sustainability

Article

Theoretical Perspectives on Sustainable Supply Chain Management and Digital Transformation: A Literature Review and a Conceptual Framework

Asterios Stroumpoulis * and Evangelia Kopanaki

Department of Business Administration, University of Piraeus, 18534 Piraeus, Greece; evik@unipi.gr
* Correspondence: stergiostrou@unipi.gr

Abstract: In an era where environmental and social pressures on companies are increasing, sustainable supply chain management is essential for the efficient operation and survivability of the organizations (members of the chain). Digital transformation and the adoption of new technologies could support the development of sustainable strategies, as they support supply chain processes, decrease operational costs, enable control and monitoring of operations and support green practices. The purpose of this paper is to explore the relationship between sustainable supply chain management and digital transformation through the adoption of specific technologies (Blockchain technology, big data analytics, internet of things). It aims at theory building and the development of a conceptual framework, enabling the explanation of under which circumstances the above combination could lead to the development of sustainable performances. It also aims to examine how companies can increase their competitive advantage and/or increase their business performance, contributing both to academics and practitioners. After conducting a literature review analysis, a significant gap was detected. There are a few studies providing theoretical approaches to examining all three pillars of sustainability, while at the same time analyzing the impact of big data analytics, internet of things and blockchain technology on the development of sustainable supply chains. Aiming to address this gap, this paper primarily conducts a literature review, identifies definitions and theories used to explain the different pillars of flexibility, and examines the effect of different technologies. It then develops a theoretical conceptual framework, which could enable both academics and practitioners to examine the impact of the adoption of different technologies on sustainable supply chain management. The findings of this research reveal that digital transformation plays an important role to companies, as the combination of different technologies may lead to the development of significant capabilities, increasing sustainable performances and enabling the development of sustainable strategies, which can improve companies' position in the market.

Keywords: sustainable development; supply chain management; information systems; blockchain technology; digital transformation; IoT; dig data analytics; sustainable performance; sustainable strategy

check for updates

Citation: Stroumpoulis, A.; Kopanaki, E. Theoretical Perspectives on Sustainable Supply Chain Management and Digital Transformation: A Literature Review and a Conceptual Framework. *Sustainability* **2022**, *14*, 4862. https://doi.org/10.3390/su14084862

Academic Editors: Claudia Colicchia and Sara Perotti

Received: 28 February 2022
Accepted: 13 April 2022
Published: 18 April 2022

1. Introduction

Nowadays, there is an increase in the development of new technologies, which affect the digital transformation (DT) of companies, changing and improving their operations. According to Verhoef et al. [1], the new, digital companies have surpassed many traditional companies. Despite the fact that the impact of DT on companies is so visible and could contribute to their performance, academics have paid little attention to these developments and technologies, and only recently have they started to address the topics of digitization, digitalization, and digital transformation [2].

DT has the ability and power to transform traditional supply chains into highly efficient digital and smart supply chains by connecting all operations and processes, such as product development, procurement, manufacturing, logistics, suppliers, customers, and services [3].

Internet of things (IoT) and big data analytics (BDA) are the two most prevailing technologies of contemporary DT and play a significant role in the process of the decision-making of a company. The IoT technology is one of the most innovative of information and communication technologies, which is changing the traditional industrial form and human production and lifestyle [4]. The development of this technology, in combination with the globalization of supply chain management, has increased the amount of data produced and has reinforced dependence on a globally interconnected supply chain ecosystem.

Furthermore, due to the large increase in the generated data, big data are strategically very important and have become one of the most valuable assets for a company [5]. The huge amount of data has led many companies to develop and create analytical means (BDA), so as to transform the data into useful information, which will be able to improve the decision-making process and positively influence the performance of the supply chain management [6].

Moreover, during the last decade there was a rise of a new technology which has gained the attention of companies and academics, that of blockchain technology (BT). BT was primarily used in the cryptocurrency Bitcoin and in the financial industry, but there is now significant research into its use in supply chain management. Due to its transparency and data sharing capabilities, it could play an important role in the digitalization of the supply chains.

Apart from the rise of new technologies, sustainability has gained the attention of many companies during the last years. This is happening because the United Nations and the European Union pay more attention not only to the environmental issues but also to the well-being of the society. So, companies must focus on their supply chains and develop socially and economically sustainable supply chains as well as green supply chains, while also taking into consideration every stakeholder inside and outside their task environment. Therefore, every supply chain member would benefit if the adoption of information technologies could be combined with sustainable development within the digital supply chains [7].

This research, which is based on a literature review, revealed that there is an important research gap in the amount of previous literature examining the relationship between sustainable supply chain management (SSCM) and DT. The authors' findings agree with Birkel and Muller's [8] argument, which supports the assertion that there is a limited amount of research examining the impact of the above combination on each sustainability pillar separately, especially in the social pillar, which is the most underrated one. Moreover, there are a limited number of studies which analyse the three sustainability performances according to the triple bottom line (TBL). So, there is a need for the development of a conceptual framework which could unify and analyze all the three dimensions of sustainability.

Therefore, in order to elaborate and complete this research, the following key questions were raised:

- How can an organization evaluate the economic, environmental, and social performance of its supply chain?
- How, and to what extent, is DT able to contribute to sustainable supply chain management objectives?
- How could this combination increase the performance of each pillar and lead to the development of specific strategies to increase business performance?

So, the purpose of this research is threefold and covers the following specific objectives. Firstly, based on a literature review, this research tries to address the above concepts by examining the relationship between DT (related to technologies, such as BT, IoT, and BDA) and SSCM, focusing on the performance of each pillar. Secondly, the research develops a conceptual framework, based on specific theories, including natural-resource based view (N-RBV), stakeholder theory, transaction cost theory, and legitimacy theory. This framework addresses the existing research gap and helps both practitioners and academics to investigate how new technologies (of the fourth industrial revolution) support SSCM.

Finally, this research shows how this combination could support specific strategies and lead to the improvement of business performance.

Therefore, the contributions and novelty of the present study are as follows:

1. The analysis of the literature and the clarification of the impact of DT (BT, BDA, and IoT) on SSCM.
2. The use of theories contributing to the understanding and analysis of all thee pillars of sustainability.
3. The development of a conceptual framework, based on the initial work of [9], showing that the combination of IT resources (embodying the three technologies of DT) with supply chain resources can lead to business capabilities and sustainability performances, affecting the development of sustainability strategies.

Therefore, this study bridges the gaps identified in the literature regarding the implementation of new technologies in SSCM. It provides an insight regarding the effects of BT, IoT, and BDA upon SSCM and reveals the issues that every company should deal with. It then proposes a conceptual framework, which uses relevant theories (as mentioned above) and gives academics and practitioners the capability to fully understand the potentials of DT inside the SSCM, both for companies and managers. Hence, the study can establish a starting point for the use and analysis of the above technologies, while its findings can be considered a base for future research [10].

The rest of the paper is organized as follows: Section 2 presents all the relative literature reviews. Section 3 describes the theories that are used in the development of the conceptual framework, which is presented and described in Section 4. The results are presented in Section 5, while the conclusions and limitations are developed in the Section 6.

2. Literature Review

This research analyzes the impact of DT on SSCM. It also tries to explain how this combination could lead companies to increase their business performance. In order to better understand, examine, and clarify these specific concepts, the authors conducted a literature review [11], studied relevant theories, and built a conceptual framework. The analysis of the literature review was conducted in different phases, as mentioned below [12]:

- Phase 1: Planning the review.
- Phase 2: Conducting the review.

Moreover, in order to address the objectives of the study, the authors followed the steps described below:

- STEP 1: Search for articles by keywords.
- STEP 2: Narrow the article selection by reading the abstracts.
- STEP 3: Clarify the meanings and the relationships between them.
- STEP 4: Identify the gaps in the literature.
- STEP 5: Identify and study relevant theoretical approaches.
- STEP 6: Discuss the framework and results developed in this study, based on previous literature.

The goal of the literature review is to cover a wide range of information and data, so as to reassure the objectivity and validity of this specific research [13]. One of the most important steps in this procedure was to locate the relevant studies [14]. Guided by the research questions, as mentioned in the previous section, the authors conducted a comprehensive review of scientific papers in the field of SSCM and DT. For scientific papers published in academic journals, the search was based mainly on the ScienceDirect and ResearchGate databases.

The use of keywords allowed the authors to identify the most relevant papers dealing with SSCM and DT. Besides the main keywords related to the research topic, additional keywords were used, including business performance, capabilities, Blockchain technology, internet of things, big data analytics, strategies, competitive advantage, resource-based view, stakeholder theory, legitimacy theory, and transaction cost theory. After finding the papers, authors used the titles in order to eliminate the duplicated papers and compile the final database of papers that they were going to use.

According to Kilibarda et al. [13], the above action has the ability to identify a large number of scientific papers, so that authors are in a position to extract a relevant sample for further study. Moreover, the aim of this action is to find papers which are relevant and can help authors to answer to their research questions. Therefore, through the analysis of all selected papers, some main conclusions were derived.

As far as the reviewing process is concerned, the authors read the abstracts and conclusions of each paper in order to find the relevance to their research. Based on analysis and elimination, 237 papers were identified for extra study. Finally, the authors limited their choice to 168 journal papers, 1 diploma thesis and 4 books. In the next step, the authors read the papers and conducted their analysis, taking into consideration the contribution to the scientific area, the alignment with the research questions and the significance and impact factor of the journals. The number of papers that were used from the most dominant journals are presented in Figure 1.

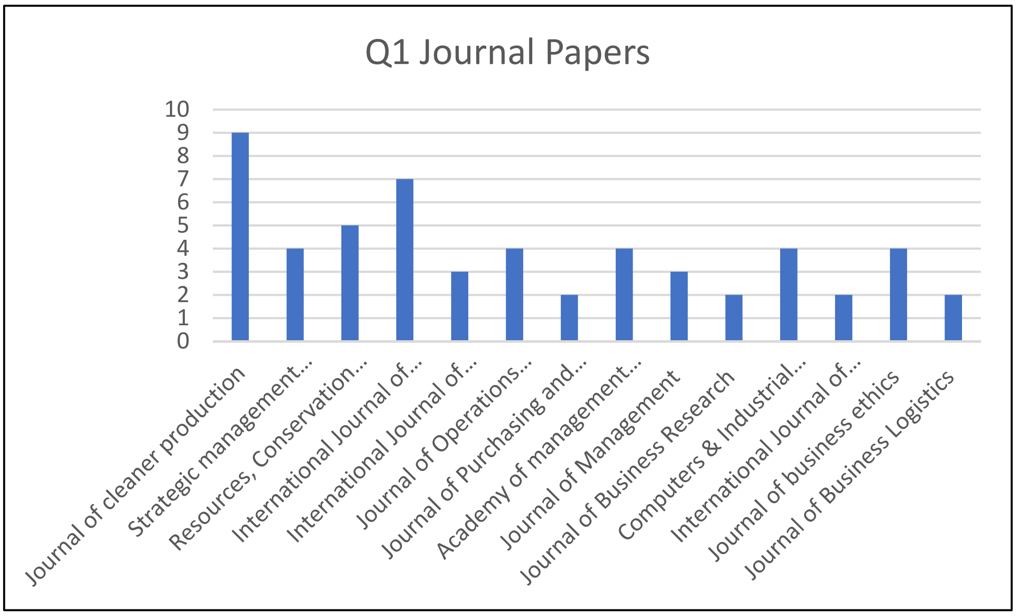

Figure 1. Papers from the dominant journals (Q1).

In this research, the literature review allowed us not only to examine and understand the main topics and theories associated with the phenomenon under study, but also to develop a conceptual framework [9].

2.1. Sustainable Development and Companies

In 1987, the Brundtland Commission developed the definition of sustainable development, i.e., "the ability to make development sustainable, to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" [15] (pp. 45–65), which is the most common and frequently used definition in the international literature. A few years later, during 2002, the World Summit on Sustainable Development expanded the above definition and introduced the definition of the three pillars (social, environmental, and economic) [16]. Therefore, sustainable development is a concept associated with the aim to provide society with a better quality of life by enforcing processes from all the pillars [17].

As mentioned above, the three dimensions of sustainability are the social, the environmental, and the economic. According to Dempsey et al. [18] (p. 290), the social pillar is a multi-dimensional concept and answers the question "what are the social goals of sustainable development?". Because of its nature, the social pillar is very complex and difficult to be applied. As a result, there is not yet a commonly accepted definition. The social pillar is very different from the other pillars because it is ambiguous and intangible and that is the reason why it is very difficult for it to be quantified into something more understandable [19].

As far as the environmental pillar is concerned, this pillar is the most well-known pillar of sustainable development, because it is concerned green policies and the protection of the environment. According to Agyeman et al. [20] (p. 78), "a truly sustainable society is one where the wider questions of social needs and welfare, and economic opportunity are integrally related to environmental limits imposed by supporting ecosystems". The protection of nature is related and connected to the conservation of any environment and area that is inhabited by human and any other form of life, which proves that this pillar is related to the others [21].

Last but not least, there is the economic dimension of sustainability. There are two aspects of this pillar, the one that is related to the financial performance and the other, which is related to the interests of any external stakeholder [22]. Moreover, the economic pillar is strongly connected with the legal regulation of any task environment of the organization [21].

