate process with an overriding goal of attention to detail and adherence to scientific standards. The study focuses on theoretical research, which serves as preparation for empirical research in the next stage. The SLR provides a solid theoretical foundation and identifies research gaps, enhancing credibility and enabling the more effective planning and implementation of empirical research in the future, increasing its usefulness in practical scenarios. Although the literature review is limited to two databases, Scopus and Web of Science, they are among the most reputable and widely recognised scientific databases available. The selected keywords potentially limit the scope of the study but help to keep the literature review and data collection process exclusively relevant to the main topic of the study, thus avoiding the inclusion of unrelated information. The restriction applied in this study related to the use of papers from open access is intended to promote the democratisation of access to scientific knowledge. The elimination of literature sourced from predatory journals is intended to reassure the scientific community that the data used for analysis come from sources whose quality and ethical values of the selection process are beyond doubt.

The study results justify the need for empirical research to verify the relevance of the various areas of sustainability occurring in the digital transformation process. Nevertheless, to do that, there is a need to diagnose what the impact factors are in each area of sustainability when implementing the sustainable digital transformation process, and how they interact with each other. In the view of the authors, these results are an excellent initial step towards developing an enterprise digital transformation strategy based on sustainable factors. Among the articles reviewed, a number of definitions were identified that, at a high level of generality, are similar when it comes to the vision and fact of combining sustainability with digital transformation in a single process. However, these definitions differ at the operational level of the process. The current research suggests that a sustainable digital transformation approach could be used to implement digital changes in an organisation in a way that is beneficial for the organisation and all the stakeholders involved. Further research is needed to identify a uniform definition and assumptions for this process. Additionally, the table (Table 4) includes two additional streams that are worth deepening: Problem 2 on the parameterisation of sustainability in the digital transformation process and Problem 3 on the implementation of a sustainable digital transformation in organisations.

Tab. 4. Further research proposition

POTENTIAL FUTURE THEORETICAL DEVELOPMENTS	POTENTIAL FUTURE EMPIRICAL INVESTIGATIONS	POTENTIAL RESEARCH QUESTIONS
Problem 1: A uniform definition of sustainable digital transformation is lacking.		
- constructing a new definition of sustainable digital transformation - reconsidering existing theories used in the process of digital transformation	- testing the understanding of the definition of sustainable digital transformation - comparative analysis of existing definitions by experts	- To what extent does the definition reflect the process of sustainable digital transformation? - What are stakeholders' attitudes towards the transformation process after learning its definition?
Problem 2: Companies struggle to parameterise the impact of sustainability in the digital transformation process.		
- exploring the areas of sustainable digital transformation in terms of characteristics - determining factors in each of the identified individual areas - theorising the level of relevance of different areas of sustainable digital transformation	- examining the correlation between the impacts of factors in the areas of sustainable digital transformation - exploring potential paradoxes between areas	- How can the results of the parameterisation of the sustainable digital transformation process be interpreted? - To what extent are the different areas of sustainable digital transformation relevant?
Problem 3: Lack of a uniform implementation of sustainable digital transformation in organisations.		
- theorising the positive and negative effects of the sustainable digital transformation process - theorising the role of different stakeholders in organisations before, during and after the process of sustainable digital transformation	- testing whether one framework can be applied to different industries with positive results - showing the consequences of sustainable and unsustainable digital transformation processes	- How can the process of sustainable digital transformation be conducted? - What should the evaluation process look like?

The proposed research directions offer a complementary blend of focused theoretical and empirical investigations, contributing to research rigour and quality. From the perspective of the parameterisation of the concept, it would be beneficial to place particular emphasis on the empirical dimension of the research, while still acknowledging the importance of theoretical foundations. The outlined research paths have the potential to shape a new approach to digital implementation, positioning sustainability concerns as the primary point of departure.

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