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To Align Technological Advancement and Ethical Conduct: An Analysis of the Relationship between Digital Technologies and Sustainable Decision-Making Processes

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Abstract: Digitalization and sustainability is widely investigated; however, only few studies have analyzed the role of sustainable decision-making processes in the business strategy field for achieving sustainable development goals: The study proposes a structured literature review (SLR), analyzing 318 documents published in the period 2019–2023. The results of the SLR bring to light that the publications on the topic mainly regard seven research areas. Green supply chains, logistics and digital management is the principal one, followed by sustainable goals, green indicators, and digital advancement. Furthermore, the analysis marks future research lines: although this document offers an overview of the main studies in literature, the major limitation is the use of only one database and a time span of 5 years. This study could contribute to generate further research on sustainable decision-making processes, promoting a different organizational approach to value creation and sustainable performance.

Keywords: sustainability; decision-making processes; digitalization; ethical conduct; digital technologies

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1. Introduction

Digitization, "as process of application of digital technologies within a firm" [1], has led organizations towards important changes in business administration by attracting great attention in the literature to the newly offered opportunities relating to the productivity, efficiency, and sustainability of processes. Firms are the main sustainable process creators, being able to internally modify the organization, the business models and the strategic choice considering economic and ethical aspects. According to Fiorentino et al. [2] and Merendino et al. [3], the essentiality of smart technologies is demonstrated; however, they are not always adopted in strategic decision-making processes due to the lack of capabilities or awareness of the opportunity that they offer.

Digital technologies could take on an enabling role in the circular economy (CE) [4], arriving "to improve the decision-making processes across different stages of the industry life cycle" [5]. In the CE, stimulating economic growth in line with environmental sustainability [6] is a crucial aspect of the application of reuse, recycling, recovery, and re-manufacturing practices [7], necessary to contribute to the creation of the sustainable development goals of Agenda 2030. In this context, digitalization should be read as a process economically, environmentally, and ethically sustainable, suited to foster firms in addressing the right direction for world wellness. Going beyond themselves is the main goal of firms that intend to fully embrace the creation of a sustainable organization. How? Firms should adapt and effectively build their capabilities to the requirements of environmental sustainability, and to do so they have a great opportunity: to use digital technologies like the internet of things, cloud computing, artificial intelligence, big data analytics [8], blockchain technology [9], next-generation telecommunication networks [10], and 3D printing. Although the role of technologies in modifying the means of decision-making is known [11], it is necessary to deepen how it takes place and how the firms can

modify the organizational elements impeding the implementation of sustainable principles. Due to the influence of digital technologies on organizational capabilities, by making them competitive and dynamic [12], the convergence of sustainability and digital technologies is beginning to gain more attention in the private and public sectors [13]. However, there is still a lack of systematic and rigorous research in this field, which should highlight how decision-makers are seeking new bases and drivers for economic growth, considering sustainable development. In fact, despite the existing literature, which tries to demonstrate how digital technologies sustain the achievement of sustainability in all its aspects, there are few studies focused on decision processes [14]. In this regard, although some recent articles try to investigate the link between sustainability and digitalization, these do not embrace and fully explain the effects on decision-makers in the context of the circular economy. Considering this, this research tries to identify new directions in the literature on the relationship between sustainable decision-making and digital technologies by using a structured literature review (SLR) [15–17]. SLR aims to establish the foundations of research in the field and reduce subjectivity, bias, and errors [18–21]. Referring to the main existing contributions, it also provides and shows some insights for future research. Through the Scopus database, 318 articles published between 2019 and 2023 were selected to investigate how digitization sustains and influences decision-making processes, providing elements that show how digitalization is functional for sustainability and how it can influence the still hidden aspects of decision-making processes in the era of circular economy.

To reach the target, the authors set the following research questions:

RQ1. What are the main research lines in which sustainability and digital technologies are investigated?

RQ2. What are the research focus and settings of interest of these research lines?

RQ3. What are the possible future trends of research?

As stated by De Felice and Petrillo [22], to ensure convergence between technological and sustainable development it is necessary to define decision-making priorities committed to sustainability. Noting that sustainability means building development able to satisfy the needs of the current generation, preserving, at the same time, the availability of resources for future ones [23], digital technologies represent a great support for social business due to their capabilities to leverage practices towards financial and operational sustainability by generating sustainable value [24].

This paper offers several implications for scholars and practitioners, revealing a link between digital technologies and sustainability through decision-making processes. Furthermore, from a theoretical perspective, this research contributes both to the emerging literature on CE and strategic management literature on the decision-makers' role in resource management. The support of digitalization in sustainable decision-making processes could lead to a different organizational approach to value creation and firm performance.

The article is structured as follows: Section 2 provides the research background for the SLR; Section 3 describes the methodology used; Section 4 presents the findings; Section 5 discusses the results and the theoretical and managerial implications; Section 6 shows the conclusion, future research directions, and limitations of the study.

2. Theoretical Framework

2.1. The Role of Digitization in the Circular Economy Era

The emergence of digitization. with its high potential, is the topic of several existing studies in different fields of research [25–31], due to its countless benefits to firms' behavior, changes in production methods, and organizational processes [32]. According to Nambisan et al. [33], a digital orientation promotes the acquisition of new knowledge and new competencies as well as the generation of new processes or products and fosters sustainability. Nowadays, after the COVID-19 emergency, firms are more often called to follow market requirements about CE, whose practices and strategies can lead toward increasing sustainability and resilience [34,35].