Aside from the three pillars, the United Nations, in 2015, in collaboration with many companies, developed the Sustainable Development Goals (SDGs), which are widely known as Agenda 2030 [23]. According to Kolk et al. [24], SDGs are going to be the most important frame of the global development agenda until 2030.

During the last decade, and due to the new regulations, environmental issues play an important role in decision making policies and have gained attention from academics and companies [25]. Due to the economic meltdown in 2008, companies and society paid more attention to the economic pillar of sustainability, as governments often have to deal with financial crises and ensure that jobs are not lost. In contrast, the social pillar of sustainable development deals with the well-being of society and is concerned with non-economic issues [26].

These two pillars (environment and social) have very distinct and separate traditions and are only beginning to relate to one other [27]. During previous years, companies had the impression that corporate social responsibility related only to financial aspects. However, this issue has changed, and companies provide the stakeholders with non-financial reports in an attempt to increase the awareness in society of how firms manage issues in their operations [28].

The research which was conducted by Van Zanten and Van Tulder [29], revealed that most of the companies (which helped in the creation of SDGs) responded immediately to these new challenges. Moreover, the 2016 United Nations Global Compact-Accenture Strategy CEO Study [30] showed that most companies and CEOs had developed new strategies, which target sustainable development.

According to the above strategies, companies and organizations try more and more to solve the problems that are related to poverty, energy, climate change, etc. However, in the international literature, there is a lack of research which tries to examine the main actions and strategies of individual companies and how they approach the sustainable development [29].

In addition, firms and organizations must embody policies and develop strategies which are related to society in order to improve their image, increase their business performance, and/or gain competitive advantage [31], aside from environmental policies and economic controls. In order to achieve this, companies have to embody theories which are associated with the corporate environmental and social pillar of sustainable development [32].

A business concept that addresses this need is the triple bottom line (TBL), which shows that, in addition to their financial performance, firms should focus on measuring their social and environmental impact. The TBL is not an easy concept for most organizations, because it states that a company's responsibilities are more than its economic goals for its shareholders and the production of products and services for its clients [33]. The TBL uses measurements of environmental and social performances, aside from the economic ones. Social performance refers to the company's impact on society and stakeholders' groups. Environmental performance refers to the number of natural resources that a company uses. So, the TBL states that corporations and organizations should not only consider their financial bottom line but also their environmental and social bottom line [34]. According to the TBL [35], companies which manage to contribute to sustainability are those which achieve economic, social, and environmental goals simultaneously [36]. Therefore, the TBL has been acknowledged as a win–win–win strategy, which benefits people, planet, and profits [37]. However, according to John Elkington [38], there are not many business decision-makers and managers in the world who pay attention to all the dimensions of the TBL.

Therefore, companies have to realize that they belong to a bigger task and natural environment if they want to achieve better financial profits. So, companies must develop environmental and social policies in order to achieve better economical results [39]. According to Gilbert et al. [40], there is a continuing pressure on companies to think about their social and environmental actions.

For instance, no company wants to gain the reputation of being socially irresponsible. Therefore, it is very important for companies to have CSR policies or policies about sustainable development because it will help them to increase their market share in the task environment [41]. CSR is a very general and complex concept, as each company has different social, environmental, and ethical impacts on society [41].

According to Carroll [42], CSR is a mix of four basic responsibilities, and these are: economic, ethical, legal, and voluntary. In order to better report and manage their CSR actions, companies develop a new set of standards, which are called GRI (The Global Reporting Initiative) [43]. These standards are voluntary for each company [44], but nowadays there is an increasing pressure from the different groups of stakeholders to implement them [45].

2.2. Definition of Sustainable Supply Chain Management

According to Bhuniya et al. [46], a supply chain is a system of organizations, people, activities, information, and resources, which are involved in delivering a product or a service from the supplier to the final client. Supply chain management, as a term, was defined by Mentzer et al. [47] (p. 18) as, "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" and by Lambert et al. [48] (p. 2) as, "the integration of key business processes from end-user through original suppliers, that provides products, services, and information that add value for customers and other stakeholders". Moreover, Mubarik et al. [49] have argued that supply chain management is able to increase the performance of a company.

As far as the sustainable supply chain management (SSCM) is concerned, the two most prevailing definitions are the following: Seuring and Müller [50] (p. 1700) define SSCM as "the management of material, information, and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development", while Carter and Roger [51] (p. 368) define it as "the strategic, trans-parent integration and achievement of an organization's social, environmental, and eco-nomic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains".

So, SSCM is an extension of the traditional supply chain management, which combines environmental and social issues [9]. Growing environmental concerns (due to the increased sensitivity of organizations and the UN regulations) and social issues, such as human rights, have forced many firms and organizations to think beyond their economic-related goals and include a wider range of objectives in their supply chain decisions [52].

SSCM is characterized by the explicit integration of environmental and social objectives that extend the economic dimension to integrate environmental and social considerations [53]. As it is very difficult and complex to measure all three pillars of sustainability through the same theory, in this research, different theories are used, such as the stakeholder and legitimacy theory, transaction cost theory and N-RBV. All these theories have a common base, which is the analysis of the resources inside the company's environment.

2.2.1. Environmental Pillar of Sustainable Supply Chain Management

As mentioned above, SSCM, as a definition, must achieve an approved level of sustainability, which means that it has to focus on each pillar separately [54]. Many companies have been planning since 2013 to transform their supply chains to green supply chains, due to strict regulations from UN and EU and public awareness [55].

The research which was conducted by Curkovic and Sroufe [56] found that the aim of sustainable supply chains is to move away from the negative impact of goods towards the environment. Research on the environmental pillar of SSCM (green supply chain management) has to, as a goal, adopt environmental policies into supply chain operations, such as product design, supplier selection, operations, and transportation, as well as the end-of-life management of used products [57].

So, Srivastava [57] (pp. 54, 55) defined SSCM, as far as the environmental pillar is concerned, as "integrating environmental thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life".

If companies do not take environmental sustain-ability into consideration on their own, the main groups of stakeholders will be forced to implement eco-friendly policies and practices themselves [58]. So, companies must implement green policies in order to protect their image and relationships with their stakeholders and customers [59].

2.2.2. Economic Pillar of Sustainable Supply Chain Management

Another pillar of sustainable development is the economic one. According to the economic pillar, SSCM tries to make the supply chain less costly and more efficient while ensuring no harm to the natural environment and social groups [60].

However, it should be noted that when a firm tries to implement environmental and social policies within supply chains, the costs and the expenses may increase, especially in the short-term [61], which may negatively affect the decision-making process [62]. So, decision makers must gain a clear image of the cost–benefit analysis of environmental and social issues in both short-term and long-term decisions.

Therefore, economic sustainability tries to achieve financial objectives while protecting the environment and society [63].

2.2.3. Social Pillar of Sustainable Supply Chain Management

It is an undeniable fact that economic and environmental sustainability have received the greatest amount of attention in the literature and in practice from academics and companies, while social sustainability has received the less attention [64]. This is unfortunate because all three pillars of sustainable development need to be investigated in order to create a truly sustainable organization or company [50].

According to Jorgensen and Knudsen [65] (p. 450), social SSCM is defined as "the means by which companies manage their social responsibilities across dislocated production processes spanning organizational and geographical boundaries". Social supply chain sustainability (SSCS), as a concept of social issues, includes the below:

- equity
- safety

- labor rights
- philanthropy
- product responsibility

These are all aspects that affect the safety and welfare of the people within the supply chains [64].

Social issues in supply chains are complex. Thus, in order to better understand and analyze them, the company needs to understand who it must be socially responsible for and what issues it must address [64]. Stakeholder theory explains how managers have fiduciary duties to the corporation, shareholders, and stakeholders [66]. The company has to be socially responsive to all stakeholders in order to achieve sustainable advantage [67]. Academics support the idea that being socially sustainable means integrating ethical principles and policies into supply chain practices [68].

According to the stakeholder and legitimacy theories, transparency is an essential factor for companies to develop social and environmental sustainability [69]. Transparency could also be considered a valuable resource for the company.

Hall and Matos [70] support the idea that that the social pillar of sustainable development is the key element in SSCM, due to the fact that companies have to involve and cooperate with many groups of stakeholders with different goals and demands in order to achieve a truly sustainable supply chain.

2.3. Digital Transformation in Supply Chains

Information systems (IS) play an important role in supply chain management because it has been proven that it is impossible to achieve an effective and efficient supply chain without the support of information technology (IT), since it is the backbone of sup-ply chains [71]. Similarly, according to Wang et al. [72], IS are one of the most significant factors in achieving environmental sustainability.

According to Nadkarni and Prügl [73] (p. 236), DT is defined "as organizational change triggered by digital technologies". Accurate information is very important and if it is instantly and simultaneously available to partners along the entire supply chain, then it could trigger valuable data-driven decisions [74]. So, the creation of trust, a common vision among the supply chain, and the improvement of existing information technologies could be used as a base to increase suppliers' and business partners' willingness to exchange process data [75]. Digital technologies are able to make this assumption a reality.

Due to the above assumption, DT is still gaining attention from practitioners and academics, while there are countries which are developing their own initiatives to establish IT infrastructures [76]. However, the interaction between DT and TBL is also influenced by society. Society and all stakeholder groups are expecting a change in the value creation process, from pure economic benefits toward the holistic approach of sustainability [77]. The economy should change in order to equally meet economic, environmental, and social standards, so as to ensure sustainable development, summarized in the approach of the TBL [78]. So, according to Hah et al. [79], all three dimensions of the TBL must be harmonized and are essential for effective technology adoption.

In this article, the authors describe how three technologies of the fourth industrial revolution (BT, IoT, and BDA) will influence supply chain management. These technologies were selected because they can contribute to the sustainability of the supply chains.

According to Birkel and Muller [8], who conducted a systematic literature review, there are a few studies concerning these new technologies, which are part of the Industry 4.0 and the DT of supply chains and can contribute to SSCM. The majority of the relevant studies are paying more attention to the economic dimension and the financial results of companies. However, in the coming years, there will be an increased interest in how these technologies would contribute to the environmental and social dimensions of sustainability. Hence, there is still a gap in the international literature, related to the lack of a holistic approach involving all the dimensions.

2.3.1. Blockchain Technology and Supply Chains

During the previous decades, ERP systems were one of the most integral parts within the supply chain processes. However, most companies and organizations had problems with the visibility of demand, orders, and supply [80]. In addition, they did not have the entire picture of their supply chain, as they could not be aware of the location of their products at any time outside their organization's network [80]. The research of Koh et al. [81], which was conducted in 2011, noticed the need for making information available to supply chain trading partners at any time. Therefore, ERP systems appear insufficient, because their purpose is primarily to improve the internal organization operations, and secondly to connect the other stakeholders to the company [80].

The main problem deriving from the above situation is that supply chains are highly dependent on systems such as ERP that store all information in one central place/server [82]. The structure of this centralized system makes it easy to be attacked, corrupted, and hacked [83]. An additional problem is the lack of trust among partners [82].

So, there are many issues within supply chains, such as central data storage, inefficient transactions, and fraud, which have led to a need for better information sharing among business partners. The answer to these issues is to improve supply chain data exchange, security, durability, and process integrity [84]. Moreover, transparency is turning out to be an increasingly urgent requirement [84].

A solution to this problem seems to be blockchain technology (BT). According to Crosby et al. [85] (p. 8), BT is "a distributed database of records or shared public/private ledgers of all digital events that have been executed and shared among blockchain participating agents". BT is quite different from the other information systems because its design includes four key characteristics: non-localization (decentralization), security, auditability, and smart execution [84].

BT could support supply chain processes and transportation of products. Any information could be attached to the product in order to link the physical product to its virtual identity inside the blockchain [86]. By making this connection, blockchain can help supply chains to detect unethical suppliers and counterfeit products, because information can only be recorded by authorized partners [84].

Moreover, the adoption of BT can help a company and its supply chain increase its economic performance. Blockchains can lead to supply chain disintermediation, resulting in smaller chains with reduced transaction costs and fewer delays [87]. Furthermore, BT could make information stable and immutable, so that information cannot be modified without the permission of the authorized actors, preventing the corruption in that way. Aside from the above, blockchain could decrease the environmental problems of the supply chains by decreasing and controlling the recall and rework [84].

Therefore, BT could have a positive impact on supply chain management. It can be used to track products from the first steps of the chain to the final customer and prevent waste, fraud, and any other unethical practice by making supply chains more transparent. It can also provide consumers with better information about the way a product is constructed and delivered so they will be able to make more environmentally friendly choices.

2.3.2. Internet of Thing and Supply Chains

There are many definitions of the internet of things (IoT) in the international literature. According to Atzori et al. [88], this occurs because IoT is composed of two words and meanings: "Internet" and "Things". The first definitions of IoT that appeared were more oriented to the second word [88] and concerned mainly with RFID technology, which is connected to a network to transmit specific information [89].

The term and concept of the IoT covers various aspects and fields which are related to the extension of the internet and the web into the physical devices. According to Miorandi et al. [90], the IoT tries to create a future where digital and physical entities can be linked to create new possibilities for the companies. So, the IoT is a new information technology, which is in the early stages of its development. It has not formed a complete technology framework and has not yet obtained a unified architecture that is a standard [91].

The IoT enables information sharing through the internet among all partners within a supply chain by using sensor-based technology. Tu, Lim, and Yang [92] proposed that IoT should be used inside the supply chain transportation systems. The proposed system would be in a position to track goods along the supply chain. Moreover, the IoT could help stakeholders to become part of the decision-making process by having real time information [93]. The IoT could also contribute to food supply chains by providing a live monitoring system and allowing the sharing of information with stakeholders [94].

