Focusing on the Role of the Circular Economy in the Supply Chain to Reduce Waste: Evidence from Hotel Supply Chains

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ABSTRACT

The objective of this study is to examine the relevance of the circular economy in relation to the utilisation of big data, specifically within the supply chain, with the aim of reducing waste. The research is conducted within the hotel industry in the Kingdom of Saudi Arabia. The variables under consideration in this study encompass circular economy supply chain design, circular economy supply chain relationship management, digital sustainability, and circular economy innovation. The dependent variable under investigation pertains to the concept of reverse logistics. The mediating variable in this study refers to the extent to which data utilisation influences the relationship between the independent and dependent variables. On the other hand, the moderating variable pertains to the role of information sharing in influencing the strength or direction of the relationship between the independent and dependent variables. The study employs a quantitative research design, wherein data was gathered through the administration of a survey to employees employed in various restaurants and hotels within Saudi Arabia.The study's results indicate that the design of circular economy supply chains and the management of circular economy relationships have a significant influence on reverse logistics. Additionally, the impact of digital sustainability and circular economy innovation on reverse logistics is also found to be significant. The study revealed that the utilisation of big data and the sharing of information were both found to have a significant impact. This study contributes to the existing body of literature by examining observed variables and offering practical applications for the hotel industry, with a specific focus on Saudi Arabia and its global implications. Finally, the present study addresses its inherent limitations and offers suggestions for future research endeavours.

KEYWORDS: Big Data Utilization, Digital Sustainability, Reverse Logistics, Circular Economy Supply Chain Design, Circular Economy Relationship Management, Circular Economy Innovation, Information Sharing, Saudi Arabia.

1. INTRODUCTION

The hotel industry has experienced substantial expansion in various countries worldwide as a result of the rise in tourism. Similarly, in response to fluctuations in oil prices and demand over the past few years, Saudi Arabia has implemented certain economic strategies aimed at diversifying its reliance on sectors other than oil to foster economic growth, such as the hotel and tourism industries (Farrukh et al., 2020). Saudi Arabia is widely recognised as a prominent destination for travellers in the Middle East. The number of international arrivals to the country in 2016 was recorded at 18,758,000 million. It is projected that this figure will experience a gradual growth of approximately 68%, reaching 31,573,000 million by the year 2025 (El-Dief & El-Dief, 2019). Hence, it can be observed that the tourism and hotel industry hold the position of the second-largest contributor to the Gross Domestic Product (GDP) in the Saudi

Arabian economy.

Specifically, the hotel industry accounts for approximately 10.26% of the overall GDP. Based on a report published by Statista in 2023, it is projected that the revenue generated by the hotel industry will amount to US$2.51 billion in 2023, indicating an anticipated annual growth rate of 4.73%. This forecast suggests that the market volume is expected to reach US$3.02 billion by the year 2027. However, the hotel industry encounters significant difficulties in implementing sustainable practices within its supply chain due to the substantial amount of waste it generates (Rawal & takuli, 2021). The hotel supply chain refers to a network of interconnected entities, such as suppliers, logistics partners, and participants, that collaborate to provide various hotel amenities and services to customers (Al-Aomar & Hussain, 2018). The hotel supply chain operates based on the flow of information pertaining to various aspects, including reservations, payments, charges, and the availability of essential items such as food, toiletries, and linens. The figure below illustrates the hotel supply chain.

Furthermore, the term "reverse logistics" is used to refer to the process of material flowing in the opposite direction, specifically from customers back to suppliers for purposes such as reprocessing, repair, amendment, recycling, and restoration. Reverse logistics is increasingly being implemented in the hotel industry, particularly with regards to the reprocessing and reuse of materials. Reverse logistics plays a significant role in the development of sustainable supply chains, as it leads to the reduction of waste and production costs (Turrisi, Bruccoleri, & Cannella, 2013). Presently, the hotel industry has acknowledged the imperative of waste reduction and is actively seeking novel approaches to minimise disposal expenses, safeguard the environment, and cultivate a favourable reputation that engenders customer confidence.