CE is defined as "a sustainable development initiative with the objective of reducing the societal production-consumption systems' linear material and energy throughput flows by applying materials cycles, renewable and cascade-type energy flows to the linear system" [36]. It aims to create "a resource-effective and resource-efficient economic system" without generating environmental destruction [37,38]; that is, it combines economic development without worsening the environmental load with economic activities [4], through the actions of reducing, reusing, recycling, recovering, and remanufacturing [39]. The CE transition has several barriers that must be overcome. Digital technology implementation can help to pursue this purpose of saving and promoting sustainability [40], since it represents an excellent ally [41,42], capable of supporting, equipping, and generating a strategy based on resource efficiency for smart firm creation [43]. According to Massaro et al. [44], digital technologies can help in achieving higher sustainability where the customers become an integral part of the process by offering their contribution [45]. Industry 4.0 [46] refers to "new technological infrastructure, interconnected set of cyber-physical systems, and advanced data management solutions enabling new manufacturing processes, value chain organizations, and strategy development paths" [47]. It is based on advanced digital technological innovations and on design principles that make it possible to define the actions required for the Industry 4.0 transition [48–50]. Digital technologies can give life to new circular business models capable of being profitable and are contributing to the dematerialization processes of products. Although the integration and the impact of CE principles in innovative business models is the focus of many studies [38], so far there is a limited amount of research that investigates the crucial elements for the success of CE in businesses [51] and why digital technologies promote the implementation of CE strategies [52]. In this regard, it is necessary to observe digital technologies' role, which is crucial in virtue of the opportunities that digital tools offer in tracking the flow of products in resource management and in decision-making processes. The relationship between new technologies and CE [53] is possible, among other things, thanks to the remarkable amount of data that they produce [4]. In recent years, a strong digitization and automation of processes took place, leading firms towards increasing awareness of digital technologies' relevance and their adoption for the creation of smarter and better-connected business models [54]. According to Akbari and Hopkins [28], if previous studies are focused on barriers to adoption and challenges, to date there is a need to explore the relationship between "current adoption" and "future impact" in order to become fully aware of the opportunities embedded in technological change, especially if the goal is becoming a sustainable organization. "Digitalization requires specific organizational structures, such as separate business units and agile organizational arrangements" [55], and sustainability requires new processes or new configurations for existing capabilities [56]. Indeed, circular business models can promote environmental improvements [57]. Regarding this, it is useful to take into consideration the four different scenarios summarized by the European Agency for Safety and Health at Work [25] and correlated implications, as reported in Table 1.

Finally, as noted by EU-OSHA [25] as well as Junge and Straube [58], the transition to a circular economy requires digital technologies that "optimize the logistics resources and energy efficiency to pave the path for CE". CE brings to attention the role of firms in the transition towards a sustainable model by acting in a proactive way on stakeholder networks [59].

2.2. The Impact of Digitization on Sustainability (for Better or for Worse)

Del Vecchio et al. [60] state, "being smart also means being sustainable". Indeed, the role of sustainability is not limited to preserving the environment, but represents "a key priority aimed to drive long-term success and value creation" [61] through the development of new business models that are able—thanks to the exploitation of new technologies—to implement innovative strategies [62,63] and effective value propositions [64].

Table 1. An overview of the four scenarios and the potential OSH implications resulting from digitalisation.

The Roaring 40 s—Fully Circular and Inclusive	**Carbon Neutrality—Of a Hazardous Kind**	**Staying Afloat—Amid Economic and Environmental Crises**	**Regional Circularities—With European Divides**
In 2040, the products that sell best are those that are cradle-to-cradle and 'net-positive' in terms of social and environmental sustainability. Re-use takes precedent over replacement; environmental and safety considerations dominate decision-making.	The year 2040 marks the achievement of carbon neutrality in Europe. However, with environmental outcomes having been prioritized above all else, this has often come at the expense of job quality and working conditions, with workers widely dispersed and frequently alone.	In 2040, the biggest concern for many is just having a job—not what the job entails. Most people are focused on keeping things afloat, so that there's little consideration for much else—not the environment, social rights or job quality.	In 2040, everyone knows that contracted employees are well looked after, but those in non-standard employment are not. Neither is the environment, with circularity being mostly regional.
Potential Implications for OSH in 2040 Resulting from Digitalisation in the CE			
Physical hazards are reduced across all industries, but psychosocial risks increase due to the increased digitalisation and automation in the CE. Databases for all materials and products reduce hazards in repair, reuse, and recycling.	Decentralized deployment of workers makes OSH supervision and monitoring much more difficult. Mobile work means that workers are more likely to work in unsafe environments. Rapid introduction of new materials means that documentation is insufficient, resulting in worker exposure to unknown hazards.	Workers lack the skills necessary to navigate or find employment, increasing the likelihood of employment with low OSH standards. A preponderance of platform work means that responsibility for OSH is unclear, mental health risks increase, and there is insufficient protection for freelance and contingent workers.	Workers displaced by new technologies are pushed into the informal economy with very low OSH standards. Regionally, digitalisation is very uneven, making the exchange of OSH-relevant information difficult.

Source: EU-OSHA, 2021.

Sustainable business models can be defined as business models that pay attention and direct their view towards sustainable value creation, pro-active stakeholder management, and a long-term perspective [65]. Rapid and rising attention to firms and several actors in the market regarding sustainability and, precisely, to the relationship between digitalization and sustainability, requires understanding of how organizations can reinforce a change in responsible thinking between actors when they have to carry out decision-making processes. Considering the value relevance of new technologies in all their forms, the firms anticipate getting positive sustainable and economic performance by virtue of the relationship between digital technologies and sustainability.

According to Lutfi et al. [66], the use of a digital accounting system could be an effective support to achieve excellent comprehension of the "tools adopted by firms to develop digital technology for sustainable decisions and competitive performance".

