

Digital Transformation and Sustainability. A Systematic Literature Review



Giada Pierli , Federica Murmura , and Laura Bravi 

Abstract The study contributes to enriching the current literature on the connection between digital transformation and sustainability at the industry level, by developing a Systemic Literature Review (SLR). The database used to identify the documents was Web of Science; the selected time period was from 2010 to 2022 in order to perform an as comprehensive as possible analysis of the published articles on this topic. Three research categories were selected: Business, Management, and Economics. The results underlined that digital transformation can significantly support the achievement of sustainable goals, representing a key opportunity for both institutions and businesses to change their management models to meet the community's increasingly pressing expectations in terms of environmental protection and social welfare. In this sense, the results show the need for more comprehensive studies on the relationship between digital transformation and the pillars of sustainability, especially the social one. The study has some limitations deriving from only using articles, a single database, and a specific query to identify relevant documents.

Keywords Digital transformation · Sustainability · Systemic literature review

1 Introduction and Theoretical Background

Over the past decade, the topic of sustainability has become the focus of a major academic, industry, and policy debate. As environmental, social, and economic pressures have become increasingly severe and unrelenting, international organizations

G. Pierli · F. Murmura · L. Bravi (✉)

Department of Economics, Society, Politics, Carlo Bo University of Urbino, 61029 Urbino, Italy
e-mail: laura.bravi@uniurb.it

G. Pierli

e-mail: g.pierli@campus.uniurb.it

F. Murmura

e-mail: federica.murmura@uniurb.it

and countries worldwide have begun to promote the adoption of new action plans [1] that are able to combine economic growth with environmental protection and societal well-being.

In this context, the concept of sustainable development—closely intertwined with that of sustainability—has become the guiding principle of development policies globally. Although this theme has undergone a profound evolution depending on the different contexts of application [2–4], the widely shared definition of sustainable development is the one formulated in the Brundtland Report carried out in 1987 by the World Commission on Environment and Development (WCED). According to this report, sustainable development can be defined as “development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs” [5, p. 43]. This concept is the result of the increased awareness of the planet’s resource exhaustibility and the consequent need to preserve the natural heritage [6], through the definition of more balanced economic-social development models than those adopted in the past. On this basis, sustainability can be declined into three main pillars: environmental, social, and economic [7, 8].

The environmental dimension is concerned with the need to preserve the reproducibility and availability of natural resources, the social dimension is aimed at tackling inequalities and ensuring the inclusion and accessibility of services, and the economic component is related to the ability to ensure economic efficiency and income for businesses and jobs for people’s livelihoods [9, 10]. Over the last few years, the idea of sustainability has been increasingly intertwined with that of digital transformation [11], emphasizing the important role of technology in improving global well-being. Since 2016, the United Nations have been committed to an international agenda to achieve the 17 Sustainable Development Goals (SDGs) by 2030, underlining the relevance of technology to their achievement [12]. Similarly, the European Commission has recently highlighted the fundamental function of digital technology for the implementation of the Green Deal, which is Europe’s new growth strategy to promote the green transition with the ultimate goal of reaching climate neutrality by 2050 [13]. Most recently, the Next Generation EU fund, set up by the European Union in response to the significant economic and social impacts generated by the Covid-19 pandemic, further stressed the need to combine sustainability and digitalization, laying the foundations for a significant transformation in this direction [14].

Despite being apparently distant, the themes of sustainability and digital transformation are closely related and mutually complementary. In order to understand this interconnection, it might also be useful to introduce the definition of digital transformation. Among the many existing notions, it could be generically described as “the most profound and accelerating transformation for business activities, processes, competencies, and models to leverage the changes of digital technology and their impact in a strategic and prioritized way” [15, p. 723]. Digital transformation thus represents an evolutionary process in which digital technologies and capabilities generate new opportunities for value creation, requiring fundamental changes in organizations that can also have a strong impact in terms of sustainability [16, 17]. According to the United Nations and the Organization for Economic Co-operation

and Development (OECD), digital technologies are not only essential tools for business operations, but they can also significantly facilitate the achievement of sustainable goals [12, 18]. Similarly, Seele and Lock [19, p. 183] state that “digital technologies in the form of e-health services, robotics, or emission reduction solutions could help individuals, organizations, and nations achieve a more sustainable planet in light of the sustainable development goals.”