The hotel industry is accountable for a significant amount of waste, which amounts to 289,700 metric tonnes on a global scale annually. This waste primarily consists of food waste as well as the waste of water and fuel resources. Therefore, it is imperative to implement sectoral arrangements aimed at mitigating waste in the hotel industry. These arrangements should involve making necessary adjustments to internal procedures within hotels to ensure alignment with waste management practices in the hotel supply chain. However, organisations within the hotel supply chain face a significant challenge pertaining to identifying the specific elements that can effectively minimise waste and concurrently enhance profitability and sustainability. However, limited scholarly attention has been devoted to the investigation of the hotels' supply chain and the implementation of big data and information sharing strategies for the purpose of waste reduction, as evidenced by the works of Del Giudice et al. (2021) and Stroumpoulis, Kopanaki, and Oikonomou (2021).

It is evident that the utilisation of big data and the sharing of information play a significant role in the reduction of waste. Numerous hotels are leveraging data and information to formulate strategies aimed at achieving zero waste (Agrawal et al., 2022). However, there is a lack of empirical evidence regarding the ways in which information sharing and big data impact the circular and digital economy in the context of reverse logistics in the hotel supply industry. The circular economy is widely recognised as a foundational model for mitigating waste (Tomić &

Schneider, 2020). Consequently, this study has developed a framework to assess the influence of the circular economy on reverse logistics within the hotel supply chain. Moreover, a considerable number of scholarly investigations (Pires & Martinho, 2019; Salmenperä et al., 2021) have examined the influence of the circular economy on waste reduction.

However, it is worth noting that the majority of these studies have been conducted in developed nations. In contrast, the hotel industry in Saudi Arabia, which has experienced significant growth, has received limited attention in terms of research on this topic (Almulhim & Al-Saidi, 2023). This paper presents a comprehensive empirical study that explores the intervention of big data and information sharing within the context of the circular economy supply chain and reverse logistics in the hotel sector of Saudi Arabia. The primary objective of this study is to examine the correlation between the circular economy and the utilisation of big data, thereby contributing to the existing body of literature.

Furthermore, policymakers can establish a regulatory framework to effectively manage waste by utilising recent advancements in reverse logistics and waste management techniques. Moreover, the outcomes of this study have the potential to provide hotel managers with a comprehensive understanding of the concepts of the circular economy and reverse logistics. This understanding can assist them in minimising waste by efficiently reimbursing and recycling resources to their maximum potential. Furthermore, based on the findings of this research, it is recommended that future scholars undertake comprehensive studies in this particular region.

2. LITERATURE REVIEW

Circular economy principles play a crucial role in ensuring the sustainability of supply chains in the contemporary business landscape. This literature review explores the utilisation of hotel supply chains, encompassing aspects such as design, relationship management, innovation, and digital sustainability. This study examines essential components such as reverse logistics and digital tools, specifically big data. This study additionally emphasises the significance of information sharing as a moderating factor. This study offers a thorough examination and analysis of circular economy strategies, shedding light on their effectiveness in mitigating waste and fostering sustainability within hotel supply chains.

2.1. The Role of Circular Economy in Supply Chains

The circular economy offers a more advantageous alternative to the conventional linear economy through the adoption of a sustainable approach that takes into account the complete life cycle of products. The primary objective of this initiative is to reduce waste and promote the sustainable utilisation of resources. Circular supply chains are of great significance in this approach, as they are specifically designed to minimise waste and establish production systems that can sustain themselves. Circular economy practises prioritise the continuous utilisation of resources and the elimination of waste, thereby establishing a pathway towards a future that is both environmentally sustainable and economically viable (Santibanez Gonzalez, Koh, & Leung, 2019; Sharma et al., 2021). Circular supply chain management is a significant paradigm shift that involves the incorporation of circular economy principles into the functioning of supply chain operations.