According to the above, a primary issue for traceability inside supply chains is the need for efficient data sharing among all the stakeholders [95]. So, the IoT could help dealing with this issue by providing real time data among all the partners. If companies have all the necessary data, then they will be able to provide and carry out an efficient environmental impact analysis [96], which could positively affect the environmental performance of the products [97].

Furthermore, IoT is able to interconnect the machines, components, devices, and users within an enterprise. It has the potential to connect multiple companies and organizations, forming many digital supply-chain lines in that way [98]. Therefore, the IoT is a technology which provides stakeholders with information to manage their resources efficiently and remotely.

Although the IoT implications are still in an initial stage inside the supply chains, companies should invest in this technology in order to gain benefits in the near future [99]. According to Manavalan and Jayakrishna [99], companies and organizations have gradually started to implement and use digital technologies which could lead them to gain competitive advantage and set the basis for future sustainable supply chain practices and strategies. The literature review indicates that the impact of Industry 4.0 and of IoT technology on sustainable supply chain management has still not been thoroughly examined and this is considered a gap [99].

2.3.3. Big Data in Supply Chains

Supply chains have to be aligned with the preferences of the customers so as to pro-vide better sustainable goods and logistical services [100]. At the same time, the digitalization of processes and operations in production, transportation, and warehousing accelerates the DT of the supply chain [101]. Due to the continuous adoption of various digital information technologies [102] (IoT, sensors, cloud computing, social media, mobile devices, etc.), nowadays, there is a huge amount of information and data, which are available for companies and organizations. The collection, extraction, and storage of large datasets are related to big data [103].

Big data are extremely important to companies and to society [104]. According to Tseng et al. [104], big data must be analyzed in order to provide companies with trends in marketing, to enable the monitoring of economic results, and assess the environmental and social impact of goods and services. Big data are used mostly in the area of marketing, due to the ability to reveal trends, and in the financial sector, due to the capability to generate of economic results [105]. Therefore, big data are able to support supply chains by providing better strategic and operational decision-making [106].

Big data have the power to provide firms with the ability to reduce the costs of taking unnecessary risks where the predictions are based on imprecise qualitative thinking [104]. So, the force of big data is more like prophetic analytics, which uses statistical knowledge to forecast future events and improve supply chain network function [104]. Regarding the above, BDA will be truly beneficial not only to the operations of supply chain management but also to the supply chain relationships [106].

Sustainability issues inside the supply chain management are vital for organizations and companies to takle. So, managers and executives must design a model or framework in order to measure the performance for the evaluation of the sustainability of supply chains. As big data could measure environmental indicators, such as CO_2 emission and air pollutants, it could be used for the better understanding of environmental impacts on SSCM [107].

It is true that without innovation, it is not easy for any company to achieve a competitive advantage or to increase its performance, and the success of supply chain management relies on digital innovation [108]. Therefore, sustainable supply chain performance is dependent on innovation [109]. According to Wamba et al. [110], the resource-based view (RBV) was used in order to develop a model for how firms could leverage BDA. So, big data may be considered a resource of a company, which is able to create value [111].

Therefore, big data could be proven beneficial to supply chains because it may improve companies' performance, environmental impact, and economic results [104]. BDA can also be beneficial, even if the level of adoption is low [112]. This low adoption level may be due to the lack of understanding and skills, inability to find and process suitable data, and low acceptance by partners [113].

2.4. Research Gaps

According to the analysis of the literature review, some research gaps have been revealed, which this study aims to address by proposing theoretical approaches for the three pillars of sustainability and developing a conceptual framework. The identified limitations of the literature are the following:

Firstly, although SSCM is oriented to the three pillars of sustainable development, not all of them are developed and framed properly in the literature. According to Mani et al. [64], the social dimension of SSCM is the one with the least attention, but without its involvement, companies will not be able to truly achieve sustainability. Similarly, Birkel and Muller [8] stated that TBL and the use of information technologies inside the supply chains are oriented mainly toward financial results and not toward the environmental and social pillars. So, according to this literature review, limited studies examine the above combination in all dimensions and combine the economic, social, and environmental performances.

As far as new technologies are concerned, BT, as mentioned in the previous section, could assist supply chains as a decision-making tool, by helping managers to develop their social pillar by being aligned with their partners, and by reducing fraud. Moreover, it could contribute to the environmental pillar by managing and reducing the waste of specific industries, such as the tourism industry. Although it is understandable that BT could contribute to the sustainability practices of the supply chains, there are not many studies in the literature examining its impact [84].

The same applies to the use of the IoT in supply chains. The implications of the IoT are still in their initial stages inside the industry of supply chains [99]. This means that there are few studies in the literature which indicate that the IoT could contribute to the development of SSCM and to the increase in the SC performances [99].

Taking into consideration the papers reviewed, none of them has developed a holistic, conceptual framework which covers the gap of TBL and DT or has studied these new technologies and their contribution to supply chains. To demonstrate this, the authors developed the below table (Table 1), which presents the main conclusions and technologies studied, as well as the pillars of SSCM examined in each paper. Similar tables are often used in papers (e.g., [114]) to demonstrate the results of the literature review. This table contains papers which analyze the three technologies inside the SSCM. However, most of these papers focus on one or two technologies and do not analyze all pillars of sustainability.

Table 1. Contributions of previous work.

Paper	Paper Contribution/Conclusions	Tech	Environmental	Social	Economic
Nayak, G.; Dhaigude, A. S. 2019	"For supply chains to become sustainable, culture among the partnering firms plays a significant role, along with financial constraints and competition. Traditional supply chains are hit by self-optimizing behavior by various entities, resulting in poor performance. Lack of transparency and traceability are the key parameters that need to be addressed. This could be done by adopting Blockchain Technology, thereby creating an environment of trust and harmony.", [82] p. 17	BT		√	
Manavalan E.; Jayakrishna K. 2019	" . . . the vision of Industry 4.0 in SSC is that the entire business should be connected digitally; reduce the carbon footprint and help the stakeholders to take dynamic decisions on real time. IoT enables interconnecting the machines, components, devices and users within an enterprise. Further, it is not only to connect with one manufacturing site, by leveraging cloud and internet it should be possible connecting multiple sites forming many digital supply chain lines . . . ", [99] p. 945	IoT	√	√	
Saberi, S.; Kouhizadeh, M.; Sarkis, J.; Shen, L. 2019	"Blockchains as distributed, immutable, transparent, and trustworthy databases, shared by a community, can also influence sustainable supply chain networks.", p. 2122 "Economically, adopting blockchain technology can benefit a firm and its supply chain from different business dimensions affecting their economic performance.", p. 2122 "Blockchain technology has the potential to contribute to social supply chain sustainability. Making information stable and immutable is one way of building supply chain social sustainability.", p. 2122 "Blockchain technology also aids in environmental supply chain sustainability. It can do so from many different perspective applications.", [84] p. 2123	BT	√	√	√
Roßmann, B.; Canzaniello, A.; von der Gracht, H.; Hartmann, E. 2018	"Taking these circumstances and developments into consideration, it is apparent that BDA will not only affect SCM operations but will also have an impact on SC relationships and social structures within SC functions.", [106] p. 137	BDA		√	
Badiezadeh, T.; Saen, R. F.; Samavati, T. 2018	"Big Data can be used to address environmental crises such as CO2 emission and air pollutants. We can have better understanding of environmental impacts on SSCM. Big Data can be used to evaluate social crises...", [107] p. 288	BDA	√	√	
Bag, S.; Wood, L. C.; Xu, L.; Dhamija, P.; Kayikci, Y. 2020	"These findings suggest that firms might use BDA and BD in their operations to developing a competitive edge, while also enhancing their supply chain innovativeness . . . ", p. 7 "Our results suggest a connection between the employee development and human capital of the organization and the sustainable supply chain outcomes.", [109] p.7	BDA		√	

Table 1. *Cont.*

Paper	Paper Contribution/Conclusions	Tech	Environmental	Social	Economic
Tseng, M. L.; Wu, K. J.; Lim, M. K.; Wong, W. P. 2019	" . . . big data are a basic attribute to improve SSCM performance, drive the environmental impact criteria, and control the firm's economic benefits operational risk and social development activities related to firm performance.", [104] p. 770	BDA	√	√	√
Liu, J.; Chen, M.; Liu, H. 2020	" . . . BDA techniques, such as data mining, can improve supply and demand visibility in the supply chain and enable collaboration within the supply chain network . . . firms can improve collaborative performance to attain sustainable development goals . . . " [115] p. 81	BDA		√	
Zelbst, P. J.; Green, K. W.; Sower, V. E.; Bond, P. L. 2019	. . . RFID, IIoT and Blockchain technologies can be combined to enhance SCT. RFID is an established technology that supports the implementation of IIoT and Blockchain technologies. Our results show that the three technologies are complementary in that they combine to improve end-to-end transparency.", [116] p. 454	RFID, BDA, IoT		√	
Jeble, S.; Dubey, R.; Childe, S. J.; Papadopoulos, T.; Roubaud, D.; Prakash, A. 2018	" . . . BDPA as an organizational capability may help organization's initiative to improve environmental, social and ECOP of the organization. The data analyses suggest that BDPA and EP, SP and ECOP are positively related.", [117] pp. 527–528	BDA	√	√	√
Kouhizadeh, M.; Sarkis, J. 2018	"This accurate and secure data about vendors' environmental performance help companies to improve their vendor selection processes based on green performance values. Using blockchain not only facilitates the vendor selection processes, but provides information regarding the whole supply chain across multiple tiers and sub-suppliers . . . ", [118] pp. 6	BT	√	√	
Schmidt, C. G.; Wagner, S. M. 2019	" . . . blockchain might significantly reduce transaction and governance costs of supply chain transactions.", [119] p. 11	BT			√
Zhang, X.; Yu, Y.; Zhang, N. 2020	"The big data-driven supply chain can fundamentally tap market demand and enable enterprises to timely adjust their market strategies. At the same time, the original information barrier is broken, so that the operating cost of the supply chain is reduced, and the long-term stable development of the enterprise is guaranteed.", [120] p. 428 "Sustainable supply chain management within the context of big data has important research value and significance. The reform of enterprise supply chain management is closely related to innovation and economic development and environmental protection.", [120] p. 442	BDA	√		√
Hazen, B. T.; Skipper, J. B.; Ezell, J. D.; Boone, C. A. 2016	" . . . BDPA resources and outputs can be leveraged to increase sustainability in the supply chain.", [98] p. 593	BDA	√	√	√

Table 1. *Cont.*

Paper	Paper Contribution/Conclusions	Tech	Environmental	Social	Economic
Wu, Z.; Wang, S.; Yang, H.; Zhao, X. 2021	"The application of the Internet of Things technology improves the supervision mechanism of the logistics industry, makes the logistics supervision mechanism real time, and saves the human resources of the logistics department of the logistics industry.", [91] p. 2	IoT			√
Tagarakis, A. C.; Benos, L.; Kateris, D.; Tsotsolas, N.; Bochtis, D. 2021	"Various sensor technologies, incorporated to IoT systems, support technologies involved in each stage of the food supply chain, hence, providing a more effective way for the purpose of recording and exchanging useful information.", [94] p. 3	IoT	√		
Rezaei, M.; Shirazi, M. A.; Karimi, B. 2017	"By reviewing 45 recent application papers of the SCOR model, they distinguished that while the SCOR model is suitable for SC financial performance evaluation, it is also a practical decision support tool for environmental assessment and competing decision alternatives along the chain.", [93] p. 690	IoT			√
Paliwal, V.; Shalini C.; Suneel S. 2020	" . . . traceability and transparency as the key benefits of applying blockchain technology. They also indicate a heightened interest in blockchain-based information systems for sustainable supply chain management . . . ", [121] p. 1 "Blockchains that use a proof of stake system are less energy-intensive than those using evidence of the work system.", p. 19 "Blockchain is gaining momentum in supply chain finance by supporting transactions around the globe . . . ", [121] p. 22	BT	√	√	√
Mageto, J. 2021	"BDA can help identify areas to improve in order to reduce operational costs, predict demand with accuracy, shape future demand with changing conditions and create supply chain resilience by minimizing disruptions and promoting all three dimensions of SSCM.", [122] p. 20	BDA	√	√	√
Mastos, T.D.; Nizamis, A.; Vafeiadis, T.; Alexopoulos, N.; Ntinas, C.; Gkortzis, D.; Papadopoulos, A.; Ioannidis, D.; Tzovaras, D. 2020	"The use of IoT technologies that provide remote monitoring have a positive impact on the entire supply chain sustainability, since the resources are managed more efficiently and effectively.", [123] p. 11	IoT	√	√	√
Esmaeilian, B.; Sarkis, J.; Lewis, K.; Behdad, S. 2020	"Blockchain can also: (1) facilitate paperwork processing in global container shipping; (2) identify counterfeit products in pharmacy supply chains; (3) facilitate origin tracking in the food supply chain for solving foodborne outbreak challenges, and (4) facilitate checking the status of sensor-equipped shipments in IoT enabled supply chains. These actions can all contribute to environmental and social sustainability.", [124] p. 9	BT, IoT	√	√	