Digital transformation is not an exclusively organization-focused process, but rather a phenomenon that triggers changes in industry and society [20]. Indeed, digital technologies are able to produce widespread effects that simultaneously involve all dimensions of sustainable development [11], including global productivity, social equality and inclusion, and environmental protection. The main technological innovations to drive the transition to sustainability include the Internet of Things (IoT), big data analytics, blockchain, artificial intelligence and machine learning, cloud, 5G Internet, and virtual reality systems [21–23]. Specifically, the environmental pillar can benefit significantly from the use of such digital tools, which can effectively protect the ecosystem by contributing to emissions reduction, waste management, resilience to natural hazards, and minimization of climate change effects in any economic sector [11, 16, 24]. Regarding the social dimension, digital transformation offers effective methods and solutions for ensuring access to basic services—such as food, health, water, and energy—thus reducing inequalities and improving the health and food conditions of populations [11]. Finally, the economic component can take advantage of digital technologies in terms of innovation in production processes, which allows an increase in efficiency and a reduction in emissions [11].

It is therefore evident that sustainability and digital transformation are closely interconnected. According to Weipl et al. [25], information and communication technologies (ICTs) are a key determinant in achieving sustainable development goals through their potential for more efficient use of resources, education, and business operations. As stated by Vinuesa et al. [26], artificial intelligence can contribute to the fulfillment of the most sustainable goals by acting on all dimensions of sustainability. Kostoska and Kocarev [27] developed a new Information and Communications Technology (ICT) framework to address sustainability, arguing that digital technologies can enable its effective achievement.

Despite the consistent discussion on the different possible ways to meet sustainability goals, there are still few studies on the relationship between digital transformation and sustainability [11, 16, 17, 28], especially at the corporate level. In this context, a useful recent tool for identifying a company’s sustainable performance is the Environmental, Social, and Governance (ESG) score. As outlined by the European Banking Authority (EBA) [29], ESG factors are “environmental, social or governance matters that may have a positive or negative impact on the financial performance or solvency of an entity, sovereign or individual.” Precisely, ESG is a standard used by investors to evaluate corporate behavior and future performance based on three key elements, namely Environment (E), Social (S), and Governance (G) [1]. In this sense, companies are required to adopt innovative business models capable of fostering the joint pursuit of environmental, social, and economic performance.

Given the need for more knowledge to understand the connection between digital transformation and sustainability, this study aims to fill this gap by developing a Systemic Literature Review (SLR) on the topic. Specifically, it aims to address the following research question:

What is the current state of the art on the relationship between digital transformation and sustainability at the industry level?

In this perspective, the study contributes to enrich the current literature and identify potential future research directions and developments. Furthermore, it could offer useful insights for institutions and companies on what are the main benefits and controversial aspects encountered in the combination of digital and sustainability, encouraging their application and possible support measures.

The paper is organized as follows: Sect. 2 describes the methodology used to develop the systematic literature review, Sect. 3 illustrates the results, and Sect. 4 provides the main conclusions and future research.

2 Methodology

In order to present current and future research trends with respect to the relationship between digital transformation and sustainability in industrial settings, a Systematic Literature Review (SLR) was developed. Indeed, it provides an effective method for identifying the current state of research and defining future research opportunities [30, 31]. Based on guidelines from the previous studies on doing a Systematic Literature Review [32, 33], the following steps were implemented:

- (a) Selection of sources. The database used to identify the documents of interest was Web of Science, which is considered as one of the most relevant academic search systems [34].
- (b) Setting search criteria. The keywords used in the search were (“sustainability” OR “sustainable development” OR “ESG”) AND “digital transformation.” In this way, it is possible to find all articles that have the words sustainability and digital transformation, sustainable development and digital transformation or ESG and digital transformation in the title, keywords, or abstract.
- (c) Selection criteria. The selected time period was from 2010 to 2022 in order to perform an as comprehensive as possible analysis of the published articles related to this last topic. It is clarified that the information included for 2022 corresponds to the first six months of the year since the search process was carried out on July 1, 2022. The analysis includes all articles published in English. Publications such as books, conference proceedings reports, working papers, etc., were excluded from this study. Based on the objective of the study, three research categories were selected, namely, Business, Management, and Economics. Finally, the abstract of each article was read to confirm or not its relevance to the investigated topic.