In contrast to the conventional linear model of 'take-make-dispose', the approach under consideration places emphasis on resource optimisation and waste reduction (Incorvaja et al.,

2022). This approach not only mitigates the environmental impact but also strengthens economic resilience by promoting the continued utilisation of resources. By incorporating circular economy principles, businesses have the potential to establish supply chains that are both environmentally friendly and economically efficient, thereby making significant contributions towards the attainment of long-term sustainability goals.

The packaging recovery systems in China and Brazil are the subject of a study by Batista et al. (2019). The authors propose a circular supply chain framework that expands the closed-loop perspective. This methodology incorporates the management of post-production activities and the inclusion of open loops within alternative supply chains. Circular supply chains enable the efficient management of used packaging by incorporating third-party entities and adapting to local market dynamics. This highlights the potential for implementing adaptable circular supply chain strategies in developing economies like China and Brazil. Furthermore, according to Santibanez Gonzalez et al. (2019), the primary objective of green supply chain management is to mitigate environmental consequences by implementing efficient procurement strategies that adhere to the principles of reduction, reuse, and recycling. Although there are currently sustainable practices in place, there is a need for further enhancements to align with the comprehensive impact of circular economy principles. This entails emphasising a more holistic and sustainable approach.

The implementation of circular economy principles presents opportunities for improving global supply chains, with a particular focus on sectors such as the hotel industry. Circular economy products deviate from the traditional linear model, presenting distinct opportunities for global supply chains (Terdpaopong, 2020). The adoption of non-linear practices facilitates the reassessment and enhancement of supply chain structures within industries, thereby fostering the promotion of sustainable practices. Furthermore, Dwivedi et al. (2023) asserted that circular supply chains possess the capacity to reduce the generation of waste and establish self-sustaining production processes through the reintegration of materials into the production cycle.

In the face of worldwide disruptions, the continued implementation of circular economy practices is contingent upon the enduring influence exerted by stakeholders, the cultivation of a sustainability-oriented culture, the continuous integration of cleaner technologies, the establishment of a dependable feedback mechanism, and the provision of consistent training on circular economy principles. The combination of these factors collectively guarantees the durability and adaptability of circular economy initiatives, even in times of adversity.

2.2. Exploring Diverse Aspects of Circular Economy in Supply Chain

This paper aims to investigate the concepts of circular economy supply chain design, circular economy supply chain relationship management, circular economy innovation, and digital sustainability. To design a supply chain for the circular economy, circular principles must be incorporated into the financial aspects, network structures, and decision-making processes of the chain. The primary aim of this initiative is to facilitate the advancement of sustainable development, mitigate the generation of unnecessary waste, improve operational effectiveness, and maximise the extraction of value. A multitude of scholarly articles have extensively explored this subject matter. The study conducted by Patra, Wankhede, and Agrawal (2023) involved a bibliometric analysis aimed at identifying prevailing patterns in the field of circular supply chain finance research. The authors,

Foroozesh et al. (2023) proposed a novel methodology consisting of three stages to optimise

the design of supply chain networks with a focus on resilience. This approach incorporates considerations of product lifespan, financial resources, and technological capabilities. In their study, Govindan et al. (2023) proposed an integrated bi-objective model that aims to optimise both operational and strategic decisions within closed-loop supply chain networks. This model takes into account the implementation of carbon tax policies and vehicle scheduling strategies, with the ultimate goal of minimising emissions and reducing waiting times. The authors, Amir et al. (2022) introduced a comprehensive conceptual model that outlines the implementation of circular supply chains. The model classifies circular supply chains into four fundamental elements, namely systemic approaches, primary drivers, decision-making levels, and mechanisms for achieving complete loop closure.

In their study, Krstić et al. (2023) employed a novel multi-criteria decision-making model to identify and prioritise the key risk groups within agri-food circular supply chains.