Nowadays, the increasingly strong relationship between digital technologies and sustainability have inspired the inception of "Digital sustainability" [67,68]. Digital sustainability is a concept that refers to the innovative approach adopted by firms to pursue sustainable development through digital toolboxes. In particular, George et al. [67] underline that digital sustainability supports "ecosystem-level coordination among disparate players, enabling them to work together toward shared objectives related to sustainable development". Therefore, the use of digital technologies can help to achieve the purpose of CE, "incorporating sustainability into production- and consumption-related processes" [69] and promoting value creation based on the minimization of negative environmental consequences. In agreement with Lobschat et al. [70], when firms decide to act responsibly without neglecting ethical concerns, beyond considering the multiple benefits of digitization, it is necessary to also consider the risks that the use of smart devices provoke for consumers and firms. For this purpose, at the present, further studies are needed. Bag et al. [35] try to list the main barriers that manufacturing firms run into in digital technology implementation and business sustainability, identifying technological and financial challenges as the most significant challenges, followed by process challenges, human resource challenges and collaboration challenges, security challenges, and leadership challenges.

2.3. Digitization and Sustainable Decision-Making Processes: What Is the Link?

A comprehensive change in the whole organization in terms of norms, culture, and attitude is necessary to govern the development of digital technologies, which should not be considered as a single technological challenge but as an important process that involves all human resources in the organization. If the firms intend to open themselves to ethical responsibility, they should be aware of the potential and risks of digital technology use [70]. Specifically, decision-makers take on an important role in the improvement of sustainable actions thanks to the use of intelligent management systems [71]. In fact, it is the adoption of these technologies that can provide the right tools to make the firm competitive in terms of innovation and sustainability. In other words, digital contribution affects the business environment by promoting change in the decision-making procedures for new value propositions [72]. Urbinati et al. [62] underline the role of big data in the capture and value creation process by mapping the decision-making domain, while Lobschat et al. [70] address the digital corporate sustainability issue through the identification of four different stages of the lifecycle of digital technologies and data, identifying key sources of ethical responsibility, among which decision-making processes are included. They are identified as a multilevel phenomenon that is not limited to choice, but includes intelligence and design [73]. Decision-making processes allow transforming a firm's identity to make it assume a sustainable identity. In agreement with Müller and Voigt [74], digitization and data-driven decision-making processes have a positive effect on profitability, since they make it possible to exploit more information for strategic choices as well as increase the ability to make long-term decisions. This decision-making perspective is fundamental to deeply understand the influence of digital technologies on firms' behavior, so that it assumes a socio-environmental configuration. Saura et al. [40] confirm how new digital technologies can boost sustainability and circular entrepreneurship, since the development of new technology-based systems entails better data-centric decision-making processes aimed to promote sustainable actions.

3. Research Methodology

This study applies a structured literature review (SLR). Through this methodology, it is possible to identify current research trends and future directions [16,17]. Thanks to the extensive availability of academic papers, the SLR made significant progress, allowing to avoid missing seminal articles and to eliminate most researcher bias [20]. The aim of the review is to analyze and to systematize all the collected articles in a replicable way. The choice of SLR is due to its versatility and the following advantages: (1) a higher quality of review process and outcomes [75]; (2) minimizing bias and errors [18,76]; (3) confirmation of results' validity due to the replication of steps during the review process [77]; (4) mapping, synthesis and organization of specific research areas [77,78]; and (5) the possibility to develop a framework about existing knowledge [18,79].

To allow the replication of the research, the SLR should follow some specific steps: (1) defining research questions (RQ); (2) writing the research protocol; (3) building the research sample; (4) a coding framework as well as the type of analysis to perform; (5) discussing and identifying future research directions [16,17,20,21,80].

The three research questions driving this study are the following:

RQ1. What are the main research lines in which sustainability and digital technologies are investigated?

RQ2. What are the research focus and settings of interest of these research lines?

RQ3. What are the possible future trends of research?

The first research question aims to identify the main existing contributions on the relationship between digital technologies and sustainability. The second research question aims to determine the state of the art. The third research question aims to pave the way for future research ideas in this field.

As mentioned, after having outlined the RQ, defining the research protocol is needed. In this regard, the research provides for the extraction of the articles through the use of

the Scopus database, which is widely used and is the largest available database in the multidisciplinary scientific literature [81].

To collect all publications about sustainability and digitalization during the period from 2019 to 2023 (Figure 1), two searches were launched and then integrated:

1. Search group 1: "sustainability", "digitalization" and "decision-making", obtaining a first sample of 984 items. In particular, the Scopus string used to extract the contributions is: (TITLE-ABS-KEY ("sustainability") AND ALL ("digitalization") AND ALL ("decision-making").
2. Search group 2: "sustainability", "digitization" and "decision-making", obtaining a second sample of 531 items. In particular, the Scopus string used to extract the contributions is: (TITLE-ABS-KEY ("sustainability") AND ALL ("digitization") AND ALL ("decision-making").