Table 1. *Cont.*

Paper	Paper Contribution/Conclusions	Tech	Environmental	Social	Economic
Varriale, V.; Cammarano, A.; Michelino, F.; Caputo, M. 2021	"The combined use of these technologies allows to trade avoiding fraud or opportunistic behavior.", [125] p. 15 "... the paper documentation is replaced by the digitization of information which allows a reduction in the waste of paper for bureaucratic procedures.", [125] p. 15 "Blockchain allows reduced delivery times, faster monitoring of goods and can reduce potential losses due to human error and the use of unnecessary bureaucratic activities.", [125] p. 17	IoT, BT, RFID	√	√	√
Yang, K.; Duan, T.; Feng, J.; Mishra, A.R. 2021	"... this paper investigated the most important challenges that individual firms and entire SSCs might face while applying IoT. This study can provide a deep insight regarding the effects of IoT upon SSCM and the issues every firm need to contemplate when it has to apply IoT solutions.", [10] p. 23	IoT			
De Vass, T.; Shee, H.; Miah, S.J. 2021	"IoT-enabled SCM had improved the retail firms' financial performance by fostering growth, reducing costs, and representing a positive return on investment. Environmental sustainability impact is evidenced primarily due to paperless operations, reduced carbon footprints, reduced energy consumption, waste minimisation, and recycling. Further, the social performance was realised by improved safety and job satisfaction, creating communities, and new job opportunities, which may transform into longstanding value. Moreover, IoT applications free up retailers' time that is allocated more on productive and innovative tasks, and planning activities.", [126] p. 620	IoT	√	√	√
Yadav, S.; Luthra, S.; Garg, D. 2021	"The research develops an IoT-based multi-tier sustainable food security model for integrating sustainable and global AFSC ... may help in the reduction of GHG emission from lower-tier/upstream and food wastage for attaining environmental- and socioeconomic-based global sustainability within AFSC.", [114] p. 16648	IoT	√	√	√
Badugu, S. 2020	"The paper offers a forum for community decision-making to promote fuzzy-based decision making for IoT (FBDM-IoT) and consistently monitor results. Risk, cost, validation time, reliability and accuracy based analyzes have been performed. The proposed FBDM system minimized risks and costs over traditional CM because of cooperation and efficient decision-making.", [127] p. 131	IoT			√

Table 1. *Cont.*

Paper	Paper Contribution/Conclusions	Tech	Environmental	Social	Economic
Nozari, H.; Fal-lah, M.; Szmelter-Jarosz, A. 2021	"Organizations gain competitive advantage by improving the environmental role of IoT and by adhering to environmental laws and standards, enhancing customer knowledge and reducing negative environmental impacts on their products and services. Since the supply chain is one of the most important organizational units and covers a large range of organizational processes from supply and supplier relationships and then to manufacturing processes and ultimately to sales, distribution and customer relationships, so considering environmental parameters in the supply chain can play an important role in the sustainability and greening of human life environment . . . ", [128] p. 26	IoT	√		
Cañas, H.; Mula, J.; Campuzano-Bolarín, F. 2020	"Therefore, it is relevant to the research of the sustainable supply chain 4.0, i.e., to adopt management practices for manufacturing supply chains that contemplate sustainability and address the digital transformation toward I4.0.", [129] p. 17		√	√	√
Choi, T.M.; Luo, S. 2019	"As blockchain's implementation requires both a fixed cost and a variable operations cost, we have found the necessary and sufficient condition under which blockchain is helpful to improve social welfare. However, there are cases in which blockchain can improve social welfare but lead to a drop of supply chain profit. This creates a dilemma. In order to achieve "win win", we have demonstrated and shown mathematically that the government can provide a sponsor to the fashion retailer for the implementation of blockchain. In addition, the government can consider implementing the environment taxation waiving scheme.", [130] p. 149	BT			√
Mani, V.; Delgado, C.; Hazen, B.T.; Patel, P. Yousefi, S.; Tosarkani, B.M. 2017	" . . . it can assist supply chain domain's practitioners in adopting big data knowledge so they will be able to not only predict and mitigate the issues but also build sustainable supply chains.", [131] p. 17	BDA	√	√	
Yousefi, S.; Tosarkani, B.M. 2022	"Blockchain technology can support responsible sourcing and ensure compliance with environmental standards by boosting traceability and transparency in sustainable supply chains.", [132] p. 1	BT	√	√	
Erol, I.; Ar, I.M.; Peker, I. 2022	"Blockchain has the potential to revolutionize supply chain towards economic, social and environmental sustainability.", [133] p. 2	BT	√	√	√

Table 1. *Cont.*

Paper	Paper Contribution/Conclusions	Tech	Environmental	Social	Economic
Cetindamar, D.; Shdifat, B.; Erfani, E. 2022	"BDAC is expected to have a positive impact on improving social performance by increasing health & safety, employment benefits, labor rights, diversity, training & education, community involvement, and human rights implementation & integration.", [134] p. 28 "BDACs are expected to have a positive impact on improving environmental performance by increasing both pollution control and resource utilization that will result in less waste and less pollution.", [134] p. 28 "BDACs are expected to have a positive impact on improving economic performance by decreasing delivery time in the supply chain, reducing the costs, increasing the quality of outputs, and augmenting profit.", [134] p. 29	BDA	√	√	√
The paper's approach	Firstly, DT can contribute to the environmental pillar of sustainability, since it can provide the ability to control and monitor the emissions and can contribute to the recall and rework. Secondly, DT can contribute to the social pillar of SCM, since it. supports the accuracy of data and provides the groups of stakeholders with real time information, ensuring transparency and traceability inside the supply chain. Thirdly, DT can also affect the economic pillar of sustainability by supporting the efficiency of operations, leading to cost cutting and providing a better image of the financial flows inside the supply chain and between trading partners.	BDA, BT, IoT	√	√	√

This paper aims to address this gap by examining these technologies under the three pillars of sustainability inside the supply chains. It also aims to propose theoretical approaches and develop a conceptual framework which will combine DT with the TBL of SSCM, leading to sustainable performances and strategies.

3. Theories Examining the Impact of Information Systems on Supply Chain Management

In order to better understand the impact of the implementation of DT on supply chain management regarding the three pillars of sustainable development, specific theories can be considered and used. The theories chosen for this research are presented below.

3.1. Natural Resource Based View (N-RBV)

According to Joshi and Li [39], research evidence shows that corporate environmental responsibility could improve the operations and processes inside a company and increase its performance. However, if this is correct, it should be examined why all companies do not follow and implement similar strategies and policies.

The resource-based view (RBV) provides a way (a managerial framework) of viewing firms. It recognizes the company's resources as important factors to increase the company's performance [135] and lead to the desirable competitive advantage [136]. It also allows researchers to analyze and interpret the companies' resources to understand how organizations may achieve a sustainable competitive advantage.

It can thus confirm the fact that not every organization is able to implement and benefit from a sustainable strategy. Mostly firms with unique resources and management capabilities are able to realize the financial and strategic benefits of sustainable development practices [39], especially if these resources and capabilities cannot be easily imitated.

The extension of RBV to N-RBV is widely used to explain why companies adopt green supply chain management (GSCM) policies. The N-RBV argues that competitive advantages can be generated by the capabilities of companies in a supply chain [137]. These capabilities can be developed beyond the framework of organizations, combining resources that exist with different members of the supply chain [138]. The resources that result from these combinations would be ambiguous and socially complex and, therefore, difficult for competitors to imitate. Therefore, the N-RBV argues that GSCM can create a competitive advantage. This can be achieved through environmental cooperation, which can lead to the development of routine knowledge exchange and the development of the ability to integrate external resources [139].

So, according to the N-RBV, the sustainable practices which have been developed, could lead to the development of environmental capabilities, which could increase the financial performance [39]. Moreover, the N-RBV resources (such as pollution prevention, product stewardship, clean technologies) must be taken into consideration in order to better understand the full potential of this view [140].

Therefore, through the capabilities arising from the cooperation of all partners of a green supply chain, GSCM helps resources to create value for the company and its partners by improving the business operations and processes. GSCM may also lead to competitive advantage by creating resources which are rare and difficult to imitate as they emerge from the cooperation and the know-how of all partners.

3.2. Stakeholder and Legitimacy Theory

For many years, companies had the impression that environmental and social issues, as non-financial and difficult to measure issues, were not so important. They also believed that corporate social responsibility was mainly concerned with financial performance. However, the situation has changed because stakeholders have realized that these issues are very important and affect sustainable development [28]. The different groups of stakeholders and organizations demand that companies be more sensitive to social and environmental problems [141].

Therefore, as mentioned before, companies have to embody theories which are related to corporate environment issues and to the social pillar of sustainable development in order to explain how and why companies are motivated for social sustainability. The most known and used theories are the stakeholder and legitimacy theories.

According to the stakeholder theory, all groups of stakeholders, and not only the companies' shareholders, should gain more from the existence of companies. According to Freeman and Reed [142], stakeholders are social groups without whose support an organization or company would cease to exist. According to this theory, every stakeholder has the right to have access to any information that is related to environmental and social issues [143]. According to the recent literature, many companies do not clearly examine the social and environmental disclosure in a complete way [141].

Aside from the above theory, the legitimacy theory could equally be used for the analysis of the social dimension of sustainability. According to this theory, the managers of a company must ensure that their company operates in such way that there is alignment with the society, in order to gain the title of legitimate. Moreover, companies are part of a broader system and do not have the sole right to resources [144]. So, companies must prove and earn the right to use them, in a legitimate way [145].

If a company or an organization is not legitimate, then they may have significant difficulties and problems in their operations and the different groups of stakeholders may decrease the demand for their goods or services. So, legitimacy is a valuable resource for a company and each company and organization should build on it, in order to create competitive advantages or increase its business performance [144]. Therefore, legitimacy plays an important role in how companies should handle their operations.

According to a survey, conducted by Gray and Milne [146], the application of the legitimacy theory remains voluntary for managers. This fact may create concerns and second thoughts in society about the validity of a company's results regarding social and environmental impact.

3.3. Transaction Cost Theory

Transaction cost theory is an economic theory which tries to explain how partners inside a supply chain govern their economic transactions with one another. It provides an insight into the economic risks that partners face as they incorporate environmental performance into their relationships [147].

Therefore, transaction cost theory is well-known and used in supply chain management in order to explain various phenomena, such as economies of integration [148], governance effectiveness, and supplier performance [149]. This specific theory is widely applicable in the economic field of supply chain management because it is able to make important and accurate predictions on the effect of uncertainty [150]. According to Carr and Pearson [151], transaction costs include all costs which are necessary to a business co-operation/relationship or transaction, including the exchange of goods, services, information, and cash. So, inside supply chains there is the need to collect and process information data, negotiate contracts, monitor and enforce agreements, and manage and maintain relationships which generate the transaction costs [152].

Transaction cost theory defines governance structures so as to minimize costs under specific exogenous conditions [119]. Governance is concerned with the coordination of the flow of goods and services throughout the value creation process [153].

4. Conceptual Framework Development

During the last few years, companies have increased their efforts to become more sustainable in order to improve operations handling, innovation management, and strategic development. They also aimed at increasing their competitive advantage and improve their position inside their task environment [154]. They have, additionally, had the chance to obtain larger benefits from the application of new technologies inside their supply chain management. To examine and analyze the benefits from the adoption of sustainability, this study uses the N-RBV, stakeholder theory, legitimacy theory and transaction cost theory as a theoretical background. Table 2 shows how the above theories are connected with the specific technologies that are under examination in this paper.

Table 2. Theories and Technologies.

Performances	Theory/Technology	BT	IoT	BDA
Environmental	N-RBV	✔	✔	✔
Economic	Transaction Cost	✔		✔
Social	Legitimacy	✔		
	Stakeholder	✔	✔	

As this paper focuses on all three pillars of SSCM, the developed conceptual framework shows the types of resources and capabilities that can lead to improved economic results, and environmental and social impacts.

According to the conceptual framework (Figure 2) presented below, companies develop and use their own SSCM and IT resources in order to make their processes more effective and efficient. The combination of the above resources can create sustainable capabilities and, in many cases, sustainable value. Companies take advantage of these new capabilities and values in order to increase their performance. Finally, companies are able to develop new sustainable strategies in order to further exploit their resources and strengthen their position in the market.