The relationship between the circular economy and supply chain management is highly interconnected. The fundamental principle of the circular economy is centred on the reduction of waste and the extension of product lifespan, thereby promoting sustainability within the supply chain (Braz & de Mello, 2023). Circular Supply Chain Management (CSCM) models, encompassing closed-loop and open-loop supply chains, have emerged as a means to incorporate circular principles into supply chain operations. The objective of these models is to incorporate circularity into supply chain operations, representing a notable transition towards sustainable and environmentally conscious practices within the corporate landscape (Shaharudin et al., 2022).

The incorporation of circular economy principles has the potential to generate favourable effects on financial performance, environmental preservation, and the overall resilience of supply chains (Kumar, Singh, & Kumar, 2021; Mauss, Ruehs, & Fottner, 2022). Supply chains are increasingly embracing circular economy practises, such as remanufacturing and the utilisation of eco-friendly packaging, in order to attain their circularity and sustainability objectives (Mishra et al., 2023). The relationship between circularity and supply chain resilience is becoming increasingly prominent in academic discourse. This is because the adoption of circular practises has been found to decrease dependence on external resources and improve internal processes, thereby strengthening the overall resilience of supply chains. The integration of circularity into supply chain strategies is essential for achieving sustainability and resilience objectives in the context of the circular economy.

Circular economy innovation refers to the development and application of novel strategies and methodologies that enable the transition from a linear economic model to a circular one. Numerous scholarly investigations have examined a range of innovative approaches that facilitate this transition. The study conducted by Arfaoui et al. (2023) highlights the significance of complex and frugal innovations in the adoption of circular economy practices. The authors, Behún and Behúnová (2023) put forth a set of sustainable construction concepts that centre around the utilisation of recycled aggregate within the framework of circular economy principles.

In their study, Dokter et al. (2023) placed particular emphasis on the utilisation of prototyping and co-creation strategies within the context of circular-oriented innovation in the kitchen industry. In their study, Ren and Albrecht (2023) conducted an examination of policy instruments such as command-and-control regulation and technology-push strategies, which

were identified as significant catalysts for promoting innovation in the circular economy. In their study, Sehnem et al. (2023) conducted research on startups, emphasising the significance of circular business models, innovation, and Industry 4.0 technologies in engaging key stakeholders and fostering sustainability within the context of the circular economy.

Digital sustainability is becoming increasingly important in the hotel industry as hotels strive to improve operational efficiency, reduce expenses, and meet the expectations of their customers (Kolobkova, Romanov, & Frolova, 2021). The integration of digital technologies, such as information systems and IT practices, enables hotels to effectively pursue sustainability goals and enhance their overall performance (Shumakova, 2021). These tools facilitate the process of making informed decisions, promoting seamless sharing of information, and augmenting managerial capabilities (Parvez et al., 2018). The continuous digital transformation within the hospitality industry requires hotels to adapt and maintain competitiveness (Terdpaopong, 2020). The adoption of emerging technologies in hotel operations enables establishments to optimise their brand visibility, operational efficiency, and customer satisfaction, thereby ensuring their continued relevance and success within the contemporary competitive market.

2.3. Understanding Reverse Logistics in Supply Chains

The implementation of reverse logistics is of paramount importance in the realm of environmental conservation as it effectively mitigates waste generation by means of recycling and curtails energy consumption through the practice of reuse. The process entails managing the merchandise that is returned to manufacturers by customers. The results of the study indicated a clear influence on the operational effectiveness of fast-moving consumer goods (FMCG) companies, highlighting the significance of implementing strategies such as recycling, reuse, and remanufacturing. The strategies outlined in the aforementioned study are in accordance with the principles of sustainable growth, thereby contributing to the objectives set forth in the Kenyan Vision 2030 (Panya & Marendi, 2021). In the realm of circular and closed-loop economies, the significance of reverse logistics cannot be overstated, as its primary objective is to mitigate environmental consequences and optimise the retrieval of resources (Bakås, Tveit, & Thomassen, 2022).

