

Digitalization and Sustainability: Where do we stand? A systematic review of reviews in managerial studiesMartina Tomasetig – *Università degli Studi di Udine***Abstract**

The connection between digitalization and sustainability has become a focal point for academics and practitioners, who are called to actively find solutions to today's sustainable development issues. Academia has up to date generated a growing body of literature reviews. Nonetheless, the knowledge around these two trending topics still appears scattered. This ongoing study addresses this issue by developing an umbrella review to provide a comprehensive understanding of this evolving field and to identify future research directions. Through the adoption of the PRISMA approach, we developed a systematic review of reviews. We studied 27 literature reviews published in high-quality ABS-ranked journals between January 2010 and September 2023. The preliminary results confirm that the body of knowledge has been growing over the last decade and identify some trending topics of research. This work aims to contribute to the literature by providing a comprehensive and deep understanding of the digitalization and sustainability topics within managerial studies, while also offering insights into emerging trends and guiding future research in this dynamic domain.

Keywords: Sustainability; Digitalization; Industry 4.0; Systematic literature review; Umbrella Review

1. Introduction

In recent years, the study of digitalization and sustainability has witnessed significant growth in scholarly exploration (Kayikci et al., 2022; Srhir et al., 2023a) and in little more than a decade has become a focal point for academia, industry, governments, and stakeholders. These actors are called to find solutions to the sustainability challenges the world is facing (Bag et al., 2021), as identified by the United Nations' Sustainable Development Goals (SDGs). The existing body of literature in the management field has explored the complex dynamics existing between digitalization, often represented by the concept of Industry 4.0 and its specific technologies, and sustainability on multiple fronts, including its environmental, social, and economic dimensions (Srhir et al., 2023a).

The convergence of digital technologies and sustainability principles has generated serious implications across sectors, motivating researchers to delve deeper into their interplay. Specifically, several focused reviews on the topics of digitalization and sustainability exist in the literature (Ding et al., 2023; Ertz et al., 2022; Kamble et al., 2020). The results of the research in this field often led to divergent findings, underlying the complexity of the digitalization-sustainability nexus (Beltrami et al., 2021) and motivating the need for a better understanding of the relationship between these two concepts. Moreover, literature reviews, in their search for originality, tend to emphasize various aspects of this relationship (Beltrami et al., 2021) and often introduce a multitude of analytical frameworks and theoretical approaches that may not always align with one another. Many studies have focused on topics related to digitalization

and sustainability in the managerial field. Thus, a more organized and thorough approach to studying these topics is required (Beltrami et al., 2021). This research aims to address these gaps, offering an understanding and overview of the existing knowledge (Risso et al., 2023).

This work addresses two fundamental research questions. Firstly, it seeks to identify which are the main digitalization and sustainability topics in the literature as they emerge in existing literature reviews. Secondly, it wants to identify which directions for future research have been reported in reviews about digitalization and sustainability in managerial research. To achieve these objectives, the original approach, known as “umbrella review” or “review of reviews” is employed (Li et al., 2020; Moro et al., 2023; Risso et al., 2023). This approach draws upon evidence from existing literature reviews to allow for the synthesis and overview of the state of the art within specific research domains. Review of reviews are deemed extremely valuable when applied to rapidly growing topics (Risso et al., 2023), such as the one addressed in this paper, allowing for the creation of a comprehensive overview of the emerging, growing, and declining areas of research, as well as for the identification of future research avenues. Notably, while several reviews concerning digitalization, Industry 4.0 and its technologies, and their relationship with sustainability have been identified, little if no reviews of reviews (Risso et al., 2023) have addressed these topics, giving some edge to develop novel knowledge in the field.

2. Theoretical Background

In the proposed exploration of research on digitalization and sustainability, it is fundamental to define these two complex topics. Drawing from several scholarly works, in this section, we aim to build a theoretical foundation that considers the concepts of digitalization and sustainability.

