An innovative approach for circular data-driven decision-making in the new normal scenario: opportunities for the agri-food sector

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Received 3 May 2023 – Accepted 26 May 2023

Abstract

This conceptual paper aims to develop an approach that integrates the circular economy paradigm (4-R) with the new pathway proposed by McKinsey & Company for the post-Covid-19 renaissance (5-R) to reimagine the post-pandemic context as a new normal scenario. From an ecosystem perspective, the authors highlight the interconnections between this approach and the widely adopted theories in circular economy studies – the Stakeholder Theory and the Resource-Based View Theory – to provide a resilient model for decision-makers. In this context, the paper spotlight on how digital technologies can represent the enabling factor for implementing the newly proposed approach. In particular, the authors suggest that this approach could be applied within the agri-food sector, characterised by complex supply chains, to cope with future challenges and become more resilient in the new normal scenario. Our contribution is crystallised into a series of research propositions on the intersection between circular economy and digital technology in the data-driven decision-making literature.

Keywords: circular economy, digitalisation, agri-food, supply-chain, Covid-19, twin transition

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Corporate Governance and Research & Development Studies, n. 1-2023
(ISSN 2704-8462-ISSNe 2723-9098, Doi: 10.3280/cgrds1-2023oa15832)

Sommario

Il presente lavoro si prefigge l'obiettivo di sviluppare un approccio concettuale che integri il paradigma dell'economia circolare (4-R) con il percorso per reimmaginare il contesto post pandemico, inteso come la nuova normalità, proposto dalla società di consulenza McKinsey & Company (5-R). In particolare, in un'ottica ecosistemica, gli autori evidenziano le interconnessioni tra questo approccio e le teorie ampiamente usate nella letteratura sull'economia circolare – la *Stakeholder Theory* e la *Resource-Based View Theory* – per fornire un modello resiliente ai *decision-makers*. In tale contesto, lo studio evidenzia come le tecnologie digitali possano rappresentare il fattore abilitante per l'implementazione del nuovo approccio proposto, come strumento a supporto dei processi strategici di *data-driven decision-making*. In particolare, gli autori suggeriscono l'applicazione di tale approccio al settore agroalimentare, caratterizzato da filiere oltremodo complesse, per far fronte alle sfide future attraverso l'adozione di modelli di business più resilienti e adattabili a tale contesto, complesso e in continua evoluzione. Il contributo sviluppa una serie di proposizioni di ricerca basate sull'integrazione dell'economia circolare e le tecnologie digitali, contribuendo ad un avanzamento della letteratura sul *data-driven decision-making*.

Parole chiave: economia circolare, digitalizzazione, filiera agroalimentare, Covid-19, transizione gemella

1. Introduction and background

The agri-food sector (AFS) is considered one of the most important sectors worldwide, accounting for US$ 9.43tn in 2023, with an expected growth of 6.21% *per* year (Statista, 2023). Recent studies have forecasted an increased volume growth of 5.1% in 2024 (Statista, 2023). These data show that, on the one side, in response to the crisis generated by Covid-19 and the Russia-Ukranian conflict, the AFS in the new normal context is rethinking its processes to become more resilient to crises, focusing its strategies on novel approaches that combine the economic, social and environmental requirements (Scandurra *et al*., 2023). On the other side, the growing population poses continuous challenges to match the food demand, increasing pressure on food production, safety and security and on the environment (Rowan and Galanakis, 2020). In fact, the AFS is called to manage problems related to resource scarcity and dependency on scarce resources, as well as costs reduction and processes efficiency to increase productivity and improve material and energy flows (Bocken *et al*., 2023).

From this perspective, agri-food organizations are engaged in guaranteeing a high level of food safety and security – through the reduction of po-

tential healthcare risks – and in addressing the environmental crisis by implementing sustainable business models and practices (Bocken *et al*., 2023; Sica *et al*., 2022). This sustainable transition has been guided by a relatively new production and consumption model which overcame the traditional "take-make-dispose" paradigm, fostering Circular Economy (CE) models based on Reduce-Reuse-Recycle-Recover (4-R) activities and strategies (Kirchherr *et al*., 2017). This paradigm has emerged as a feasible solution to maintain resources and minimize the negative externalities generated by production systems (Merli *et al*., 2018).