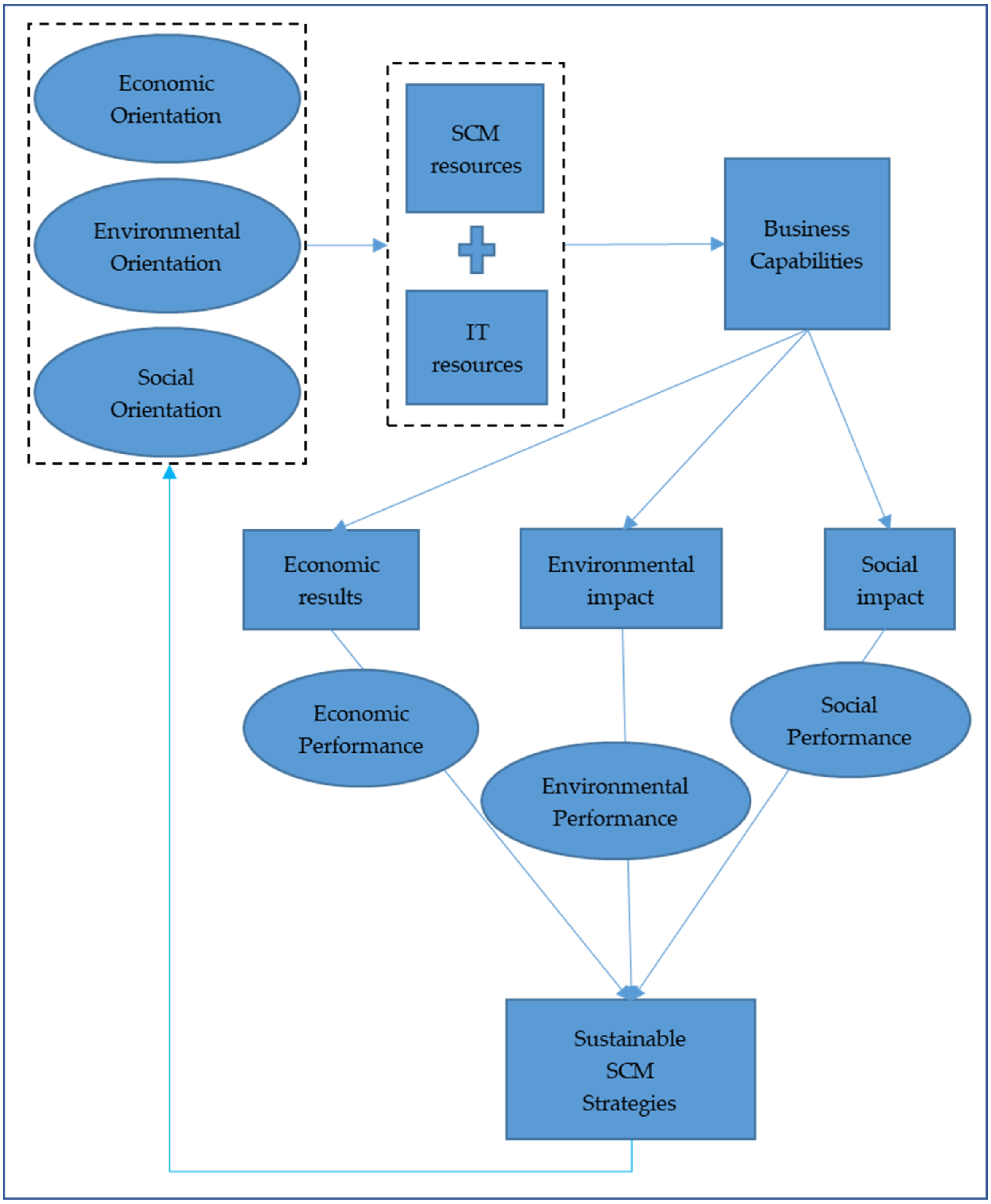

Figure 2. The impact of IT and sustainable resources.

The main concepts of this framework are further explained in the following sections.

4.1. Resources and Capabilities

According to the literature review, IT and supply chain management resources must be both internal and external. This means that companies must not only be early adopters, but also be totally aligned with their partners in all domains, so as to have the desired outcome. For example, there will be no gain for a company if it is the only one adopting the BT. So, the implementation of DT across the whole supply chain demands common technological standards and clear implementation strategies from all partners [8]. Business alignment is imperative for all partners to enjoy the benefits of digitalization. According to the N-RBV, IT and SCM resources could play an important role in the increase of business performance or the attainment of a competitive advantage. Therefore, the internal resources must be enhanced, following the technological advances of industry 4.0.

According to Chan et al. [155], SSCM uses all the available resources inside the supply chain with environmental awareness. Therefore, it is an undeniable fact that DT should be applied to supply chains and be combined with the SCM resources so that companies can develop sustainability capabilities, which could lead to competitive advantages [156]. The study, which was conducted by Sezhiyan et al. [157], revealed that supply chain capabilities and information capabilities are able to affect a firm's performance, directly and indirectly.

According to Dao et al. [156], the combination of IT and SCM resources can provide companies with unique capabilities. These capabilities could help companies increase their efficiency and profitability, as well as to obtain competitive advantages inside their task environments [156]. These capabilities, such as know-how, are not easily gained because no company can buy them, but they can be developed over time.

Furthermore, according to Hart [137], business capabilities that belong inside a supply chain based on the N-RBV can create competitive advantages. These capabilities can be developed beyond the limits of companies by combining the resources, which are available to different partners of the supply chain [138].

4.2. Business Performance

DT in supply chain management affects firms' performances in several ways. First, DT may increase financial performance by leading to better economic results. Moreover, it could have a positive environmental impact by controlling emissions and the whole product line and transportation. Last but not least, it could have a social impact by allowing information sharing with all stakeholders.

4.2.1. Economic Performance

Financial data and flows belong to one of the main pillars of sustainability and sustainable supply chain management [47]. However, academics, during the previous decade, started to develop analytical models in order to discover how to plan, manage, and control financial flows inside supply chains [158]. According to the analysis of the literature, DT can help supply chain management, regarding the third pillar of sustainability. For example, BDA have the potential to analyze all the necessary information and create financial trends. In that way, BDA could help a company's marketing sector make predictions. Moreover, BT could cut the supply chain into smaller chains and, in combination with BDA, could provide a company with knowledge of all costs deriving from the supply chain management, so that executives are able to reduce them. Moreover, by using the transaction cost theory they can obtain a better overview of product, information, and financial flows that need to be managed, as this theory analyzes all costs and information among partners. In that way, executives would be able to provide better economic results and help their company to achieve its financial goals.

4.2.2. Environmental Performance

DT provides supply chain management with many IT resources which are able to make it greener. For example, BT has the ability, through rework and recall, to decrease resource consumption and reduce greenhouse gas emissions; for example, blockchains could be used to reassure stakeholders that green products are actually environmentally friendly [159]. Moreover, BDA and the IoT provide all the necessary information about CO_2 emissions, so that a company and its partners would be able to monitor environmental pollution and make a positive impact on the environmental pillar [160].

Therefore, according to the N-RBV, DT inside supply chain management may be considered valuable resources which could lead the supply chain to improve its performance and its position towards its opponents inside the task environment [161].

Moreover, the environmental pillar is positively related to financial flows because customers are more willing to buy products that are green from companies which respect the environment and society. Furthermore, there are partners who decide to collaborate only with green companies.

4.2.3. Social Performance

According to the literature review, new information technologies, such as BT, are able to provide the whole supply chain with traceability, which helps the social pillar of sustainability by enabling better assurance of human rights. Legitimacy theory states that any company or organization must convince all its stakeholders that it is legitimate. Therefore, legitimacy may be considered a significant resource of a company inside the supply chain, which could help companies to build on this in order to survive and create a competitive advantage [144]. Moreover, DT (specifically the technology of the IoT) has the ability to provide information to all the stakeholders of a supply chain and society in real time, so there is transparency inside the supply chain, which enforces the social dimension of the chain. So, new technologies have the power to develop this resource inside the chain and create social sustainability.

Social impact derives from the collaboration of the above resources. In order to better understand and measure social impact, companies must measure social performance, which can be measured with the use of the social return on investment (SROI) model. This specific model uses the standards of GRI (as mentioned in a previous chapter) and tries to convert social impact into monetary units, which is derived from the policies of corporate social responsibility [162]. The aim of this specific model is to turn the social dimension of the supply chain into a more understandable and manageable part of the company.

According to Maier et al. [162], there is a positive correlation among the social and the economic pillars, which means that when social performance is increased, it also helps economic performance to increase by pushing clients and partners to choose a specific company [162]. In this way, small and medium companies could gain a competitive advantage against bigger ones, but also develop their own strategies in order to achieve their aims and strengthen their position in the market.

4.3. Sustainable Supply Chain Management Strategies

The first goal of SCM is to increase the value of products and services that are provided to customers and partners within the supply chain, to improve their quality, and to reduce the inventory carrying costs [163]. In addition, in combination with the SDGs and the three pillars of sustainability, another primary goal of SCM is to become aligned with sustainable policies and to protect the environment and society. The value which is created by a company's SSCM efforts clearly supports the organizational strategy.

According to Sezhiyan et al. [157], supply chain management strategies have become a contemporary component of a firm's strategy. The success of a company depends on its SCM practices and policies and its related strategy [164], including sustainable practices.

Nowadays, the demands of clients for higher quality in services and goods, and for sustainable and green policies, have led many companies to control and reduce their operational costs and to create beneficial partnership strategies with suppliers, distributors, retailers, and other firms inside their task environments, with the main purpose to increase their performances.

Therefore, reputation is a key strategic concern for modern companies [16] and environmental, social, and economic performances have become important tasks for companies. Poor sustainable practices and policies may harm their reputation and create a negative impact on their goals [165], so companies must develop specific SSCM strategies in order to survive, gain market share, and create a competitive advantage.

According to Gupta et al. [166], there are specific sustainable strategies that should be adopted so that sustainable supply chains deal with their problems and barriers. These strategies are oriented in all dimensions of sustainability and should be applied together, because each strategy covers a different pillar. First of all, the "Sustainable information technology development strategy", which aims to develop information technology capabilities, can contribute to sustainable development through innovation. The "Networking strategy" aims to build collaborative skills within the company and among all stakeholders. The "Economic and incentives-based strategy" includes investments in technologies related to sustainability and aims to provide financial incentives to employees for the proposals and implementation of innovative ideas. The "Marketing and promotion strategy" aims to develop marketing and promote the benefits of sustainable products to customers, so that the demand for products and services increases. The "Research and Development strategy" aims to develop research units within the company, so as to improve products and processes. Last but not least, the "Sustainable proficiencies and skill development strategy" aims to create a favorable environment for employees in order to develop green and sustainable skills.

So, according to the above framework, due to the new and strict regulations of the EU and UN, but also due to the awareness of society and the environmental crisis, companies have to develop new strategies which should be oriented to the three pillars of sustainability. Due to this orientation, companies have to develop their own IT and SCM resources, which, with the right use and alignment with the trading partners and customers, could lead to specific business capabilities. These capabilities, which derive from the combination of resources [167] using specific theories, could play an important role in the improvement of economic results, decrease the environmental impact of the chain, and increase the social impact. By improving all the above, there can be a significant improvement in the performance of each pillar, which would lead a company to reposition its main strategies and develop new ones by using these new technologies [120] that are able to create and increase the performance in each pillar of sustainability.

5. Discussion

Dao et al. [155] argued that IS are an important and necessary support tools for every sustainable supply chain, since IS can bring benefits to a company, its partners, and clients. Moreover, according to the analysis conducted in the previous section, DT can enable companies to develop IT in order to support specific sustainable strategies within their supply chain.

According to Sharma et al. [168], the implementation of new technologies can sup-port the development of SSCM initiatives, which can maximize the economic results, re-duce environmental impact, and contribute to social impact. Firstly, DT can contribute to the environmental pillar of sustainability, since it can provide the ability to control and monitor emissions and can contribute to recall and rework. Secondly, DT can contribute to the social pillar of SCM, since it supports the accuracy of data and provides groups of stakeholders with real-time information, ensuring transparency and traceability within the supply chain. Thirdly, DT can also affect the economic pillar of sustainability by supporting the efficiency of operations, leading to cost cutting and providing a better image of the financial flows within the supply chain and between trading partners.

As Table 1 shows, the results of this research are partly aligned with the research of other authors. First of all, Manavalan and Jayakrishna [99] stated that the new technologies of Industry 4.0 will contribute to SSCM, especially in the environmental and social pillar, by using the IoT technology. In addition, the research, which was conducted by Bag et al. [109], revealed that the BDA could increase the social impact in the internal environment of the company. Furthermore, the adoption of BT is capable of decreasing all transaction costs and improving financial results [119]. Although the authors agree with these specific points, these three technologies should have been combined because they will all play an important role in the near future, being an integral part of the DT of supply chains. Therefore, they all need to be examined in order to reveal the scope of their contribution in SSCM.

So, the results from the analysis of the literature review and the development of the conceptual framework revealed that the use of these technologies (BT, BDA, and IoT), in collaboration with sustainable development practices in supply chains, can improve the economic results of a company, create a better social impact for the stakeholders, and improve environmental footprints. All these will lead to better business performance. Therefore, sustainable supply chains in Industry 4.0 should focus on DT to support sustainability practices [129].

However, it is important to note that the implementation of IT is not sufficient to lead a company to a competitive advantage, as new technologies are available for all companies [9]. Only in combination with sustainable practices, could digital transformation play an important role in increasing business performance and developing sustainable strategies. According to the N-RBV and the theories of stakeholder, legitimacy, and transaction-cost, the right combination and relationships between IT and SCM resources can lead to sustainability capabilities, which can allow a significant increase in the social, environmental, and financial performances of a company and its supply chain. These capabilities can support the development of sustainable strategies, which can potentially allow companies to gain competitive advantages and improve their position inside their task environment.

6. Conclusions and Limitations

This literature review revealed that there is a limited amount of academic research and case studies in the field of SSCM that explores all three dimensions of sustainability. In addition, according to Birkel and Muller [108], there is a limited number of studies which examine the relationship of all the three pillars with the DT of supply chains. Most studies focus on the financial impact, which constitutes a high concern of companies. In contrast, the combination of the social pillar of sustainable supply chains with IT is something relatively new and difficult to understand and analyze ([50,169]). Moreover, the impact of this combination (the three pillars and digital transformation) on the performance of a company or its supply chain is still unclear. This paper argues that there is a need for more academic research, both at a theoretical level and of real case studies, in order to examine and analyze practices related to the three pillars of SSCM and to sustainability strategies that may lead to competitive advantages.