Within the context of the hotel industry, the concept of social sustainability in supply chain management places significant emphasis on the cultivation of favourable relationships, the guarantee of equitable working conditions, timely remuneration, and the provision of health insurance coverage for employees (Janczewski, 2019). The comprehension of reverse logistics within the hotel industry contributes to the improvement of circularity performance, thereby promoting sustainable long-term growth (Craiu & Duță, 2019). The study conducted by Fanta and Pretorius (2022) investigates the role of reverse logistics in facilitating the circular economy. Furthermore, this study examines the effects of digital technologies associated with Industry 4.0 on enhancing reverse logistics in order to align with the principles of a circular economy.

The incorporation of circular economy principles into supply chains has a substantial impact on both reverse logistics and the hotel industry. There is a growing trend among companies to embrace these principles as a means of minimising waste and extending the lifespan of their products, thereby fostering sustainability and reaping environmental benefits. In the context of the fourth industrial revolution, the integration of reverse logistics with the principles of the circular economy is of utmost importance. The implementation of reinforcement learning (RL)

strategies is crucial in facilitating the successful transition towards sustainable collaborations among firms (Khan et al., 2022).

Hotels, which are known for their substantial waste generation, are increasingly adopting circular economy strategies, particularly in sectors such as kitchens, storage, and accommodation facilities. Efforts are being made to implement strategies aimed at mitigating waste generation through the reduction, reuse, and recycling of materials, with a focus on fostering environmental sustainability and optimising resource utilisation. By implementing these circular practices, hotels are not only able to effectively tackle waste management concerns but also make significant contributions towards achieving wider sustainability goals (Rajput & Singh, 2022). The implementation of circular economy strategies allows hotels to enhance their sustainability initiatives, thereby transforming their operations into environmentally friendly practices.

These methodologies aim to enhance the efficiency of resource allocation, thereby maximising the utilisation of materials and minimising waste generation. Furthermore, this methodology enhances operational efficiency, allowing hotels to reduce expenses, optimise workflows, and actively contribute to a more environmentally conscious future (Sinha & Fukey, 2020). The integration of circular economy principles into supply chains has the potential to revolutionise traditional reverse logistics procedures, thereby fostering sustainability in various sectors, including hospitality, by means of environmentally conscious approaches (de Oliveira, Luna, & Campos, 2019). Based on this, the following research hypotheses has been proposed:

H1*: Circular economy supply chain design significantly influences reverse logistics in hotel supply chains.*
H2*: Circular economy relationship management significantly affects reverse logistics in hotel supply chains.*
H3*: Digital sustainability significantly impacts reverse logistics in hotel supply chains.*
H4*: Circular economy innovation significantly influences reverse logistics in hotel supply chains.*

2.4. Big Data Utilization as a Mediator

The utilisation of big data analytics capabilities (BDAC) has an indirect impact on the creation of sustainable value within supply chains, as it influences the development of both supply chain management capabilities (SCMC) and circular economy practices (CEP). The utilisation of BDAC has been found to facilitate more effective decision-making processes, enhance the efficiency of supply chain operations, and provide a deeper comprehension of consumer demands (Riggs et al., 2023). By incorporating Big Data Analytics and Cloud Computing (BDAC) into supply chain operations, organisations have the ability to enhance operational efficiency, minimise inefficiencies, and enhance the utilisation of resources. Consequently, this facilitates the promotion and adoption of sustainable practices within the supply chain. The influence of Supply Chain Management and Circular Economy Principles (SCMC and CEP) results in the generation of enduring value within the supply chain ecosystem.

The promotion of sustainability within supply chains is influenced by the adoption of environmentally friendly production methods and the cultivation of consumer consciousness regarding carbon emissions. Business enterprises that adopt environmentally sustainable practices effectively reduce their carbon footprint, thereby aligning with the preferences of

environmentally conscious consumers who prioritise products with lower emissions. Consequently, this consumer demand serves as a driving force for companies to implement eco-friendly methods. The collaborative endeavour promotes the development of supply chains that prioritise environmental responsibility (Qiao et al., 2023).