- (d) Content analysis and synthesis. After selecting a sample of articles, a content analysis was conducted. To this end, each article has been analyzed in terms of authors, year of publication, paper title, type of research category, journal, and citations. This provided a framework for understanding the current state of the art on the topic. Subsequently, the articles were analyzed and grouped by research area, with the aim of identifying the main themes addressed.

Initially, 501 different manuscripts were identified in the search. After applying the selection criteria defined above (iii), 60 articles were considered within the scope of this analysis.

3 Results

This section presents the main results of the analysis conducted. It has been divided into three parts, consistent with the perspectives considered: (1) time, (2) journal, (3) subject areas, topic, and citations.

3.1 Paper by Time

As shown in Fig. 1, the topic investigated has increased in recent years. In particular, 2021 has the highest number of publications on the relationship between digital transformation and sustainability, while 2010 is the year when the first article on the topic was published. The research was carried out in June 2022, so it is interesting to note that in just 6 months, 19 articles have already been published, which is a very close number to those of the previous year.

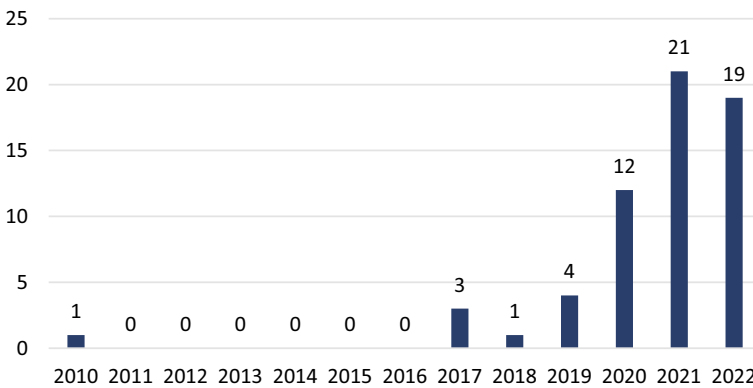


Fig. 1 Article’s distribution over time

3.2 *Papers by Journal*

The articles analyzed are distributed in 48 different journals. The journal with the highest number of publications on the subject is *Business Strategy and the Environment*, in which there are 4 articles published during the period considered. *Technological Forecasting and Social Change* follows with 3 published articles. Other relevant journals where at least 2 papers on this issue have been published are *Journal of Asian Finance Economics and Business*, *Ecological Economics*, *Total Quality Management & Business Excellence*, *Journal Of the Knowledge Economy*, *Journal of Business Research*, *Industrial Marketing Management*, *Economic Annals-XXI*.

3.3 *Papers by Subject Area, Topic, and Citations*

Figure 2 shows the distribution of the documents analyzed with respect to the selected subject areas. It should be noted that some papers do not belong exclusively to one category, but were included in at least two subject areas. Thus, the category with the highest number of manuscripts is *Business* (16), followed by *Management* (15), *Business & Management* (12), and *Economics* (9). The remaining areas are *Business & Economics* and *Management & Economics*, with 6 and 2 papers each.