The purpose of this study was three-fold. The first objective was to clarify the impact of DT (including BT, BDA, and IoT) on sustainable supply chain management, regarding the pillars of sustainable development. A second important objective was to understand and explain how the combination and use of these new technologies can support sustainable supply chain management. Finally, the most important one, was the contribution to the literature through the development of a theoretical conceptual framework, which can explain under which circumstances the above combination could increase the performance in each sustainability pillar separately and could support specific sustainable strategies to improve the business performance of companies.

The development of this conceptual framework, based on relevant theories, provides the main theoretical and practical contribution of the paper. It provides both academics and practitioners with a tool to examine and analyze the impact of sustainability practices and strategies on supply chain performance. It can be used as a base for the analysis of the impact of DT on the sustainability capabilities of specific case studies. It can be also used by practitioners, within specific business contexts, to better understand how the combination of new technologies and sustainable practices could contribute to the improvement of the social, economic, and environmental performance of their company. Hence, it will support them in the development of their own sustainable strategies in order to play an important role inside their task environment.

The main and most important limitation of this study is that it was developed only theoretically. Therefore, it is necessary to further examine the results of the study through empirical work. The authors intend to apply the proposed framework to logistics companies with similar characteristics in order to develop more in-depth conclusions.

In conclusion, future work should investigate the impact of DT inside SSCM in practice, so as to provide a deeper understanding of the subject under study. The mentioned theories, with their focus on different areas and pillars of sustainability, suggest that mixed methods of research would be highly beneficial, and possibly necessary, in order to examine the relationship between DT and SSCM in varied business contexts. This work could combine a survey of research data with qualitative data from semi-structured interviews from selected companies. The results could enable academics to draw specific conclusions and practitioners/managers to realize the business capabilities and performance of their company.

To sum up, DT will be a competitive necessity for supply chains in the near future. Thus, further research of its impact on all sustainable performances would be valuable in order to guide both practitioners and academics toward the anticipated changes of the business environment.

Author Contributions: Conceptualization, A.S. and E.K.; methodology, A.S. and E.K.; validation, A.S. and E.K.; formal analysis, A.S. and E.K.; investigation, A.S. and E.K.; resources, A.S. and E.K.; data curation, E.K.; writing—original draft preparation, A.S.; writing—review and editing, E.K.; visualization, A.S. and E.K.; supervision, E.K.; project administration, A.S.; funding acquisition, E.K. All authors have read and agreed to the published version of the manuscript.

Funding: This work has been partly supported by the University of Piraeus Research Center.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data sharing not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Verhoef, P.C.; Broekhuizen, T.; Bart, Y.; Bhattacharya, A.; Dong, J.Q.; Fabian, N.; Haenlein, M. Digital transformation: A multidisciplinary reflection and research agenda. *J. Bus. Res.* **2021**, *122*, 889–901. [CrossRef]
2. Loebbecke, C.; Picot, A. Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. *J. Strateg. Inf. Syst.* **2015**, *24*, 149–157. [CrossRef]
3. Brettel, M.; Bendig, D.; Keller, M.; Friederichsen, N.; Rosenberg, M. Effectuation in manufacturing: How entrepreneurial decision-making techniques can be used to deal with uncertainty in manufacturing. *Procedia CIRP* **2014**, *17*, 611–616. [CrossRef]
4. Zhu, Z.; Lan, K.; Rao, Z.; Zhang, Y. Risk assessment method for IoT software supply chain vulnerabilities. *J. Phys. Conf. Ser.* **2021**, *1732*, 012051. [CrossRef]
5. Dubey, R.; Gunasekaran, A.; Childe, S.J.; Bryde, D.J.; Giannakis, M.; Foropon, C.; Roubaud, D.; Hazen, B.T. Big data analytics and artificial intelligence pathway to operational performance under the effects of entrepreneurial orientation and environmental dynamism: A study of manufacturing organisations. *Int. J. Prod. Econ.* **2020**, *226*, 107599. [CrossRef]
6. Papadopoulos, T.; Gunasekaran, A.; Dubey, R.; Altay, N.; Childe, S.J.; Fosso-Wamba, S. The role of Big Data in explaining disaster resilience in supply chains for sustainability. *J. Clean. Prod.* **2017**, *142*, 1108–1118. [CrossRef]
7. Farahani, P.; Meier, C.; Wilke, J. Digital supply chain management agenda for the automotive supplier industry. In *Shaping the Digital Enterprise*, 1st ed.; Oswald, G., Kleinemeier, M., Eds.; Springer: Cham, Switzerland, 2017; pp. 157–172.
8. Birkel, H.; Müller, J.M. Potentials of industry 4.0 for supply chain management within the triple bottom line of sustainability—A systematic literature review. *J. Clean. Prod.* **2021**, *289*, 125612. [CrossRef]
9. Stroumpoulis, A.; Kopanaki, E.; Karaganis, G. Examining the Relationship between Information Systems, Sustainable SCM, and Competitive Advantage. *Sustainability* **2021**, *13*, 11715. [CrossRef]
10. Yang, K.; Duan, T.; Feng, J.; Mishra, A.R. Internet of things challenges of sustainable supply chain management in the manufacturing sector using an integrated q-Rung Orthopair Fuzzy-CRITIC-VIKOR method. *J. Enterp. Inf. Manag.* **2021**. [CrossRef]
11. Jia, F.; Blome, C.; Sun, H.; Yang, Y.; Zhi, B. Towards an integrated conceptual framework of supply chain finance: An information processing perspective. *Int. J. Prod. Econ.* **2020**, *219*, 18–30. [CrossRef]
12. Tranfield, D.; Denyer, D.; Smart, P. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *Br. J. Manag.* **2003**, *14*, 207–222. [CrossRef]
13. Kilibarda, M.; Andrejić, M.; Popović, V. Research in logistics service quality: A systematic literature review. *Transport* **2020**, *35*, 224–235.
14. Agatz, N.A.; Fleischmann, M.; Van Nunen, J.A. E-fulfillment and multi-channel distribution–A review. *Eur. J. Oper. Res.* **2008**, *187*, 339–356. [CrossRef]

15. Bruntland, G. Our Common Future. The World Commission on Environment and Development. 1987, pp. 45–65. Available online: https://sswm.info/sites/default/files/reference_attachments/UN%20WCED%201987%20Brundtland%20Report.pdf (accessed on 27 February 2022).
16. Roberts, P.W.; Dowling, G.R. Corporate reputation and sustained superior financial performance. *Strateg. Manag. J.* **2002**, *23*, 1077–1093. [CrossRef]
17. Scheidel, A.; Temper, L.; Demaria, F.; Martínez-Alier, J. Ecological distribution conflicts as forces for sustainability: An overview and conceptual framework. *Sustain. Sci.* **2018**, *13*, 585–598. [CrossRef]
18. Dempsey, N.; Bramley, G.; Power, S.; Brown, C. The social dimension of sustainable development: Defining urban social sustainability. *Sustain. Dev.* **2011**, *19*, 289–300. [CrossRef]
19. Lehtonen, M. The environmental–social interface of sustainable development: Capabilities, social capital, institutions. *Ecol. Econ.* **2004**, *49*, 199–214. [CrossRef]
20. Agyeman, J.; Bullard, R.D.; Evans, B. Exploring the nexus: Bringing together sustainability, environmental justice and equity. *Space Polity* **2002**, *6*, 77–90. [CrossRef]
21. Pawłowski, A. How many dimensions does sustainable development have? *Sustain. Dev.* **2008**, *16*, 81–90. [CrossRef]
22. Sheth, J.N.; Sethia, N.K.; Srinivas, S. Mindful consumption: A customer-centric approach to sustainability. *J. Acad. Mark. Sci.* **2011**, *39*, 21–39. [CrossRef]
23. United Nations. *Draft Outcome Document of the United Nations Summit for the Adoption of the Post-2015 Development Agenda*; United Nations: New York, NY, USA, 2015.
24. Kolk, A.; Kourula, A.; Pisani, N. Multinational enterprises and the Sustainable Development Goals: What do we know and how to proceed? *Transnatl. Corp.* **2017**, *24*, 9–32. [CrossRef]
25. Kaab, A.; Sharifi, M.; Mobli, H.; Nabavi-Pelesaraei, A.; Chau, K.W. Combined life cycle assessment and artificial intelligence for prediction of output energy and environmental impacts of sugarcane production. *Sci. Total Environ.* **2019**, *664*, 1005–1019. [CrossRef] [PubMed]
26. Hall, A. Social policies in the World Bank: Paradigms and challenges. *Glob. Soc. Policy* **2007**, *7*, 151–175. [CrossRef]
27. Fitzpatrick, C. What is the difference between 'desistance'and 'resilience'? Exploring the relationship between two key concepts. *Youth Justice* **2011**, *11*, 221–234. [CrossRef]
28. Al Amosh, H.A.M.; Mansor, N. Sustainability and corporate reporting: A review on environmental and social accounting disclosure. *Int. J. Account.* **2018**, *3*, 78–87.
29. Van Zanten, J.A.; Van Tulder, R. Multinational enterprises and the Sustainable Development Goals: An institutional approach to corporate engagement. *J. Int. Bus. Policy* **2018**, *1*, 208–233. [CrossRef]
30. Lacy, P.; Gupta, P.; Hayward, R. From incrementalism to transformation: Reflections on corporate sustainability from the UN global compact-Accenture CEO study. In *Managing Sustainable Business*; Springer: Berlin/Heidelberg, Germany, 2019; pp. 505–518.
31. Miles, M.P.; Munilla, L.S. The potential impact of social accountability certification on marketing: A short note. *J. Bus. Ethics* **2004**, *50*, 1–11. [CrossRef]
32. Mani, V.; Gunasekaran, A.; Delgado, C. Supply chain social sustainability: Standard adoption practices in Portuguese manufacturing firms. *Int. J. Prod. Econ.* **2018**, *198*, 149–164. [CrossRef]
33. Żak, A. Triple bottom line concept in theory and practice. *Soc. Responsib. Organ. Dir. Chang.* **2015**, *387*, 251–264. [CrossRef]
34. Isil, O.; Hernke, M.T. The triple bottom line: A critical review from a transdisciplinary perspective. *Bus. Strategy Environ.* **2017**, *26*, 1235–1251. [CrossRef]
35. Elkington, J. The triple bottom line. *Environ. Manag. Read. Cases* **1997**, *2*, 49–66.
36. Hart, S.L.; Milstein, M.B. Creating sustainable value. *Acad. Manag. Perspect.* **2003**, *17*, 56–67. [CrossRef]
37. Farooq, Q.; Fu, P.; Liu, X.; Hao, Y. Basics of macro to microlevel corporate social responsibility and advancement in triple bottom line theory. *Corp. Soc. Responsib. Environ. Manag.* **2021**, *28*, 969–979. [CrossRef]
38. Elkington, J. 25 years ago I coined the phrase "triple bottom line". Here's why it's time to rethink it. *Harv. Bus. Rev.* **2018**, *25*, 2–5.
39. Joshi, S.; Li, Y. What is corporate sustainability and how do firms practice it? A management accounting research perspective. *J. Manag. Account. Res.* **2016**, *28*, 1–11. [CrossRef]
40. Gilbert, D.U.; Rasche, A.; Waddock, S. Accountability in a global economy: The emergence of international accountability standards. *Bus. Ethics Q.* **2011**, *21*, 23–44. [CrossRef]
41. Moon, J. The contribution of corporate social responsibility to sustainable development. *Sustain. Dev.* **2007**, *15*, 296–306. [CrossRef]
42. Carroll, A.B. A three-dimensional conceptual model of corporate performance. *Acad. Manag. Rev.* **1979**, *4*, 497–505. [CrossRef]
43. Waddock, S. Building a new institutional infrastructure for corporate responsibility. *Acad. Manag. Perspect.* **2008**, *22*, 87–108. [CrossRef]
44. Brunsson, N.; Rasche, A.; Seidl, D. The dynamics of standardization: Three perspectives on standards in organization studies. *Organ. Stud.* **2012**, *33*, 613–632. [CrossRef]
45. Vigneau, L.; Humphreys, M.; Moon, J. How do firms comply with international sustainability standards? Processes and consequences of adopting the global reporting initiative. *J. Bus. Ethics* **2015**, *131*, 469–486. [CrossRef]
46. Bhuniya, S.; Pareek, S.; Sarkar, B. A supply chain model with service level constraints and strategies under uncertainty. *Alex. Eng. J.* **2021**, *60*, 6035–6052. [CrossRef]