Digitalization is a wide concept that entails a transformation of business models, leading to substantial modifications within the internal processes of a firm, its customers, interactions, products, and services, and requires extensive use of information and communication technologies (Isensee et al., 2020). Often, within the study of digitalization, the managerial literature focuses on the concept of Industry 4.0. This concept was developed by the German government in 2011 as the cornerstone of its high technology plan (Mastrocinque et al., 2022) and has soon become a transformative idea for practitioners and academics. Digitalization at large, and in a business context Industry 4.0, includes a vast array of technologies and applications (Rani et al., 2023) that have been studied and oftentimes summarized by scholars. These technologies include but are not limited to the Industrial Internet of Things, cybersecurity, cloud services, additive manufacturing, big data analytics, smart manufacturing, smart products, smart supply chain, and smart working (Frank et al., 2019).

The concept of sustainability is multifaceted as well. Sustainability plays a critical role in facing the sustainability challenges of this century (Khan et al., 2021). Sustainable development has been commonly considered as “the ability to meet the needs of the present generations without compromising the ability of future generations to meet their own needs” (WCED, 1984). This definition considers no specific constraints to sustainability, if not those dictated by the limits of technologies, social structures, and

environmental resources to absorb the impact of human activities (Khan et al., 2021). Sustainable development and sustainability are at times considered synonyms (Norton, 2005), even though they may be regarded to have different meanings. Following the approach by Khan et al. (2021) this review will be based on the understanding of sustainability and sustainable development as social learning processes, with sustainability being a means to achieve the sustainable development objectives. The conceptualization of sustainability does not only include environmental aspects but has evolved over the years to entail a more operational definition encapsulated in the concept of Triple Bottom Line (TBL) (Isensee et al., 2020). TBL was first developed by Elkington (1998) and is a framework comprising three pillars of sustainability – economic, social, and environmental (Khan et al., 2021). Another conceptual idea considered within the notion of sustainable development is the one of circular economy, which has been addressed both in literature reviews and empirical papers (Kim et al., 2023) and suggests a shift from the linear model of production and consumption to a circular model allowing for the reduction, reuse, recycling, remanufacturing, and redesign of products and processes (Khan et al., 2021).

In addition to these foundational elements and definitions, the analysis presented here seeks to get deeper into existing literature reviews. This analysis provides an opportunity to gain insights into the dominant themes, conceptualizations, and future developments within the existing body of literature.

3. Methodology

The research uses a rigorous methodology to conduct a systematic umbrella review (Risso et al., 2023). The focus of the research is on the interplay between digitalization and sustainability within managerial studies, intending to synthesize existing knowledge, offer critical insights, and identify gaps in the current understanding of the topic under scrutiny. Thus, the aforementioned methodology appears appropriate to tackle the dual research question. To ensure methodological transparency, the study adopts the PRISMA approach (Page et al., 2021). This approach is widely recognized for systematic literature reviews as the one proposed and allows to enhance the rigor, transparency, and replicability of the research process. The keyword selection entailed a first exploratory analysis of the literature to identify the most adopted terms. The keywords were divided into two main categories. The first group included words related to digitalization. These keywords were chosen considering previous works (Del Río Castro et al., 2021), as well as the definition of Industry 4.0 provided by Frank et al. (2019). A second group of keywords included words related to sustainability (Sarkis and Zhu, 2018). These were combined in a unique query and connected using logical operators. The research adopted Scopus as the primary research database due to its extensive coverage. To maintain the rigor within the results stringent and objective inclusion and exclusion criteria were included. A clear synthesis of these can be found in **Table 1**.

Only reviews published in peer-reviewed journals were considered for inclusion (Risso et al., 2023). Thus, a limitation was put on the document type within the research query. Papers published from 2010 to 2023 were included, encompassing a complete view of the digitalization-sustainability landscape. The research yielded 14,050 results. A first screening performed on Excel included the consideration solely of works published in

4*, 4, and 3 ABS-ranked journals to guarantee the quality of the results (Chartered Association of Business Schools, 2021). This allowed for the identification of a first larger sample of 208 papers which was further screened.