Table 1 summarizes the main topics of the articles analyzed with a subdivision by category. In the *Business* area, the main topics are the impact of digital transformation in terms of corporate financial, production and environmental performance and the use of digital technologies to effectively communicate Corporate Social Responsibility (CSR). On the other hand, the main topics in the *Management* category are the impact of digital transformation in achieving the Sustainable Development Goals (SDGs), the importance of developing innovative business models for sustainable business transformation, the positive relationship between digital transformation and the company's environmental and financial performance, the role of digital technologies in improving production and managerial processes, the link between digital

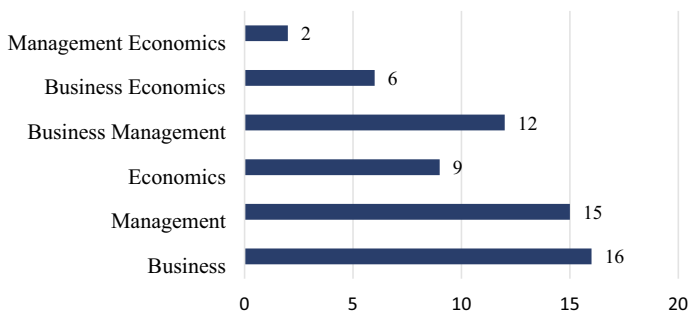


Fig. 2 Distribution of papers by subject area

technologies and the circular economy, and the importance of digitization in making the supply chain sustainable. For the *Economics* area, the main topics include the role of digital transformation as a key factor for governments in promoting inclusive economic growth, social development, and environmental protection; the efficiency of governance in implementing sustainable goals using digital technologies; challenges and opportunities of the digital and sustainable transition; and the use of digital tools to implement sustainable practices within public institutions. Finally, the categories Business & Economics, Business & Management, and Management & Economics mostly present an overlap of issues compared to those illustrated individually for the three previous areas. Nevertheless, new issues can be identified in terms of Green Digitization, complexity of digital and sustainable transformation at the organizational level, and the importance of adopting automated methods and processes to reduce energy waste and CO₂ emissions.

Consistent with the years in which publications began to increase, the highest number of citations is recorded from 2019 (Fig. 3). The year 2021 represents the one with the highest number of citations (305), showing a significant increase from the previous year's 84 citations. The date for 2022 is also quite positive, with 211 citations achieved just in the first six months of the year.

4 Discussion and Conclusion

The aim of this study was to analyze and identify the state of knowledge related to the relationship between digital transformation and sustainability, with a focus on the industry level. In order to achieve this goal, a Systematic Literature Review (SLR) was developed through which selected papers could be examined in terms of year of publication, journal, subject area, main topic, and citations. In particular, the analysis performed indicates that interest in the topic has grown in recent years, especially since 2021. The fact that the first six months of 2022 reached a number of publications rather close to that of 2021 is an indicative of increasing attention to the topic. Articles have been published in several important journals, among which Business Strategy and the Environment ranks first in terms of publications on the issue. Consistent with the period of greatest publications, the highest number of citations is in 2021. The main topics of the selected papers include (i) the impact of digital transformation in achieving sustainable goals, especially with respect to the environmental and economic dimensions; (ii) the importance of adopting innovative business models in order to facilitate digital and sustainable transformation; (iii) the role of digital transformation as a key factor for governments in promoting inclusive economic growth, social development, and environmental protection. These results confirm the need for more comprehensive studies on the relationship between digital transformation and the different pillars of sustainability, especially with respect to the social one [20, 35]. They also support that most scholars have focused on the

Table 1 Topic by subject area

Business	Management	Economics	Business and Economics	Business and Management	Management and Economics
Digital transformation impact on logistics sustainability	Link between digitalization and the achievement of the Sustainable Development Goals (SDGs) in the Italian agri-food sector	Efficiency of governance and sustainability of public finance based on digital transformations	Impact of Digital Transformation's (DT) readiness on SMEs' sustainability	Collaboration and coordination in a digital supply chain to achieve sustainability	Role of digital technology adoption, digital dynamic capabilities, and digital transformation performance in the textile sector in facing the opportunities and challenges of sustainable development
Digital transformation impact on production process	Significant impact of digital transformation in corporate environmental performance	Impact of digital transformation in the localization and achievement of sustainable development goals, at the government level	CRM as Green IT, oriented toward digital transformation and sustainable business model innovation	Digitization of business as a tool to enable a better dialogue between business economic theory, sustainability studies, and business ethics	Application of green digitization in the electric power sector, its prerequisites and potential economic and social impacts
Effect of digital transformation on sustainability, considering the important role of customers, data and innovation	Positive impact of digital transformation in achieving Sustainable Goals 4 and 9	Resources, capabilities, and management choices necessary to implement digital transformation and achieve sustainable goals	Impact of corporate digitalization on the corporate sustainability performance and barriers and supportive institutional frameworks for corporate digital technology adaptation	Influence of sustainable development, organizational drivers, cultural context, and digital transformation at a strategic level	