47. Mentzer, J.T.; DeWitt, W.; Keebler, J.S.; Min, S.; Nix, N.W.; Smith, C.D.; Zacharia, Z.G. Defining supply chain management. *J. Bus. Logist.* **2002**, *22*, 1–25. [CrossRef]
48. Lambert, D.M.; Croxton, K.L.; Garcia-Dastugue, S.J.; Knemeyer, M.; Rogers, D.S. *Supply Chain Management Processes, Partnerships, Performance*, 3rd ed.; Hartley Press Inc.: Jacksonville, FL, USA, 2006; p. 2.
49. Mubarik, M.S.; Naghavi, N.; Mubarik, M.; Kusi-Sarpong, S.; Khan, S.A.; Zaman, S.I.; Kazmi, S.H.A. Resilience and cleaner production in industry 4.0: Role of supply chain mapping and visibility. *J. Clean. Prod.* **2021**, *292*, 126058. [CrossRef]
50. Seuring, S.; Müller, M. From a literature review to a conceptual framework for sustainable supply chain management. *J. Clean. Prod.* **2008**, *16*, 1699–1710. [CrossRef]
51. Carter, C.R.; Rogers, D.S. A framework of sustainable supply chain management: Moving toward new theory. *Int. J. Phys. Distrib. Logist. Manag.* **2008**, *38*, 360–387. [CrossRef]
52. Varsei, M. Sustainable supply chain management: A brief literature review. *J. Dev. Areas* **2016**, *50*, 411–419. [CrossRef]
53. Tseng, M.L. Modeling sustainable production indicators with linguistic preferences. *J. Clean. Prod.* **2013**, *40*, 46–56. [CrossRef]
54. Seuring, S. A review of modeling approaches for sustainable supply chain management. *Decis. Support Syst.* **2013**, *54*, 1513–1520. [CrossRef]
55. Zhu, Q.; Sarkis, J.; Lai, K.H. Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *J. Purch. Supply Manag.* **2013**, *19*, 106–117. [CrossRef]
56. Curkovic, S.; Sroufe, R. Using ISO 14001 to promote a sustainable supply chain strategy. *Bus. Strategy Environ.* **2011**, *20*, 71–93. [CrossRef]
57. Srivastava, S.K. Green supply-chain management: A state-of-the-art literature review. *Int. J. Manag. Rev.* **2007**, *9*, 53–80. [CrossRef]
58. Carvalho, H.; Govindan, K.; Azevedo, S.G.; Cruz-Machado, V. Modelling green and lean supply chains: An eco-efficiency perspective. *Resour. Conserv. Recycl.* **2017**, *120*, 75–87. [CrossRef]
59. Gast, J.; Gundolf, K.; Cesinger, B. Doing business in a green way: A systematic review of the ecological sustainability entrepreneurship literature and future research directions. *J. Clean. Prod.* **2017**, *147*, 44–56. [CrossRef]
60. Pagell, M.; Shevchenko, A. Why research in sustainable supply chain management should have no future. *J. Supply Chain Manag.* **2014**, *50*, 44–55. [CrossRef]
61. Wu, Z.; Pagell, M. Balancing priorities: Decision-making in sustainable supply chain management. *J. Oper. Manag.* **2011**, *29*, 577–590. [CrossRef]
62. Soriano, D.R.; Ross, A.D.; Parker, H.; del Mar Benavides-Espinosa, M.; Droge, C. Sustainability and supply chain infrastructure development. *Manag. Decis.* **2012**, *50*, 1891–1910.
63. Yusuf, Y.Y.; Gunasekaran, A.; Musa, A.; El-Berishy, N.M.; Abubakar, T.; Ambursa, H.M. The UK oil and gas supply chains: An empirical analysis of adoption of sustainable measures and performance outcomes. *Int. J. Prod. Econ.* **2013**, *146*, 501–514. [CrossRef]
64. Mani, V.; Gunasekaran, A.; Papadopoulos, T.; Hazen, B.; Dubey, R. Supply chain social sustainability for developing nations: Evidence from India. *Resour. Conserv. Recycl.* **2016**, *111*, 42–52. [CrossRef]
65. Jorgensen, A.L.; Knudsen, J.S. Sustainable competitiveness in global value chains: How do small Danish firms behave? *Corp. Gov. Int. J. Bus. Soc.* **2006**, *6*, 449–462.
66. Donaldson, T.; Preston, L.E. The stakeholder theory of the corporation: Concepts, evidence, and implications. *Acad. Manag. Rev.* **1995**, *20*, 65–91. [CrossRef]
67. Sodhi, M.S. Conceptualizing social responsibility in operations via stakeholder resource-based view. *Prod. Oper. Manag.* **2015**, *24*, 1375–1389. [CrossRef]
68. Hemingway, C.A. Personal values as a catalyst for corporate social entrepreneurship. *J. Bus. Ethics* **2005**, *60*, 233–249. [CrossRef]
69. Wognum, P.N.; Bremmers, H.; Trienekens, J.H.; van der Vorst, J.G.; Bloemhof, J.M. Systems for sustainability and transparency of food supply chains–Current status and challenges. *Adv. Eng. Inform.* **2011**, *25*, 65–76. [CrossRef]
70. Hall, J.; Matos, S. Incorporating impoverished communities in sustainable supply chains. *Int. J. Phys. Distrib. Logist. Manag.* **2010**, *40*, 124–147. [CrossRef]
71. de Camargo Fiorini, P.; Jabbour, C.J.C. Information systems and sustainable supply chain management towards a more sustainable society: Where we are and where we are going. *Int. J. Inf. Manag.* **2017**, *37*, 241–249. [CrossRef]
72. Wang, Y.; Chen, Y.; Benitez-Amado, J. How information technology influences environmental performance: Empirical evidence from China. *Int. J. Inf. Manag.* **2015**, *35*, 160–170. [CrossRef]
73. Nadkarni, S.; Prügl, R. Digital transformation: A review, synthesis and opportunities for future research. *Manag. Rev. Q.* **2021**, *71*, 233–341. [CrossRef]
74. Hartley, J.L.; Sawaya, W.J. Tortoise, not the hare: Digital transformation of supply chain business processes. *Bus. Horiz.* **2019**, *62*, 707–715. [CrossRef]
75. Müller, J.M.; Veile, J.W.; Voigt, K.I. Prerequisites and incentives for digital information sharing in Industry 4.0–an international comparison across data types. *Comput. Ind. Eng.* **2020**, *148*, 106733. [CrossRef]
76. Dalenogare, L.S.; Benitez, G.B.; Ayala, N.F.; Frank, A.G. The expected contribution of Industry 4.0 technologies for industrial performance. *Int. J. Prod. Econ.* **2018**, *204*, 383–394. [CrossRef]
77. Schulz, S.A.; Flanigan, R.L. Developing competitive advantage using the triple bottom line: A conceptual framework. *J. Bus. Ind. Mark.* **2016**, *31*, 449–458. [CrossRef]

78. Norman, W.; MacDonald, C. Getting to the bottom of "triple bottom line". *Bus. Ethics Q.* **2004**, *14*, 243–262. [CrossRef]
79. Hah, K.; Freeman, S. Multinational enterprise subsidiaries and their CSR: A conceptual framework of the management of CSR in smaller emerging economies. *J. Bus. Ethics* **2014**, *122*, 125–136. [CrossRef]
80. Banerjee, A. Blockchain technology: Supply chain insights from ERP. *Adv. Comput.* **2018**, *111*, 69–98.
81. Koh, S.L.; Gunasekaran, A.; Goodman, T. Drivers, barriers and critical success factors for ERPII implementation in supply chains: A critical analysis. *J. Strateg. Inf. Syst.* **2011**, *20*, 385–402. [CrossRef]
82. Nayak, G.; Dhaigude, A.S. A conceptual model of sustainable supply chain management in small and medium enterprises using blockchain technology. *Cogent Econ. Financ.* **2019**, *7*, 1667184. [CrossRef]
83. Dong, F.; Zhou, P.; Liu, Z.; Shen, D.; Xu, Z.; Luo, J. Towards a fast and secure design for enterprise-oriented cloud storage systems. *Concurr. Comput. Pract. Exp.* **2017**, *29*, e4177. [CrossRef]
84. Saberi, S.; Kouhizadeh, M.; Sarkis, J.; Shen, L. Blockchain technology and its relationships to sustainable supply chain management. *Int. J. Prod. Res.* **2019**, *57*, 2117–2135. [CrossRef]
85. Crosby, M.; Pattanayak, P.; Verma, S.; Kalyanaraman, V. Blockchain technology: Beyond bitcoin. *Appl. Innov.* **2016**, *2*, 71.
86. Abeyratne, S.A.; Monfared, R.P. Blockchain ready manufacturing supply chain using distributed ledger. *Int. J. Res. Eng. Technol.* **2016**, *5*, 1–10.
87. Stroumpoulis, A.; Kopanaki, E. The impact of Blockchain Technology in Sustainable Supply Chains. In Proceedings of the IPSERA Online Conference, Online, 29 March–1 April 2021.
88. Atzori, L.; Iera, A.; Morabito, G. The internet of things: A survey. *Comput. Netw.* **2010**, *54*, 2787–2805. [CrossRef]
89. Da Xu, L.; He, W.; Li, S. Internet of things in industries: A survey. *IEEE Trans. Ind. Inform.* **2014**, *10*, 2233–2243.
90. Miorandi, D.; Sicari, S.; De Pellegrini, F.; Chlamtac, I. Internet of things: Vision, applications and research challenges. *Ad Hoc Netw.* **2012**, *10*, 1497–1516. [CrossRef]
91. Wu, Z.; Wang, S.; Yang, H.; Zhao, X. Construction of a Supply Chain Financial Logistics Supervision System Based on Internet of Things Technology. *Math. Probl. Eng.* **2021**, *2021*, 9980397. [CrossRef]
92. Tu, M.; Lim, M.K.; Yang, M.F. IoT-based production logistics and supply chain system—Part 1. *Ind. Manag. Data Syst.* **2018**, *118*, 65–95. [CrossRef]
93. Rezaei, M.; Shirazi, M.A.; Karimi, B. IoT-based framework for performance measurement: A real-time supply chain decision alignment. *Ind. Manag. Data Syst.* **2017**, *117*, 688–712. [CrossRef]
94. Tagarakis, A.C.; Benos, L.; Kateris, D.; Tsotsolas, N.; Bochtis, D. Bridging the Gaps in Traceability Systems for Fresh Produce Supply Chains: Overview and Development of an Integrated IoT-Based System. *Appl. Sci.* **2021**, *11*, 7596. [CrossRef]
95. Björk, A.; Erlandsson, M.; Häkli, J.; Jaakkola, K.; Nilsson, Å.; Nummila, K.; Puntanen, V.; Sirkka, A. Monitoring environmental performance of the forestry supply chain using RFID. *Comput. Ind.* **2011**, *62*, 830–841. [CrossRef]
96. Germani, M.; Landi, D.; Rossi, M. Efficiency and environmental analysis of a system for renewable electricity generation and electrochemical storage of residential buildings. *Procedia CIRP* **2015**, *29*, 839–844. [CrossRef]
97. Addo-Tenkorang, R.; Helo, P.T. Big data applications in operations/supply-chain management: A literature review. *Comput. Ind. Eng.* **2016**, *101*, 528–543. [CrossRef]
98. Hazen, B.T.; Skipper, J.B.; Ezell, J.D.; Boone, C.A. Big data and predictive analytics for supply chain sustainability: A theory-driven research agenda. *Comput. Ind. Eng.* **2016**, *101*, 592–598. [CrossRef]
99. Manavalan, E.; Jayakrishna, K. A review of Internet of Things (IoT) embedded sustainable supply chain for industry 4.0 requirements. *Comput. Ind. Eng.* **2019**, *127*, 925–953. [CrossRef]
100. Dubey, R.; Gunasekaran, A.; Papadopoulos, T.; Childe, S.J.; Shibin, K.T.; Wamba, S.F. Sustainable supply chain management: Framework and further research directions. *J. Clean. Prod.* **2017**, *142*, 1119–1130. [CrossRef]
101. Gautam, A.; Chamoli, S.; Kumar, A.; Singh, S. A review on technical improvements, economic feasibility and world scenario of solar water heating system. *Renew. Sustain. Energy Rev.* **2017**, *68*, 541–562. [CrossRef]
102. Wang, J.; Jia, Z.; Campos, L.A.; Cheng, L.; Knittle, C.; Chang, G.K. Delta-sigma digitization and optical coherent transmission of DOCSIS 3.1 signals in hybrid fiber coax networks. *J. Lightwave Technol.* **2017**, *36*, 568–579. [CrossRef]
103. Decker, P. False Choices, Policy Framing, and the Promise of "Big Data". *Wall Str. J.* **2013**, 1–14. Available online: https://www.mathematica.org/-/media/publications/pdfs/appam_decker_address_11_01_13.pdf (accessed on 27 February 2022).
104. Tseng, F.H.; Cho, H.H.; Wu, H.T. Applying big data for intelligent agriculture-based crop selection analysis. *IEEE Access* **2019**, *7*, 116965–116974. [CrossRef]
105. Blazquez, D.; Domenech, J. Big Data sources and methods for social and economic analyses. *Technol. Forecast. Soc. Chang.* **2018**, *130*, 99–113. [CrossRef]
106. Roßmann, B.; Canzaniello, A.; von der Gracht, H.; Hartmann, E. The future and social impact of Big Data Analytics in Supply Chain Management: Results from a Delphi study. *Technol. Forecast. Soc. Chang.* **2018**, *130*, 135–149. [CrossRef]
107. Badiezadeh, T.; Saen, R.F.; Samavati, T. Assessing sustainability of supply chains by double frontier network DEA: A big data approach. *Comput. Oper. Res.* **2018**, *98*, 284–290. [CrossRef]
108. Hult, G.T.M.; Hurley, R.F.; Knight, G.A. Innovativeness: Its antecedents and impact on business performance. *Ind. Mark. Manag.* **2004**, *33*, 429–438. [CrossRef]
109. Bag, S.; Wood, L.C.; Xu, L.; Dhamija, P.; Kayikci, Y. Big data analytics as an operational excellence approach to enhance sustainable supply chain performance. *Resour. Conserv. Recycl.* **2020**, *153*, 104559. [CrossRef]