During the past decades, CE has gradually been embraced by agri-food firms, with a plethora of born-circular firms and start-ups that pioneer circular business models as well as projects and initiatives to support linear firms in the complex transition towards circular production and consumption models (Suchek *et al*., 2022). However, studies on CE in the AFS have shown several barriers to implementing a circular business model and radically changing their production systems (Mehmood *et al*., 2021).

Scholars have highlighted that one of the most recognized barriers to CE implementation is represented by technological barriers, constituting a prerequisite for CE implementation (Galvão *et al*., 2018; Mehmood *et al*., 2021). Digital Technologies (DT) allow firms, particularly agri-food firms, to produce and collect data to measure processes and guarantee high safety and hygiene standards, traceability and re-traceability. DT could also help firms monitor the impact of circular actions on process efficiency, particularly from a resource and energy management point of view. Furthermore, it has shown that DT can give momentum to a blooming CE, allowing collaboration, resource barter, and value co-creation for reuse and recycling practices (Blackburn *et al*., 2022). As suggested by Bocken *et al*. (2023), sustainable and digital transformation "are occurring in parallel, and synergies are needed for a positive transition to address global challenges" (p. 3). Indeed, DT could also support decision-making processes exploiting big data analyses' strategic relevance to identify key intervention areas for pursuing more restorative and regenerative business operations and to increase productivity and environmental performance (Jin *et al*., 2015; Gupta *et al*., 2019). However, literature has shown that the AFS has difficulties adopting technologies to support decision-making processes for shifting supply chains towards circular patterns (Sica *et al*., 2022).

Considering their relevance in this new normal scenario, many actions have been taken to face these technological barriers, particularly after the pandemic generated by the spread of the Covid-19 virus. In this perspective, the European Commission has stressed and supported the implementation of DT for the circular transition, defining the pathway towards sustainable development as a

"twin transition" in which the circular and digital shifts have a close interconnection, strengthening each other (European Commission, 2022).

In the new normal scenario, the double transition has to be undertaken at a triple bottom line level: individual company level, at the supply chain level, and above all, at an ecosystem level (Gupta *et al*., 2019; Blackburn *et al*., 2022). To efficiently shift from a linear economy to a circular one, scholars have stressed the relevance of adopting a value-cocreation and a resources management approach from an ecosystem perspective enabled by the use of DT (Calabrese *et al*., 2020). Therefore, the stakeholders engagement and the involvement of all the ecosystem actors becomes essential in order to develop an economic and production model in which efficiency losses in terms of raw materials, waste and energy loss are radically minimized.

In this context, after the spread of the Covid-19 virus, the consulting firm "Mckinsey & Company" has proposed a strategic approach based on Resolve, Resilience, Return, Reimagination, and Reform (5-R) to reimagine the post-pandemic context as a new normal context (Sneader and Singhal, 2020; Cucari *et al*., 2023). This approach conveyed to the agri-food supply chain (AFSC) and integrated into the 4-R CE paradigm can represent a theoretical and practical perspective for guiding agri-food firms toward sustainable development through value co-creation activated by DT. Starting from this background, this conceptual paper, adopting a theoretical approach that integrates the Stakeholder Theory (ST) and the Resource-Based View theory (RBV), aims to propose a new approach paving the way for reflections about the relevance of the development of data-driven decision-making for the circular transition in the new normal context. Furthermore, the authors draw attention to the pivotal and facilitating role of DT to enable interconnections between operational and strategic approaches, exploiting the insights derived from the DT use as decision-making and governance actions supporting tools in the AFS. The paper is structured as follows. After the introduction, the research method adopted to develop the conceptual paper is presented. The third section shows the underpinning theories on which the study is built, proposing a set of research propositions. The fourth section aims to develop and discuss the new approach in the agri-food supply chain (AFSC) context. Lastly, implications for decision-making, limitations and future research directions are presented.

2. Research method

Starting from the research method adopted by Hulland (2020) and De Angelis *et al*. (2023), the present paper is developed following several steps

related to studying, re-reading, discussing, summarizing, formalizing, hypothesizing and collecting feedback in order to build the theoretical argumentation (Cornelissen *et al*., 2021; Hulland & Houston, 2020). Accordingly, using existing theories has allowed researchers to conceptualize and develop propositional reasoning to gradually go in-depth into the "underlying causal forces or mechanisms that explain the manifestation, dynamics, and outcomes of the topic" (Cornelissen *et al*., 2021, p. 6).