(continued)

Table 1 (continued)

Business	Management	Economics	Business and Economics	Business and Management	Management and Economics
Communication of corporate transformation Industry (CTI4.0) and role of ESG disclosure	Innovative business models facilitate the company's transition to sustainable development	Digital transformation within universities as a means of setting the stage for sustainability priorities and considerations	Need for policies and strategies that foster smart tourism destinations and the development of a more digitized and sustainability-oriented economy	Complexity of a digital transformation of the business organization and how to make this transition sustainable	
Importance of adopting a stakeholder orientation in the context of digital transformation. In this way, companies have better financial and customer service performance	Opportunities related to digital transformation in terms of its impact on society and industries	Digital transformation as a key driver for governments to promote sustainable and inclusive economic growth, social development and environmental protection	Role of digital transformation in the public sector and how it affects society	Combination of corporate sustainability and digitalization facilitates in transforming the organizational nature of banks by simultaneously narrowing their boundaries and expanding their scope	
Significant effects of digital accounting on financial reporting quality, accounting information usefulness, and strategic decision effectiveness	Positive interrelationship between digital maturity and corporate financial indicators	Digital transformation in seaports as a tool to implement operational efficiency while coping with new economic issues	Importance of automated production methods and business processes in reducing energy waste	CO ₂ reduction through digital transformation in long-haul transportation	

(continued)

Table 1 (continued)

Business	Management	Economics	Business and Economics	Business and Management	Management and Economics
<p>How multinational companies are coping with the environmental and pandemic crisis in combination with digitalization</p>	<p>Positive link between digital transformation, digital business model maturity, and sustainable business excellence in the tourism sector</p>	<p>Challenges and opportunities related to the dual transition—digital and sustainable—within European countries</p>		<p>Synergies between digital technologies and the circular economy paradigm through the lens of digital functions</p>	
<p>The relationship between three growth paths for firms: internationalization, digitalization, and sustainability</p>	<p>Importance of creating equal opportunities for the current workforce to improve their digital fluency and skillset by providing information about the benefits of digital twins throughout the infrastructure sector and organizations to improve adoption and the realization of benefits</p>	<p>Country's institutional framework on the relationship between digital transformation and environmental performance</p>		<p>Role of big data and social media analytics for business to achieve business sustainability</p>	

(continued)

Table 1 (continued)

Business	Management	Economics	Business and Economics	Business and Management	Management and Economics
How global communities can address the investment collapse caused by COVID-19 through digital transformation as a driver to facilitate the achievement of sustainable development goals	Innovative business models as key elements in achieving sustainable goals	The predominant role played by information and communication technologies in boosting the economic growth		Distinct and combined effects of digital business transformation (DBT), organizational ambidexterity (OA), and circular business models (CBMs) on the relationship between I4.0 capabilities and sustainable supply chain performance	
Corporate Social Responsibility (CSR) and digital technologies as key elements for the success of food sharing platforms	Digital transformation process of family businesses from the perspective of the firm's human capital			Building responsible innovation in international organizations	
Digital transformation as a tool for creating effective and innovative business networks, making production processes more flexible and efficient	Relevance of digital transformation to the achievement of management efficiency			Purpose Product lifecycle management (PLM) as a tool to address the challenges of sustainability, traceability, and transparency in industry and inter-industry collaborations	

(continued)

Table 1 (continued)