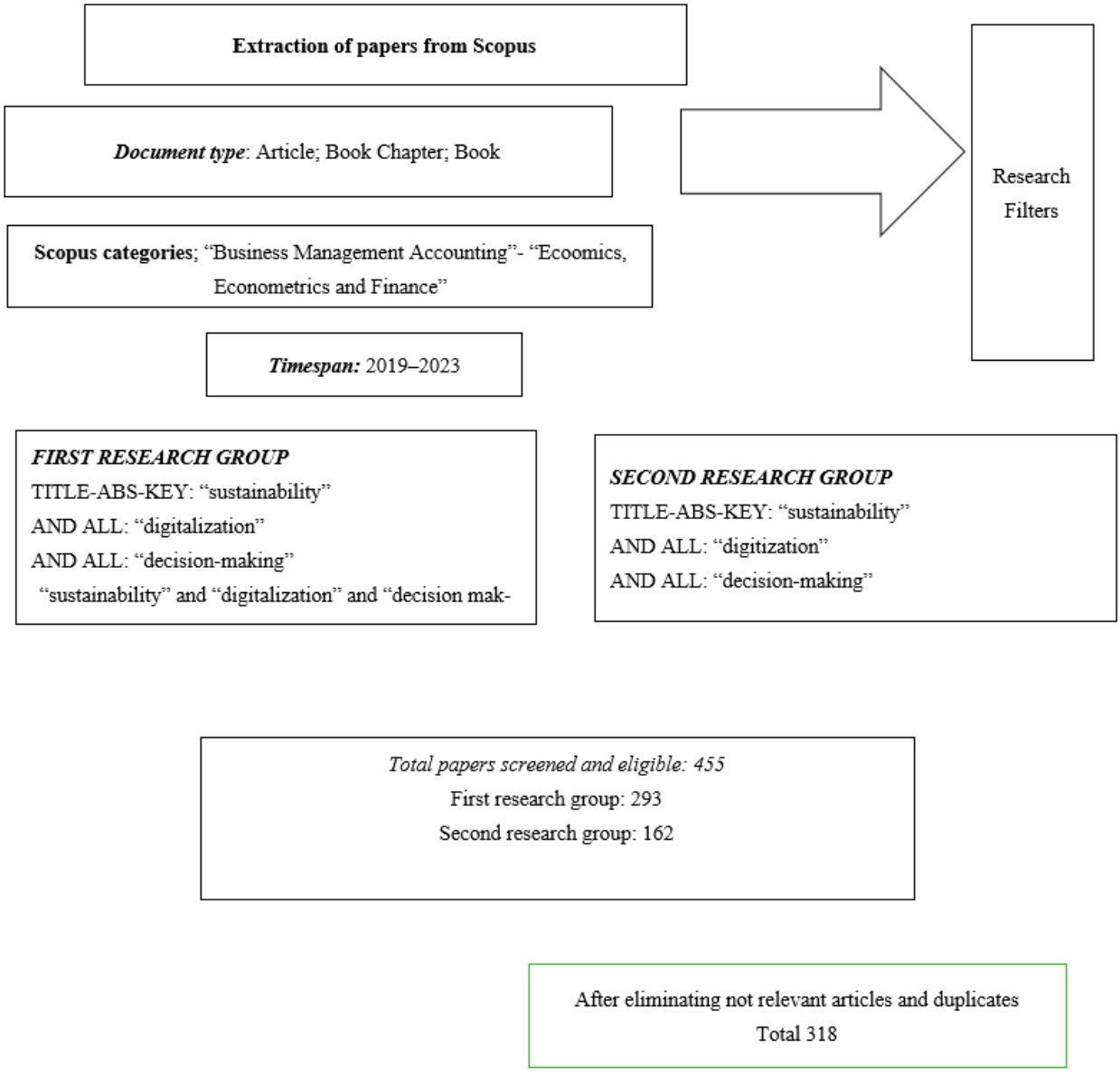

Figure 1. Summary of the extraction of papers from the Scopus database.

Once all 1.515 documents available on Scopus for both groups were identified, the research strategy focused on the inclusion and exclusion criteria pertaining to the subject area, the year of publication, and the type of scientific paper.

Specifically, the study field was limited to the "Business, Management and Accounting" and "Economics, Econometric and Finance" areas. With these filters, the total number of results was reduced respectively to 376 for the first group, of which 338 were from the "Business Management and Accounting" and 90 from the "Economics, Econometric and Finance" research areas, and 207 for the second group, of which 193 were from the "Business Management and Accounting" and 39 from the "Economics, Econometric and Finance" research areas.

Afterward, the filter related to publication year was added as detailed before (2019–2023). This choice made it possible to identify recently debated topics and the literature discussed in recent years, focusing on the timespan in which the scientific debate on these topics has become more significant.

Finally, the search was narrowed to the following types: "articles", "books", and "book chapters". This choice guarantees the inclusion of documents validated by the scientific community and the disqualification of non-validated documents.

After removing duplicated and non-relevant contributions, the final number of studies for the SLR analysis was 318.

Figure 1 shows and describes the process used to identify the eligible research.

This review is based on the framework proposed by Paoloni and Demartini [82], which is articulated through three main dimensions: article focus, research method, and geographical area.

In the following section, the chosen analytical framework is described.

To classify and analyze the items, the authors used a manual approach, reading the full papers and summarizing the results. Specifically, each author read the full papers individually, sharing the results with the entire research group. This step allowed for an in-depth sharing of the content. Moreover, the manual approach allowed the authors to shed light on research trends for each group identified.

Analytical Framework

A manual approach [83] to performing the quality assessment process was applied. Following the aforementioned framework [82], the review of the selected articles is based on three main dimensions:

A. Article focus

B. Research method

C. Geographical area

Based on the article focus (A), seven groups can be identified, as also reported in Table 2:

Table 2. Shows the "focus" of eligible documents per year of publication.

Year	A1. Sustainable Goals, Green Indicators, and Digital Advancement	A2. Sustainable Business Model and Digitalization	A3. Green Supply Chain, Logistics and Digital Management	A4. Sustainable Financial and Economic Performance, Value Creation, and Digitization	A5. Sustainable Entrepreneurship and Digital Technologies	A6. Circular Economy and Digitization	A7. Others	Total by Year
2019	7		8					15
2020	12	4	14	4		1	2	37
2021	26	8	35	7	2	10	2	90
2022	56	9	63	25	5	10	5	173
2023			2	1				3
Total by focus	101	21	122	37	7	21	9	318

A1. Sustainable goals, green indicators, and digital advancement

This group includes articles addressing sustainability issues and sustainable development goals and explaining how digital advancement contributes to sustainable organization creation.