Growing on this approach, this conceptual paper aims to spawn, in the light of the RBV theory and ST, an integrative theoretical framework that combines the strategic approach to managing the post-pandemic renaissance in the "new normal" context (5-R), with the operational and strategic paradigm for the CE transition (4-R), attempting to provide a plausible explanation of the critical role of DT in building interconnections among strategies and actions.

In particular, based on De Angelis *et al*. (2023), the authors have developed a conceptual paper through the development of the following research steps, detailed in Table 1: i) identify the research scope and domain; ii) integrate and summarise existing related knowledge and scientific advancement; iii) manage discrepancies; iv) highlighting gaps in the existing literature; and v) suggest future research directions.

To answer the research objective, a narrative approach to the literature review has been adopted, rather than a systematic one, considering the relevant role of researchers in selecting and defining the significant literature for the research goal (Cronin & George, 2020). This approach is considered appropriate for theory building in business research (Sovacool *et al*., 2018; Snyder, 2019) and extensively used in previous circular economy research (Ritala *et al*., 2021; De Angelis *et al*., 2023).

Tab. 1 – Steps in conceptual development

Key steps	*Features of this study*
Defining domain and scope	Domain: How can literature advance understanding of the interconnections between CE and DT to reimagine the AFS in the new normal scenario? Scope: CE and DT in AFS after the Covid-19.
Integrating and summarizing existing knowledge	ST, RBV, CE and 5-R
Identifying and solving inconsistencies	Inconsistency$_1$: McKinsey 5-R strategies for the post-pandemic renaissance are not currently analyzed in combination with CE. Inconsistency$_2$: DT has been extensively investigated in the literature relating to CE transition or post-pandemic recovery in the AFS. However, they have not been analyzed in combination. In our conceptual paper, DT is seen as the *trait d'union* between the circular transition and the decision-making processes for the AFS renaissance in the new normal scenario.
Highlighting gaps and generating insights	Literature has provided few contributions on the perspective of analysis that combines theories, models and approaches to the base of this research.
Proposing a research agenda	A set of research propositions has been provided.

Source: Adopted from De Angelis *et al*. (2023) and Hulland (2020)

3. A new approach for decision-making in the new normal scenario

The following section provides a combined application at the AFSC of the 4R paradigm and 5R strategies through DT, highlighting the relevance of the combined use of RBV and ST in decision-making strategies development adaptable in a constantly changing new normal scenario. Furthermore, the 5R stages will be described, highlighting the role of CE in speeding up the resilience pathway for companies from a decision-maker's perspective. Starting from the literature analysed, the authors have developed three research propositions representing the pillars of the theoretical approach proposed in this conceptual paper.

3.1. Theoretical perspective for the circular decision-making

Starting from two interdependent theories adopted within the CE studies – ST theory and RBV theory – the authors have identified the existing interconnections to support circular decision-making processes.

Starting from the beginning of the new millennium, ST has been widely adopted in sustainability studies both from a managerial and accounting perspective (Phillips and Reichart, 2000; Steurer *et al*., 2005; Samant and

Sangle, 2016). Recently, scholars have recognized the relevance of this theoretical approach in understanding how to implement CE in organizations (i.e., Baah *et al*., 2023; Shah and Bookbinder, 2022). Some researchers have demonstrated that the transition from a linear economy to a circular one demands a collaborative view in strengthened natural capital, optimizing resource yields and minimizing consequential negative effects on the environment and society as a whole (Flynn *et al*., 2010; Min *et al*., 2015; Autry & Griffis, 2008; Gupta *et al*., 2019). Accordingly, CE has been defined as a "collective solution which cannot be successfully implemented in isolation" (Antikainen and Valkokari, 2016, p. 8). In fact, any weak link in the supply chain would render the effort unless. Nevertheless, stakeholders show resistance and uncertainty to shift towards CE.