Business	Management	Economics	Business and Economics	Business and Management	Management and Economics
A new paradigm of sustainable development for healthcare and welfare systems at the global level, through technological progress	Importance of adopting innovative and sustainable business models			Students' digital learning orientation. The indirect effect of digital learning orientation on innovative work behavior through readiness for change	
Data analytics and Artificial Intelligence (AI) toward social and economic sustainability	Big-data-driven supply chain action as a moderator of the relationship between circular economy human resource management and business performance for a circular economy supply chain				
The role of SME owners is a key factor in initiating technology readiness for organizational sustainability	Challenges to make manufacturing supply chain 4.0 sustainable				

(continued)

Table 1 (continued)

Business	Management	Economics	Business and Economics	Business and Management	Management and Economics
The role of the Internet and digital technologies in communicating corporate social responsibility (CSR)	Organizational integration of modern IT-based technologies and digitization of value chains to make production processes more effective and efficient				
Digital transformation and the improvement of manufacturing processes					

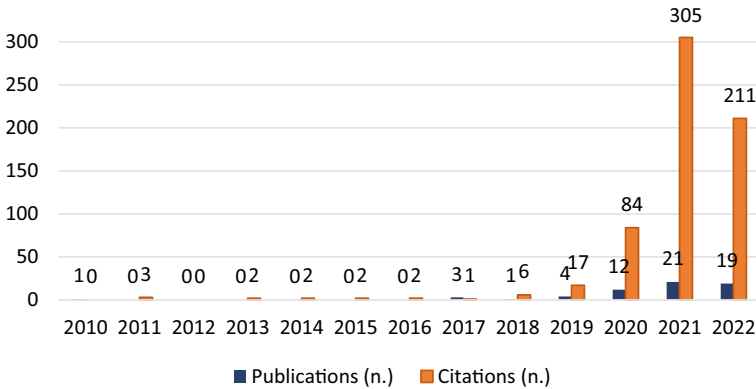


Fig. 3 Number of citations

opportunities provided by digital transformation to make a given business sustainable [11], while there are still few studies on the relationship between these two dimensions.

Nevertheless, it is possible to argue that digital transformation is an effective tool for achieving sustainability [19, 36], through a range of tools that enable organizations to significantly improve their environmental, economic, and social performance. As pointed out by Camodeca and Almici [11], artificial intelligence, blockchain, data analytics, robotics, Internet of Things, social media, cloud technology, and digital reality are tools through which businesses can contribute to the protection of the ecosystem by circular economy models, the development of sustainable production and consumption patterns, and the reduction of inequality and discrimination by ensuring equity, parity of opportunity, and broad accessibility to primary services.

It is therefore evident that digital transformation can significantly support the achievement of sustainable goals, representing a key opportunity for both institutions and businesses to change their management models in order to meet the community’s increasingly pressing expectations in terms of environmental protection and social welfare.

The paper presents both academic and practical contributions. Indeed, it contributes to the existing literature by providing a framework on the current state of the art in the field and identifying emerging and potential avenues for future research. The study provides practical implications. In particular, it emphasizes the need for action by policymakers both to introduce measures to promote sustainability-friendly technology investments and to foster international cooperation in the digital and sustainable transition. In addition, it highlights the importance of adopting key performance indicators within the enterprise—such as ESG—to monitor and assess its environmental, social, and economic impacts concurrently with the implementation of organizational and operational digital changes.

The study has some limitations. Firstly, the research focused only on articles, excluding books, conferences, and other sources. Therefore, additional sources might

lead to different conclusions. Furthermore, a specific query was used to identify relevant articles and only one database was used. The use of different terms and the consideration of multiple databases could lead to alternative results.

Future research could focus exclusively on the mutual relationship between digital transformation and sustainability. To date, most studies investigated the impact of digital technologies in achieving sustainable goals, analyzing their linkage unidirectionally. Furthermore, it might be interesting to further investigate the correlation between digitalization and the social dimension of sustainability within the business context, which is still poorly investigated. Finally, it might be important to analyze what digital transformation capabilities and organizational and operational changes are required to successfully combine digitalization and sustainability.

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