A2. Sustainable business model and digitalization

This group includes studies analyzing how digitalization affects the adoption of a new sustainability-oriented business model.

A3. Green supply chain, logistics and digital management

This group concerns studies that consider supply chain digital management to give it a sustainable identity. In addition, in this category, the authors included research related to the analysis of the relationship between digitalization and green logistics.

A4. Sustainable financial and economic performance, value creation, and digitization

This group includes studies examining the impact of digitalization on financial and economic performance by considering sustainability as a variable for value creation and high performance.

A5. Sustainable entrepreneurship and digital technologies

This group includes research investigating the relationship between green entrepreneurship and digital technologies and how digital tools efficiently support sustainable entrepreneurship.

A6. Circular economy and digitization

This group includes articles addressing the relationship between circular economy and digitalization. Specifically, this group includes articles investigating digital barriers and drivers in the circular economy.

A7. Others

This is a residual group that includes results of the SLR that belong to none of the previous categories. This class concerns studies that are not related to the aim of the present paper but were among the findings only because the keywords "decision-making" and "digitization" or "digitalization" were present in Scopus research fields. Therefore, these were considered outside of the focus of this paper.

Based on the research method (B), six clusters were identified:

B1. Literature analysis (e.g., structured literature review, systematic literature review);

B2. Qualitative research (e.g., case studies, content analysis, surveys through interviews);

B3. Quantitative analysis (e.g., generalized method of moments (GMM); partial least-square technique (PLS); structural equation modelling; regression modelling);

B4. Mixed research (studies with more than one method applied);

B5. Theoretical analysis (e.g., conceptual or discursive contributions);

B6. Other (research written with methods not described above).

Based on the geographical area (C), 11 categories were identified:

C1. Eastern Europe

C2. Middle East

C3. South and Central America

C4. North America

C5. Northern Europe

C6. Southern Europe

C7. Asia

C8. Africa

C9. UK

C10. Oceania

C11. Mixed

4. Findings

4.1. Article Focus

The authors carried out the quality assessment process [16,82,83] and progressively categorized the topics into the mentioned seven groups.

The main focuses of scholars are A1., with 101 out of 318 documents (32%), A3., with 122 documents (38%), and A4., with 37 documents (12%).

Regarding the time of publication, most research is from 2020–2022 (obviously 2023 is not cited, because publications are limited, considering that the year is yet to come.).

4.2. Research Methods

The most-used research methods are B4., with 88 of 318 documents, followed by B3., with 75, B2., with 67, B1., with 47, B6., with 22 and B5., with 19. Table 3 shows all the results.

Table 3. Research Methods.

Year	B1. Literature Analysis	B2. Qualitative Research	B3. Quantitative Research	B4. Research Mix	B5. Theoretical Analysis	B6. Other	Total by Year
2019	2	2	4	3		4	15
2020	2	12	5	11	2	5	37
2021	11	15	25	28	6	5	90
2022	32	37	39	46	11	8	173
2023		1	2				3
Total by research method	47	67	75	88	19	22	318

In addition, mixed research methodology was preferred (for the whole timespan) for A3., with 39 items out of 122 documents; A1., with 27 out of 101; A4., with 9 out of 37 documents; A6., with 6 out of 21; A2., with 4 out of 21; A7., with 2 out of 9; and A5., with one result.

4.3. Geographical Area of Authors Affiliation

Most of the analyzed documents were written by authors with affiliations from different geographical areas (135 of 318), followed by research published by Asian scholars (59 of 318) and by authors with affiliations from Northern Europe (42 of 318), as detailed in Table 4.

Table 4. C. Geographical area.

Year	C1. East Europe	C2. Middle East	C3. South and Central America	C4. North America	C5. Northern Europe	C6. Southern Europe	C7. Asia	C8. Africa	C9. UK	C10. Oceania	C11. Mixed	Total by Year
2019	1		1		4	1	3				5	15
2020	2		1		5	4	10	1	2		12	37
2021	1	1	4	2	9	9	14	1	1	2	46	90
2022	2	5	2	9	24	18	32		8	3	70	173
2023	1										2	3
Total by geographical area	7	6	8	11	42	32	59	2	11	5	135	318

4.4. Documents Citations

To understand the scientific impact of the different research topics, the most-cited publications were considered, focusing on documents with a citation index (h-index) higher than 50. This resulted in 19 documents with a h-index between 50 and 294.

The average highest citation index was recorded in 2020. These most-cited studies mainly used quantitative methodologies (B3.) and mixed-method approaches (B11.). Among the most-cited documents of 2020, no research fell into the literature analysis category (B1.) even though the most quoted of all papers is a literature analysis, published in 2019. Finally, regarding the geographical area, the most-cited research was written by authors located in different geographical areas (C11.; 58%), followed by authors with affiliations from Asia (C7.; 16%) and Southern Europe (C6.; 16%).

The main research lines are described in the following section, answering RQ2.

5. Discussion

This section intends to answer RQ2 (What are the research focus and settings of interest of these research lines?). The SLR quality assessment process pointed out that sustainability and digitization involve six main research areas.

Planning possible scenarios makes it possible to define the necessary behaviors to reduce risks in decision making and increase the probability of making the right decision regarding continuous changes [84].

Regarding the first group, "sustainable goals, green indicators, and digital advancement", the analysis of the results illustrates how sustainable system development represents an important aim when the needs and impacts of current and future generations are evaluated by decision-making models [85], aligning management's actions to a firm purpose.