Table 1: Search protocol

Information	Description
Search Criteria	
Databases	Scopus
Language	English
Scientific Areas	All
Journals	All
Article Types	Review
Search Fields	Title, Abstract, and Keywords
Date of Publication	From January 2010 to September 2023
Search Terms	("digital*" OR "Industry 4.0" OR "Industry 5.0" OR "advanced technologies" OR "IoT" OR "blockchain" OR "additive manufacturing" OR "3D printing" OR "big data" OR "artificial intelligence" OR "autonomous robots" OR "cloud services" OR "cybersecurity" OR "smart products" OR "smart manufacturing" OR "smart supply chain" OR "smart working") AND ("environment*" OR "sustainab*" OR "green" OR "eco*" OR "eco-innovation")
Search Query	TITLE-ABS-KEY(("digital*" OR "Industry 4.0" OR "Industry 5.0" OR "advanced technologies" OR "IoT" OR "blockchain" OR "additive manufacturing" OR "3D printing" OR "big data" OR "artificial intelligence" OR "autonomous robots" OR "cloud services" OR "cybersecurity" OR "smart products" OR "smart manufacturing" OR "smart supply chain" OR "smart working") AND ("environment*" OR "sustainab*" OR "green" OR "eco*" OR "eco-innovation")) AND PUBYEAR > 2009 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (DOCTYPE, "re"))

Papers that did not align with the review format were excluded (EC1), together with reviews that did not directly address the intersection of digitalization and sustainability (EC2). Specifically, those focused solely on one of the two topics were omitted (EC3 and EC4). Moreover, any further papers not falling within the managerial field were removed. Following the screening process, a final group of 27 papers emerged. These reviews were selected to be systematically analyzed.

4. Expected findings and future steps of the research

The objective of this umbrella review is dual. First, the research aims at understanding the current state-of-the-art around the topics of digitalization and sustainability in managerial studies providing an informed perspective on these evolving domains. Secondly, it wants to identify future research avenues as they have been underlined in previous review works. To achieve these goals, a comprehensive approach combining descriptive and in-depth analyses of the selected reviews is essential.

Upon examining the selected reviews some main areas of focus are identified. The two themes of digitalization and sustainability are addressed in various contexts. Several papers analyze the topic of supply chain management and the role of technology in achieving sustainability objectives (Kamble et al., 2020; Kumar et al., 2023; Schilling & Seuring, 2023). A second area of focus is one of digitalization with papers that primarily concentrate on digitalization with a secondary focus on sustainability. These

reviews encompass aspects of Industry 4.0 and related technologies (Stefanini & Vignali, 2023; Ertz et al., 2022). Vice versa, works with a focus on sustainability delve into topics like circular economy (Gebhardt et al., 2022). Finally, a set of papers focusing on other topics, such as innovation (Malacina & Teplov, 2022; Obradović et al., 2021), that identify the connection between digitalization and sustainability are identified. Looking ahead, future research avenues include the exploration of specific digital technologies (Kamble et al., 2020; Ding et al., 2023; Ertz et al., 2022). Additionally, investigating the relationship between digitalization and sustainability in specific areas and fields offers a promising avenue for future research, as indicated by Fan et al. (2021) and Kim et al. (2023), among others. It is also essential to consider the negative impact of digitalization on sustainability (Ciano et al., 2019; Schilling & Seuring, 2023). Furthermore, digital innovation for sustainability (Khorram & Nonino, 2017; Malacina & Teplov, 2022) remains a fertile ground for exploration.

Nonetheless, this research is currently in a preliminary phase. The work will proceed with several essential steps. First, we will include in our sample further reviews published in 1 and 2 ABS-ranked journals. Later further relevant descriptive analyses will be performed, aiming to provide a complete and comprehensive overview of the existing literature. This will include identifying key information about the selected reviews, such as their typology, and the key topics addressed. Subsequently, a systematic study of the further selected reviews will be performed. These steps will allow us to delve deeper into the characteristics of the selected reviews, helping to gain a deeper understanding of the findings, and gaps in the existing research. Through these steps, we aim to generate valuable insights. Specifically, we will not only identify the principal research topics but also study how these topics interconnect. By examining the relationship between digitalization and sustainability we hope to identify potential synergies and areas that require future exploration, to provide a novel foundation for future studies, allowing for a better understanding of where we stand and where we are going.

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