In the CE field, some researchers have focused their studies on a specific element of stakeholder engagement, such as i) the stakeholder pressure management in CE implementation (i.e., Jakhar *et al*., 2019; Pinheiro *et al*., 2022) and ii) stakeholder influences in building CE strategies (i.e., Govindan and Hasanagic, 2018; Marjamaa *et al*., 2021; Wang *et al*., 2022). In comparison, only a few cutting-edge research has considered stakeholder engagement from a triple-bottom-line perspective, highlighting their role in improving both economic and environmental efficiency and in reaching the circular transition global goal (i.e., Shirvastava and Guimares-Costa, 2017; Bertassini *et al*., 2021; Salvioni and Almici, 2020; Kujala *et al*., 2022). Thus, to successfully develop CE models, there is a need to focus research on the stakeholders' engagement and understand their relationship (Thomson and Bebbington, 2005).

However, literature has extensively explored the adoption of CE models from a resource standpoint (e.g., Aranda-Usòn *et al*., 2019; Jabbour *et al*., 2019; Jakhar *et al*., 2019; Mishra *et al*., 2021; Nandi *et al*., 2021; Chaudhuri *et al*., 2022; Munch *et al*., 2022; Samadhiya *et al*., 2023). One of the most widely adopted and rigorous theories to explain the impact of CE practices on a firm's performance is the RBV theory. Managing resources from a circular perspective can support firms in developing and sustaining a competitive advantage (Barney, 1991; Amit and Schoemaker, 1993). Barney (2018) argues that valuable, rare, inimitable and non-substitutable tangible and intangible resources can lead companies to improve their performance. Thus, from a circular perspective, improving resource efficiency by implementing 4-R practices and extending the total material life cycle is an excellent opportunity for companies motivated to implement CE business models (Kristoffersen *et al*., 2021).

Given these premises, although these theories differ in their perspectives and specificity, they share the same objectives: explain how companies ensure survival and growth – becoming more resilient in a changing context –

and what are the main reasons that motivate organizations to adopt CE practices (Chen and Roberts, 2010).

Some scholars have started investigating the interlinkages between the ST and RBV, emphasizing a "long-emerging convergence" (Barney, 2018; Freeman *et al*., 2021; McGahan, 2021). In particular, Freeman *et al*. (2021) have investigated how the ST can inform the RBV theory, incorporating the following principles: normativity, sustainability, people and cooperation. More specifically, they argued that this combined approach enlarges the RBV, including ST elements such as values, norms and ethics, and the role of people seen as an end and not a mean, which were completely absent in the traditional RBV theory. In this new perspective, sustainability represents a key point of overlap between ST and RBV. In fact, the sustainable management of resources and stakeholder relationships constitute themselves a source of sustainable competitive advantage that is difficult to imitate, much like a scarce resource (Freeman *et al*., 2021).

In order to activate these value co-creation mechanisms, a need to share data, information and principles among supply chain actors emerges to support the decision-making process towards the development of new business models and offer consumers and stakeholders clear information. In this light, DT could enhance transparency and reliability in managing resources and sharing data and information to align stakeholders around common circular goals and create circular governance and decision-making procedures (Gupta *et al*., 2019).

Following this ecosystemic perspective, our first preposition is developed as follows:

> **P1.** A holistic perspective that integrates a stakeholder-based and resource-based approach to decision-making could facilitate the transition towards circular supply chains.

3.2. 5R pathway guiding progress towards the new normal scenario

The economic, social, and cultural changes derived from Covid-19 have posed a significant threat to the enterprise system. In fact, companies are called to understand their contexts of reference, which are continuously changing in an intense, fast, but also unstable way. This new era of extraordinary change presents businesses, managers, and academics with an ongoing challenge: to adapt, endure, and compete in a never-normal environment (Golinelli and Quattrociocchi, 2021).

In this perspective, the McKinsey & Company consulting group have tried to provide a framework to support companies in developing a resilient adaptation to a different corporate setting, understanding and admitting the

presence of extraordinary and unusual social, economic, and technological conditions that have become usual, blurring the new normal contours (Jabeen *et al*., 2022). In particular, McKinsey has proposed a five-stage process to redesign the post-pandemic landscape: Resolve, Resilience, Return, Reimagination, and Reform, as detailed in Table 2 (Sneader and Singhal, 2020).