Recurring calls for a more sustainable world are increasing the need to investigate the economic, financial, and social implications of digital technologies used to solve sustainability tensions, which should not be neglected but considered "as a useful tool to sustain their business partnerships and enhance their organizational ambidexterity and, consequently, achieve holistic sustainability" [86]. Holistic sustainability as result of the utilization of sustainability knowledge is able to create the conditions for the development of sustainable innovation [87]. To analyze sustainable development goals, some studies examine the relationship between blockchain technologies and environmental sustainability [88–91], investigating the role of blockchain, which requires in-depth analysis of potential positive and negative effects on the environment. If the negative effects are explored in a few studies [2], just as key components that foster the transition from traditional systems to new sustainable systems, "blockchain for good" [92,93] is a responsible event influencing the way to operate some firms. It has the capability to support the development of renewable energy, and it is considered a way to realize sustainable behaviors in compliance with the standard established by the UN for SDGs, but not only this. Through its influence on supply chains as well as its capability to distinguish green suppliers from those who work without carrying out responsible behavior [94], it is able to affect the livability of the cities that take the form of smart cities. Smart cities promote sustainable development; for this reason, the concept of "smart sustainable cities" is mentioned many times [95]. These are the results of political work exerted by politicians, local governments, and policymakers to carry out SDGs, in particular, SDG 11: Sustainable Cities and Communities [96]. Guandalini [97] addresses the analysis of the relationship between sustainability and digitalization, finding five important gaps in the existing literature: the lack of a management focus on this relationship, misalignment of the terminology used, overarching strategic studies, scarcity of comparative research, and studies at an organizational level. In fact, the misalignment of the terminology is a relevant problem because it makes it difficult to identify clear strategic guidelines used by the firms to promote the effective implementation of digital technologies aimed at the compliance of standards established by United Nations. Industry 4.0 takes on a crucial role in promoting the transition and the achievement of sustainability in manufacturing [98–100]. However, there is still a research gap concerning Industry 4.0's impediments to sustainable digital manufacturing. Industry 4.0 has the potential to address some of the most pressing challenges for the achievement of the SDGs, so investigating Industry 4.0's main impediments to the advancement of digital manufacturing for long-term sustainability [101] is necessary to pursue and reduce the distance between Industry 4.0 and sustainable manufacturing.

Regarding the second group, "sustainable business model and digitalization", many studies focus on sustainable business model innovation, which represents the evolution of a traditional business model, which does not limit attention to resource coordination to create and deliver value to consumers and other stakeholders [102], but can sustain the implementation of ethical values into business strategy for firms' creation output [103]. Many studies examine business model innovation, and some of them [104] investigate platform business models contributing to the concept of value-based health care, particularly relevant due to COVID-19. However, few studies [105] analyze the health care industry, which deserves further in-depth analyses. According to Bhatnagar et al. [106], the alignment of sustainability with economic goals in the sustainable business model innovation process is fundamental to value creation for stakeholders, but further studies on the different phases of sustainable business model innovation would be appropriate. Another research trend is related to circular business models [107], which have a main quality of pursuing three different aims: reducing waste, increasing environmental performance, and increasing economic benefits [108]. Specifically, the business model assumes a new identity due to strategy implementations that intend to pursue environmental and socio-economic performance [109], generating a shift requiring a full transformation of the business processes that circular business models can realize. However, only some industries have received the right attention [110–113]. Other studies investigated the role of smart technologies in

the creation of sustainable business models [114] and analyzed how sustainable business models are the result of smart technology's impact on the change management process [2].

Regarding the third group, "green supply chain, logistics and digital management", several research trends emerge. A first trend can be attributed to the resilience and agility of supply chains viable thanks to the enabler role of digital technologies, and strongly emerged due to COVID-19. Previously, authors as Eltantawy [115] have shown that this resilience is a crucial capability to offer sustainable supply chains the opportunity to support their economic, environmental, and social performance. Frederico [116] analyzes how disruptive technologies are essential to respond to the COVID-19 pandemic, by underlining that supply chain 4.0, identified as a transformational strategic development, is effective to trigger resilience. From the analysis of results, it emerges that there is a need to eliminate influential barriers in digital supply chain development [117] to transform the traditional supply chain into a sustainable digital supply chain, considering sustainability an integral part of transformation process to improve decision-making activities based on knowledge-based systems and to make possible coordination and collaboration across stakeholders [118]. This transformation of the supply chain is necessary to reach a high level of sustainability. Concerning this point, it would be appropriate to pay attention to supply chain finance by adopting both a finance-oriented perspective and a supply-chain-oriented perspective. "By constituting a critical part of supply chain management that connects buyers, sellers, and financial institutions" [119], it can contribute to the creation of a sustainable supply chain for firms' success.

Environmental sustainability is an imperative entailing a change in the value creation process [120] and the adjustment of supply chains to embrace circular economy principles [117], but it would be appropriate to deepen the strategies promoting adoption of CE principles related to digital technologies in the supply chain. A second research trend concerns the relevance of supply chain transparency and viability [121,122], in that it does not only regard direct suppliers and customers but involves multiple level of supply chains. Even if supply chain transparency (SCT) is widely examined in literature, as noted also by Ebinger and Omondi [123], it is necessary to continue exploring the field in relation to the integration of the different digital approaches to support the achievement of transparency. Furthermore, few studies explore the role of suppliers and how their different positions impact supply chain transparency. The main studies analyze the agri-food industry [120,124–127], fashion online retail [128], the manufacturing sector [129,130], healthcare [131], and the fuel and electronics industry [132–134]. The third research trend can be recognized in the influence of the choice of logistics service providers on the sustainable performance of supply chains, and, although there are some studies that explore the sustainable service quality as an attribute to evaluate logistics providers [135], there is still a fragmented and incomplete framework.