110. Wamba, S.F.; Gunasekaran, A.; Akter, S.; Ren, S.J.F.; Dubey, R.; Childe, S.J. Big data analytics and firm performance: Effects of dynamic capabilities. *J. Bus. Res.* **2017**, *70*, 356–365. [CrossRef]
111. Yu, M.; Yang, C.; Li, Y. Big data in natural disaster management: A review. *Geosciences* **2018**, *8*, 165. [CrossRef]
112. Baryannis, G.; Validi, S.; Dani, S.; Antoniou, G. Supply chain risk management and artificial intelligence: State of the art and future research directions. *Int. J. Prod. Res.* **2019**, *57*, 2179–2202. [CrossRef]
113. Nguyen, D.; Al Mannai, K.A.; Joty, S.; Sajjad, H.; Imran, M.; Mitra, P. Robust classification of crisis-related data on social networks using convolutional neural networks. In Proceedings of the International AAAI Conference on Web and Social Media, Montreal, QC, Canada, 15–18 May 2017.
114. Yadav, G.; Luthra, S.; Jakhar, S.K.; Mangla, S.K.; Rai, D.P. A framework to overcome sustainable supply chain challenges through solution measures of industry 4.0 and circular economy: An automotive case. *J. Clean. Prod.* **2020**, *254*, 120112. [CrossRef]
115. Liu, J.; Chen, M.; Liu, H. The role of big data analytics in enabling green supply chain management: A literature review. *J. Data Inf. Manag.* **2020**, *2*, 75–83. [CrossRef]
116. Zelbst, P.J.; Green, K.W.; Sower, V.E.; Bond, P.L. The impact of RFID, IIoT, and Blockchain technologies on supply chain transparency. *J. Manuf. Technol. Manag.* **2019**, *31*, 441–457. [CrossRef]
117. Jeble, S.; Dubey, R.; Childe, S.J.; Papadopoulos, T.; Roubaud, D.; Prakash, A. Impact of big data and predictive analytics capability on supply chain sustainability. *Int. J. Logist. Manag.* **2018**, *29*, 513–538. [CrossRef]
118. Kouhizadeh, M.; Sarkis, J. Blockchain practices, potentials, and perspectives in greening supply chains. *Sustainability* **2018**, *10*, 3652. [CrossRef]
119. Schmidt, C.G.; Wagner, S.M. Blockchain and supply chain relations: A transaction cost theory perspective. *J. Purch. Supply Manag.* **2019**, *25*, 100552. [CrossRef]
120. Zhang, X.; Yu, Y.; Zhang, N. Sustainable supply chain management under big data: A bibliometric analysis. *J. Enterp. Inf. Manag.* **2020**, *34*, 427–445. [CrossRef]
121. Paliwal, V.; Chandra, S.; Sharma, S. Blockchain technology for sustainable supply chain management: A systematic literature review and a classification framework. *Sustainability* **2020**, *12*, 7638. [CrossRef]
122. Mageto, J. Big data analytics in sustainable supply chain management: A focus on manufacturing supply chains. *Sustainability* **2021**, *13*, 7101. [CrossRef]
123. Mastos, T.D.; Nizamis, A.; Vafeiadis, T.; Alexopoulos, N.; Ntinas, C.; Gkortzis, D.; Papadopoulos, A.; Ioannidis, D.; Tzovaras, D. Industry 4.0 sustainable supply chains: An application of an IoT enabled scrap metal management solution. *J. Clean. Prod.* **2020**, *269*, 122377. [CrossRef]
124. Esmaeilian, B.; Sarkis, J.; Lewis, K.; Behdad, S. Blockchain for the future of sustainable supply chain management in Industry 4.0. *Resour. Conserv. Recycl.* **2020**, *163*, 105064. [CrossRef]
125. Varriale, V.; Cammarano, A.; Michelino, F.; Caputo, M. Sustainable supply chains with blockchain, IoT and RFID: A simulation on order management. *Sustainability* **2021**, *13*, 6372. [CrossRef]
126. De Vass, T.; Shee, H.; Miah, S.J. Iot in supply chain management: A narrative on retail sector sustainability. *Int. J. Logist. Res. Appl.* **2021**, *24*, 605–624. [CrossRef]
127. Badugu, S. An integrated approach using fuzzy logic and IoT for sustainable supply chain management. *Int. J. Innov. Sci. Eng. Res.* **2020**, *7*, 124–132.
128. Nozari, H.; Fallah, M.; Szmelter-Jarosz, A. A conceptual framework of green smart IoT-based supply chain management. *Int. J. Res. Ind. Eng.* **2021**, *10*, 22–34.
129. Cañas, H.; Mula, J.; Campuzano-Bolarín, F. A general outline of a sustainable supply chain 4.0. *Sustainability* **2020**, *12*, 7978. [CrossRef]
130. Choi, T.M.; Luo, S. Data quality challenges for sustainable fashion supply chain operations in emerging markets: Roles of blockchain, government sponsors and environment taxes. *Transp. Res. Part E Logist. Transp. Rev.* **2019**, *131*, 139–152. [CrossRef]
131. Mani, V.; Delgado, C.; Hazen, B.T.; Patel, P. Mitigating supply chain risk via sustainability using big data analytics: Evidence from the manufacturing supply chain. *Sustainability* **2017**, *9*, 608. [CrossRef]
132. Yousefi, S.; Tosarkani, B.M. An analytical approach for evaluating the impact of blockchain technology on sustainable supply chain performance. *Int. J. Prod. Econ.* **2022**, *246*, 108429. [CrossRef]
133. Erol, I.; Ar, I.M.; Peker, I. Scrutinizing blockchain applicability in sustainable supply chains through an integrated fuzzy multi-criteria decision-making framework. *Appl. Soft Comput.* **2022**, *116*, 108331. [CrossRef]
134. Cetindamar, D.; Shdifat, B.; Erfani, E. Understanding big data analytics capability and sustainable supply chains. *Inf. Syst. Manag.* **2022**, *39*, 19–33. [CrossRef]
135. Freeman, R.E.; Dmytriyev, S.D.; Phillips, R.A. Stakeholder theory and the resource-based view of the firm. *J. Manag.* **2021**, *47*, 1757–1770. [CrossRef]
136. Wernerfelt, B. The resource-based view of the firm: Ten years after. *Strateg. Manag. J.* **1995**, *16*, 171–174. [CrossRef]
137. Hart, S.L. A natural-resource-based view of the firm. *Acad. Manag. Rev.* **1995**, *20*, 986–1014. [CrossRef]
138. Dyer, J.H.; Singh, H. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Acad. Manag. Rev.* **1998**, *23*, 660–679. [CrossRef]
139. Vachon, S.; Klassen, R.D. Environmental management and manufacturing performance: The role of collaboration in the supply chain. *Int. J. Prod. Econ.* **2008**, *111*, 299–315. [CrossRef]

140. McDougall, N.; Wagner, B.; MacBryde, J. Leveraging competitiveness from sustainable operations: Frameworks to understand the dynamic capabilities needed to realise NRBV supply chain strategies. *Supply Chain Manag. Int. J.* **2021**, *27*, 12–29. [CrossRef]
141. Duker, J.; Olugunna, M. Corporate Environmental Responsibility (CER): A Case of Logistics Companies in Sweden. Master's Thesis, Upsala University, Department of Business Studies, Upsala, Sweeden, May 2014.
142. Freeman, R.E.; Reed, D.L. Stockholders and stakeholders: A new perspective on corporate governance. *Calif. Manag. Rev.* **1983**, *25*, 88–106. [CrossRef]
143. Ali, W.; Rizwan, M. Factors influencing corporate social and environmental disclosure (CSED) practices in the developing countries: An institutional theoretical perspective. *Int. J. Asian Soc. Sci.* **2013**, *3*, 590–609.
144. Deegan, C.M. Legitimacy theory. *Account. Audit. Account. J.* **2019**, *32*, 2307–2329. [CrossRef]
145. Mathews, M.R. Twenty-five years of social and environmental accounting research. *Account. Audit. Account. J.* **1997**, *10*, 481–531. [CrossRef]
146. Gray, R.; Milne, M.J. It's not what you do, it's the way that you do it? Of method and madness. *Crit. Perspect. Account.* **2015**, *32*, 51–66. [CrossRef]
147. Rosen, C.M.; Bercovitz, J.; Beckman, S. Environmental supply-chain management in the computer industry: A transaction cost economics perspective. *J. Ind. Ecol.* **2000**, *4*, 83–103. [CrossRef]
148. D'aveni, R.A.; Ravenscraft, D.J. Economies of integration versus bureaucracy costs: Does vertical integration improve performance? *Acad. Manag. J.* **1994**, *37*, 1167–1206. [CrossRef]
149. Mahapatra, S.K.; Narasimhan, R.; Barbieri, P. Strategic interdependence, governance effectiveness and supplier performance: A dyadic case study investigation and theory development. *J. Oper. Manag.* **2010**, *28*, 537–552. [CrossRef]
150. Williamson, O.E. Comparative economic organization: The analysis of discrete structural alternatives. *Adm. Sci. Q.* **1991**, *36*, 269–296. [CrossRef]
151. Carr, A.S.; Pearson, J.N. Strategically managed buyer–supplier relationships and performance outcomes. *J. Oper. Manag.* **1999**, *17*, 497–519. [CrossRef]
152. Dyer, J.H. Effective interim collaboration: How firms minimize transaction costs and maximise transaction value. *Strateg. Manag. J.* **1997**, *18*, 535–556. [CrossRef]
153. Grover, V.; Malhotra, M.K. Transaction cost framework in operations and supply chain management research: Theory and measurement. *J. Oper. Manag.* **2003**, *21*, 457–473. [CrossRef]
154. Colbert, B.A.; Kurucz, E.C. Three conceptions of triple bottom line business sustainability and the role for HRM. *People Strategy* **2007**, *30*, 21.
155. Chan, H.L.; Shen, B.; Cai, Y. Quick response strategy with cleaner technology in a supply chain: Coordination and win-win situation analysis. *Int. J. Prod. Res.* **2018**, *56*, 3397–3408. [CrossRef]
156. Dao, V.; Langella, I.; Carbo, J. From green to sustainability: Information Technology and an integrated sustainability framework. *J. Strateg. Inf. Syst.* **2011**, *20*, 63–79. [CrossRef]
157. Sezhiyan, D.M.; Page, T.; Iskanius, P. The impact of supply effort management, logistics capability, and supply chain management strategies on firm performance. *Int. J. Electron. Transp.* **2011**, *1*, 26–44. [CrossRef]
158. Raghavan, N.S.; Mishra, V.K. Short-term financing in a cash-constrained supply chain. *Int. J. Prod. Econ.* **2011**, *134*, 407–412. [CrossRef]
159. Rosencrance, L. Blockchain technology will help the world go green. *Bitcoin Magazine*, 9 May 2017.
160. Bhattacharya, C.B.; Sen, S. Doing better at doing good: When, why, and how consumers respond to corporate social initiatives. *Calif. Manag. Rev.* **2004**, *47*, 9–24. [CrossRef]
161. Dev, N.K.; Shankar, R.; Qaiser, F.H. Industry 4.0 and circular economy: Operational excellence for sustainable reverse supply chain performance. *Resour. Conserv. Recycl.* **2020**, *153*, 104583. [CrossRef]
162. Maier, D.; Maftei, M.; Maier, A.; Biţan, G.E. A review of product innovation management literature in the context of organization sustainable development. *Amfiteatru Econ.* **2019**, *21*, 816–829. [CrossRef]
163. Wisner, J.D. A structural equation model of supply chain management strategies and firm performance. *J. Bus. Logist.* **2003**, *24*, 1–26. [CrossRef]
164. Degraeve, Z.; Labro, E.; Roodhooft, F. An evaluation of vendor selection models from a total cost of ownership perspective. *Eur. J. Oper. Res.* **2000**, *125*, 34–58. [CrossRef]
165. King, B.G.; Soule, S.A. Social movements as extra-institutional entrepreneurs: The effect of protests on stock price returns. *Adm. Sci. Q.* **2007**, *52*, 413–442. [CrossRef]
166. Gupta, H.; Kusi-Sarpong, S.; Rezaei, J. Barriers and overcoming strategies to supply chain sustainability innovation. *Resour. Conserv. Recycl.* **2020**, *161*, 104819. [CrossRef]
167. Yu, Y.; Huo, B.; Zhang, Z.J. Impact of information technology on supply chain integration and company performance: Evidence from cross-border e-commerce companies in China. *J. Enterp. Inf. Manag.* **2021**, *34*, 460–489. [CrossRef]
168. Sharma, M.; Kamble, S.; Mani, V.; Sehrawat, R.; Belhadi, A.; Sharma, V. Industry 4.0 adoption for sustainability in multi-tier manufacturing supply chain in emerging economies. *J. Clean. Prod.* **2021**, *281*, 125013. [CrossRef]
169. Thöni, A.; Tjoa, A.M. Information technology for sustainable supply chain management: A literature survey. *Enterp. Inf. Syst.* **2017**, *11*, 828–858. [CrossRef]