Tab. 2 – The 5R pathway

R phase	*Description*
Resolve	It refers to the need for managers to interrupt inaction and paralysis conditions in making decisions in an emergency and post-emergency situation.
Resilience	It is predominantly linked to financial resilience. Accordingly, private, public and social sector leaders are called to make "through cycle" decisions to balance economic, environmental and social sustainability.
Return	It relates to companies' challenges in restoring operational health. To this end, the engagement of the whole supply chains, reactivating cooperation mechanisms, despite the geographical disruption caused by the pandemic, became vital for decision-makers' long-term success.
Reimagination	In this stage, decision-makers must reimage their business models to be aligned with the new normal context.
Reform	It represents the final stage of a renaissance process in which managers must build up the system to endure severe and worldwide exogenous shocks, such as the Covid-19 impact.

Source: Adapted from McKinsey & Company (Sneader and Singhal, 2020).

All these five stages companies are called to pass through can vary from a temporal point of view depending on the type of company or can coexist simultaneously. In both cases, the final goal is represented by the opportunity to provide a clear path that managers must follow in the journey towards the new and never normal that the pandemic has begun.

The 5R approach to the new normal renaissance substantially affects decision-making and governance mechanisms (Cucari *et al*., 2023). In this context, the development of sustainability and circular economy strategies could greatly benefit decision-makers going into the 5R phases to strengthen their resilience, not only in the context of the new normal but also in the context of the future normal from a forward-looking perspective.

In this light, scholars have argued that if applied holistically, CE principles offer trustworthy solutions to most of the structural vulnerabilities uncovered by Covid-19 (Ibn-Mohammed *et al*., 2021). Furthermore, it has been theorized that "accidental" or pandemic-induced CE strategies can be institutionalized or exploited to generate future possibilities for resilience and competitiveness (Joshi and Sharma, 2022; Esposito *et al*., 2023a).

Hence, our second preposition is as follows:

P2. The adoption of CE principles in the decision-making processes could accelerate and facilitate the pathway towards the post-Covid-19 renaissance, seizing opportunities that may arise.

Following the same purpose – strengthening the resilience of companies and their ability to adapt to changing scenarios – some academics have emphasized on the role of DT in improving the adaptability decision-makers and decision-making preparedness in the face of epochal changes such as the ones we are currently experiencing (e.g., Lee *et al*., 2021; Järvenpää *et al*., 2021; Mboli *et al*., 2022; Shennib and Schmitt, 2021; Yazdani *et al*., 2021). Notwithstanding, the vast opportunities and action-windows for the twin transition, scholars and practitioners are still exploring how to successfully implement DT to strive in the decision-making processes for the circular transition (Ciccullo *et al*., 2021; Pakseresht *et al*., 2022).

From this background, it seems evident how CE and DT, implemented synergistically, can support managers in crossing the journey towards the new normality, enhancing flexibility and adaptability in the decision-making processes.

Accordingly, our last preposition is provided as follows:

P3. Implementing DT could catalyze the circular transition, allowing managers real-time and data-driven decision-making in a mutable new normal scenario.

4. Challenges for the agri-food sector and conclusions

4.1 Opportunities for the agri-food sector

The new proposed approach could be widely applied within the AFS, characterised by complex supply chains, to cope with future challenges and become more resilient to crises. Indeed, the AFS is one of the most significant environmental systems due to the burdens it imposes, but it is also relevant due to its social, cultural, and economic dimensions (Brankatschk and Finkbeiner, 2014). Consequently, agri-food companies are required to develop circular business models tailored to the features of each supply chain, thereby increasing the complexity of the ongoing circular transition process.

Organizations face challenges associated with adopting CE strategies and identifying methods to establish business models that optimize the use of resources and improve productivity and systemic efficiency, allowing them to gain new competitive spaces (Poponi *et al*., 2022).

Thereby, circularity entails complex challenges involving multidisciplinary issues, regulatory aspects, and empirical knowledge, prompting the active participation of all actors in the entire supply chain. Particularly, the decision-making process surrounding sustainability and circular issues

must be sustained and guided by reliable data. In fact, accurate information conveyed transparently and straightforwardly promotes the proliferation of more conscious data-driven decision processes.

In this scenario, organizations must make visible the enhancement of the socio, economic and environmental performance and engage and share their circular strategic decisions with stakeholders. Furthermore, firms must implement lean business processes that respond to and cope with a swiftly changing environment to generate value from a sustainability standpoint. Thus, new business models that may transform AFS's competitive landscape can be grown, which benefits the environment and the organization's reputation.