Regarding the fourth group, "sustainable financial and economic performance, value creation, and digitization", it mainly highlights the correlation between economic and environmental performance, which depends on firm external variables (regulations, for example) and internal variables affected by management and their choices. The decision-making perspective takes on a fundamental role, since it is able to influence the relationship, which is described as a U-shaped curve [136]. Even if many studies analyze the relationship above, showing the positive influence of sustainable strategy on financial performance [137], understanding the mechanisms at the foundation of this impact remains a question that deserves further investigation, because there is still a lack of consensus on the specific kinds of sustainability [138].

Regarding the fifth group, "sustainable entrepreneurship and digital technologies", the following trends can be identified. One is the linkage between entrepreneurial attitudes for twinning between digitalization and sustainability in regard to the attitudes that drive the actions; according to Ferreira et al. [139], there is a mutual relationship that links digital and environmental transformation with entrepreneurship, since the aforementioned variables are not mutually exclusive, but can coexist. Within this line of inquiry,

a main distinction between environmental entrepreneurship and a green entrepreneurial orientation [140] is observed, highlighting an inequality in the extent of investigations on the green entrepreneurial orientation. In fact, few studies focus on this issue [140,141]. Previously, authors as Lumpkin and Dess [142] introduced the entrepreneurial orientation as a construct that is differentiated from entrepreneurial intensity (EI). If the first is defined as a set of processes, practices, and decision-making activities for the new firms' creation, EI focuses on "the degree of entrepreneurship, the level of commitment and focus in leading a new entry" [143]. However, this relationship is little developed so far. Therefore, a second research trend could be related to the linkage between entrepreneurial intensity and sustainability [144] and could analyze how technological advances play a crucial role in the relationship, of which the aim is to intensify the firm's capability to learn innovative entrepreneurial ways to guarantee responsible performance. Another research trend concerns the analysis of digital technology start-ups to comprehend the extent of their contribution to sustainable transformation [145] and to achieve SDGs. These start-ups tend to direct their attention to economic success, moving sustainable goals to the background. For this reason, further in-depth analyses are necessary to explore how the start-ups perceive the sustainability concept. Biancone et al. [146] outline that, in the global scenario, technology's elements become fundamentals for entrepreneurs if they intend to address the challenge of the global markets. The COVID-19 emergency dictated new conditions of uncertainty, manageable thanks to the transformation of traditional entrepreneurship into digital entrepreneurship to achieve sustainable development. Therefore, firms should start this transformational process. The COVID-19 pandemic was a turning point in the ways of doing business and laid the foundations for searching new ways to interpret entrepreneurship from a digital perspective, pointing to sustainable recovery through a shared-resource model. Looking at the results, to enrich the existing literature with more current scenario analyses seems appropriate. This could make it possible to understand how entrepreneurial resilience can facilitate the overcoming of these uncertainties.

Regarding the sixth group, "circular economy and digitization", this includes the main topic about the circular economy issue and investigates barriers and drivers supporting the transition to a CE. Kayikci et al. [147] observe that governmental support and administrative burden are fundamental to promoting circular economy; furthermore, they note the lack of effective execution of environmental regulations is a barrier to this transition. Other barriers are related to ineffective CE framework adoption, and, finally, to the lack of integration and collaboration between supply chain participants. Abdul-Hamid et al. [148] define a set of industry 4.0 drivers in the circular economy for the palm oil industry, among which business model innovation, laws and policy, workforce empowerment, government support, and waste management emerge. Agyemang et al. [149], instead, observe that profitability/market share/benefit; reduction in cost; resource efficiency; environmental safety and risk management of health and safety issues; and product quality represent some of the main drivers identified as internal drivers capable to facilitate the CE transition, while international competition and pressure, stakeholder pressure, and support from parent companies represent the external drivers. From the analysis of results, it emerges that it is necessary to produce more research to develop a holistic view of circular manufacturing based on the structuring of data and information able to sustain the decision-making processes of manufacturers that intend to achieve great circular performance [150]. The increasing attention to the CE domain and digital technologies is linked to the impact that they are able to generate on practices for logistics and supply chain management [126,151]. In fact, if manufacturing organizations aspire to be competitive on an international scale, they should direct their view to Industry 4.0 and circular economy practices [151]. Therefore, firms should search for the best way to adopt these technology tools to build an integrated framework in which they develop an operative action plan for sustainable activity implementation [152]. The CE transition also deserves more investigation, especially for emerging economies, since there are still few studies which focus on countries like Pakistan [149]. Furthermore, if, on one hand, the Social Organi-

zational Life Cycle Assessment (SO-LCA) methodology is used to correlate social impact categories and subcategories with organization-specific social metrics [153], on the other hand, further research should deepen how digitalization of production processes takes on an essential role in knowing social performance. The link between firms' organizational capabilities and their digital and circular strategies is another trend emerging from our results. Kristoffersen et al. [154,155] highlight that there is a need to develop organizational capabilities making it possible to utilize digital technologies like business analytics to increase their ability to pursue circular strategies.

6. Conclusions, Future Research Directions, Implications and Limitations

6.1. Conclusions

The relationship between sustainability and digitalization, explored through an SLR methodology that used a sample of scholarly works published over the period 2019–2023, made it possible to summarize the following results.