With a substantial contribution from DT, this approach enlarges the business processes management by going beyond the mere development of strategies exclusively oriented to the target of overcoming the post-pandemic period or implementing circular models. Indeed, data and information obtained from adopting DT within the AFSC could support managers in reaching both goals, enabling the robustness and resilience of the system. Indeed, the possibility to track the environmental impacts, the resources used, and the stakeholders engaged during the entire AFSC life cycle in real-time provides objectivity in assessment processes and – in turn – develops strategies and policies to face the actual supply-chain critical issues. For instance, the innovative proposed approach can be considered a bridge between the traditional approach to decision-making processes that characterised the pre-pandemic period and the required flexible, adaptable and inclusive approach to the new normal scenario, saving time and resources. In this context, several challenges to agri-food managers are arising, mainly linked to accepting this new approach from a bottom-up perspective. Indeed, all the AFSC actors, particularly workers, employees, suppliers and clients, have to share the principles and values on which this approach is built, accepting the resulting innovations that impact standardized organizational routines and processes. Consequently, managers could create a shared value for the supply chain in this transition process.

In conclusion, the challenge for the AFS will be the widespread adoption of this new approach in the various phases of the AFSC, making organizations aware of its numerous and different benefits.

4.2 Conclusions and future research directions

This conceptual paper has provided an overview of the state-of-the-art research on CE and DT in the AFS from the crisis generated by the outbreak until the new normal scenario. More specifically, the authors have attempted to provide reflections on the role of DT and CE to push agri-food

companies in passing through the 5 R stages proposed by McKinsey & Company to survive and compete in such an ever-evolving scenario, defined by Barile *et al*. (2022) as a never normal. In particular, the use of DT to orient the decision-making processes, providing real-time and reliable insights, is useful for governance from a twofold perspective. On the one hand, receiving information about the impact of emergencies, like the pandemic, on agri-food companies' activities allows managers to take effective decisions to mitigate any reflections on productivity and profitability. On the other hand, managers could define policies and actions to make processes more efficient by monitoring processes in terms of material flow, energy use, and environmental impact. This would minimize the costs associated with using virgin raw materials, reduce the use of non-renewable energy and water, and reduce the emission of greenhouse gases, as well as their environmental effects in terms of water footprint and carbon footprint. Furthermore, this conceptual paper has revealed that the adoption of CE practices as an imposed innovation (Esposito *et al*., 2023b), could entail the AFSC survival, allowing firms to recover, resolve and reimagine the sector.

Covid-19 has brought attention to the robust agri-food industry's role as an engine of an adaptable economy, encouraged consumer behavior change, sparked demand for supply chain diversification and circularity, and illustrated the efficacy of public policy in addressing pressing socioeconomic crises (Ibn-Mohammed *et al*., 2021). In particular, the use of DT, also stimulated by the policies and actions taken by governments, is emerged as means to activate virtuous mechanisms within the AFSC among stakeholders and supply chain actors – from an ecosystem perspective – to foster the resilience of the whole system. To this end, managing the resource flows in input and output, from a data-driven perspective, through implementing, reducing, reusing, recycling and redesigning actions and policies represents a pivotal issue in triggering the twin transition.

Managers and decision-makers may rely on our reflections to define investments pathway in digital and climate-resilient infrastructures in order to succeed in the transition to a circular and low-carbon economy that can create in parallel jobs and increase environmental and economic benefits. Policymakers could also support the AFS in providing financial incentives, career paths for skill development, and professional figures with DT and CE experience.

Furthermore, this conceptual paper has shed light on the potentiality related to the integrated application of the RBV and ST for the twin transition. Accordingly, scholars can rely on our reflections to explore the theoretical mechanisms this transition could entail.

However, this study has limitations, which could be the starting point for future research directions. Firstly, this paper attempts to reflect on the

decision-making process from a general perspective without exploring the impact of DT on the various phases in which decisions are structured. Accordingly, future research may investigate the impact of data-driven insights in decision-making. Moreover, scholars may explore their effects on corporate governance mechanisms to guide the sustainable and circular transition (Lagasio & Cucari, 2019; Ludwing & Sassen, 2022). Second, the research is focused on the AFS, providing reflections on the AFSC. Future studies may apply the twin-R approach to other industries, highlighting the peculiarities of different supply chains. Lastly, future studies may adopt different theoretical perspectives, such as the viable-system approach to explore the interconnections that DT may activate among managers and stakeholders to catalyze the CE transition in the new normal scenario.

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