In response to RQ1 and RQ2, seven research groups can be delineated:

In each group, the contributions increased over recent years, confirming the relevance of digitization for sustainability from a decisional perspective. However, the results indicate that the literature is focused on only some aspects of the relationship between sustainability and digitalization, and different gaps deserve to be filled. Specifically, the SLR results show that groups A1., A3., and A4., due to the number of contributions, prevail over others, even if the sustainable financial performance and value creation cluster contains only 37 articles focused on sustainability, which is interpreted as an imperative for firms that intend to remain competitive in a sustainable future possible through digital technology adoption. Therefore, more studies in the field are required [156]. Instead, less attention is paid to the link between sustainable entrepreneurship and digitalization and relative change to generate the sustainability-oriented entrepreneurship.

In agreement with Denicolai et al. [157], digital transformation is taking on a more and more relevant role in the current era, becoming a central driver for innovation and business renewal. In fact, digital technologies are able to support sustainable business model creation by promoting an increase in productivity and a decrease in costs and emissions. From the SLR conducted, possible future research directions emerge. To answer RQ3 ("What are the possible future directions of research?") in the next lines, possible future directions are detailed for each research cluster, after a brief summary of the results.

A1. This is one of the richest strands of research. From analysis of the literature, it emerges that the concept of sustainable development requires changes in management to improve its approach to sustainability and to promote the observance of guidelines established from Agenda 2030. Hence, future research could:

1. Define a set of green indicators that can facilitate and improve the life cycle of sustainability by requiring a holistic decision-making process.
2. Investigate the use of technology in sustainable social businesses by analyzing the interaction between different dimensions of technology adoption and social firms, since, to the best of the authors' knowledge, and in agreement with Soni et al. [158], there are no articles regarding this relationship.

A2. This cluster focuses on business model innovation to promote sustainability. The analysis brought to light that contributions on the sustainable business model are considerably increasing, mainly investigating the issue through the exploration of the relevant role that it assumes to satisfy economic, environmental, and social aims. Analysis of the literature outlines the following proposals for future research:

1. Scouting the adoption of a sustainable business model that entails relevant challenges that the whole organization must deal with. For this reason, it would be useful to analyze how the transition from a traditional business model to a sustainable business model [159] in different industries occurs and to measure its impact on decision-making processes;
2. Defining shared best practices for sustainable business model adoption;

3. Analyzing the consequences of management of the COVID-19 pandemic emergency on sustainable business models' role.

A3. This cluster refers to changes in supply chain from the sustainability perspective. In particular, this group covers all the articles that study the interconnection between sustainability, supply chains, and digitalization, starting from the consideration that logistics is defined as "execution of supply chain management activities" [160]. The analysis of the literature suggests the following future research:

1. In-depth analysis of critical circular supply chain management and related indicators, in order to shed light on the best performance in sustainable circular supply chains that the measurements make it possible to identify [130].
2. Investigation of the impact of digital transformation on sustainable supply chains by analyzing the collaboration between different actors as a critical success factor for sustainable supply chain management [161].

A4. This cluster gathers publications focused on financial performance improvement. From the literature analysis, the following, not exhaustive, proposals for future research can be outlined:

1. Shed light on the relationship between financial performance and sustainable digital performance;
2. Improve the evaluation of organizations through financial and sustainable indicators to compare profit and non-profit organizations;
3. Categorize suitable financial measures and analyze them to verify their reliability for sustainable value creation;
4. Focus on moderating factors that impact the relationship between financial and sustainable performance.

A5. This group includes studies that analyze the link between sustainable entrepreneurship and digitalization, focusing on the necessary changes to generate sustainability-oriented entrepreneurship, and they reveal the new concept of the sustainable entrepreneurial model [162]. The literature analysis points out that researchers should investigate barriers and enablers to promote the sustainable entrepreneurial model and evaluate the perceived financial risks for this model adoption.

A6. This group includes articles on circular economy. It mainly investigates digital barriers and drivers for the transition to a CE. In agreement with Burmaoglu et al. [163], further exploring in this direction is necessary to understand how the CE perspective can be embedded in digital skills and aid firms to become sustainable.

6.2. Implications

The present study has several implications for scholars and practitioners. First, this SLR offers a comprehensive overview and a critical reflection on the sustainability approach and tries to define how digitalization influences every single business dimension. Furthermore, the decision-making perspective adopted highlights the role of digitalization in the capture and value creation process [110]. In particular, the analysis is able to approve the proposition under which digital technologies are an efficient tool to create and preserve a sustainable firm, and more generally, a sustainable society for a long time. Based on the decision-making perspective, this study offers an integrated analysis investigating why and how being smart also means being sustainable [60], by contributing to identifying drivers, barriers, and indicators to building a sustainable path directed toward sustainable development. Moreover, this study indicates that new business model adoption can help firms to improve their sustainable and financial performance and help them by facilitating their transition to the circular economy, leaving behind the traditional business model. Finally, last but not least, the research tries to explain the relevance of digital technology implementation able to modify the management of supply chain structures [6].

6.3. Limitations

This research suffers from some limitations. First of all, the use of a single database: even though Scopus is one of the most relevant databases for scholarly literature, other important databases, such as Google Scholar and Web of Science, could be queried for future enlargement of the study. Secondly, the manual clustering applied implies a degree of subjectivity that could impact the results. Thirdly, the relatively short period considered might influence the outcome of the analysis. Finally, the analysis could also be associated with an empirical methodology to consider the influence of digitization on the sustainability-oriented business model and sustainable decision-making processes.

To conclude, although this study intends to increase attention to the relationship between digitalization and sustainability, further analyses are necessary to fully understand the role played by digitalization and its capability to respond to social challenges in terms of sustainable development. Regarding this point, and considering the importance of SDGs, it could be useful to examine how the decision-making perspective can take on a fundamental role to increase and spread sustainable development.

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