The utilisation of big data analytics (BDA) plays a significant role in establishing a connection between the sustainable performance of supply chain businesses and key elements such as lean practices, social considerations, environmental factors, and supply chain practices (Raut et al., 2021). Additionally, it assumes a mediating function in enhancing the business performance of Supply Chain 4.0, with a specific emphasis on the transmission of information and products, as well as the establishment of sustainable procurement and sourcing practices (Narwane et al., 2021). The adoption of big data technologies, including assisted decision-making and intelligent decision-making tools, enhances supply chain resilience, especially in stable environments (Liu et al., 2023). Based on this, the following research hypotheses has been proposed:

H5*: Big data utilization mediates the relationship between circular economy supply chain design and reverse logistics in hotel supply chains.*
H6*: Big data utilization mediates the relationship between circular economy relationship management and reverse logistics in hotel supply chains.*
H7*: Big data utilization mediates the relationship between digital sustainability and reverse logistics in hotel supply chains.*
H8*: Big data utilization mediates the relationship between circular economy innovation and reverse logistics in hotel supply chains.*

2.5. Information Sharing as a Moderator

Effective stakeholder communication in the hotel sector necessitates the dissemination of relevant information, data, and updates among key parties such as managers, staff members, and suppliers. Transparent communication facilitates effective coordination, decision-making, and overall operational efficiency in the hotel industry, thereby benefiting both hotel operations and customer services. The practice of effectively sharing information is crucial for achieving successful operations and collaboration within the hotel industry (Verma & Thakur, 2020). The act of sharing information serves as a catalyst, enabling various stakeholders to engage in the exchange of vital knowledge and resources. This collaborative effort facilitates the process of making well-informed decisions, thereby fostering effective teamwork and promoting synergy among various projects and initiatives (Caputo, Evangelista, & Russo, 2018). The establishment of strong collaboration among stakeholders is imperative in order to uphold high service standards and ensure customer satisfaction.

By engaging in effective collaboration, stakeholders are able to coordinate their efforts, streamline processes, and deliver consistently exceptional services. This approach effectively aligns with customer expectations and serves to enhance their overall experience (Caputo et al., 2018). The act of sharing information is conducive to the alignment of stakeholder goals, thereby enhancing performance and fostering a competitive advantage (Xie, 2021). The establishment of equal access for all individuals facilitates efficient collaboration among teams, enabling them to effectively pursue common goals. The collaborative endeavour improves overall efficacy and fortifies the organisation's competitive standing. In addition, it facilitates the assimilation of novel technologies, thereby augmenting the overall operational efficacy of

hotels (He, Devine, & Zhuang, 2018). The establishment and promotion of a culture that prioritises the sharing of information is of utmost importance for the achievement of success within the industry and for the benefit of its various stakeholders. Based on this, the following research hypotheses has been proposed:

H9*: Information sharing moderates the relationship between big data utilization and reverse logistics in hotel supply chains.*

Despite the increasing recognition of circular economy principles within the domain of supply chain management, there exists a notable deficiency in research pertaining to the application of these principles within the specific context of hotel supply chains. Prior research has examined various components such as supply chain design, relationship management, innovation, and digital sustainability in isolation within the hotel industry. However, there is a noticeable dearth of comprehensive studies that integrate these elements holistically. This study aims to fill the existing research gap by conducting a comprehensive analysis that examines key elements of circular economy integration within hotel supply chains. These elements encompass design, relationships, innovation, reverse logistics, digital tools, and information sharing. Through its comprehensive approach, this study offers a comprehensive viewpoint, presenting valuable insights for professionals, policymakers, and scholars seeking to improve sustainability initiatives within the hotel sector. After reviewing the past literature, this study proposes a conceptual framework that is given below in figure 2.1:

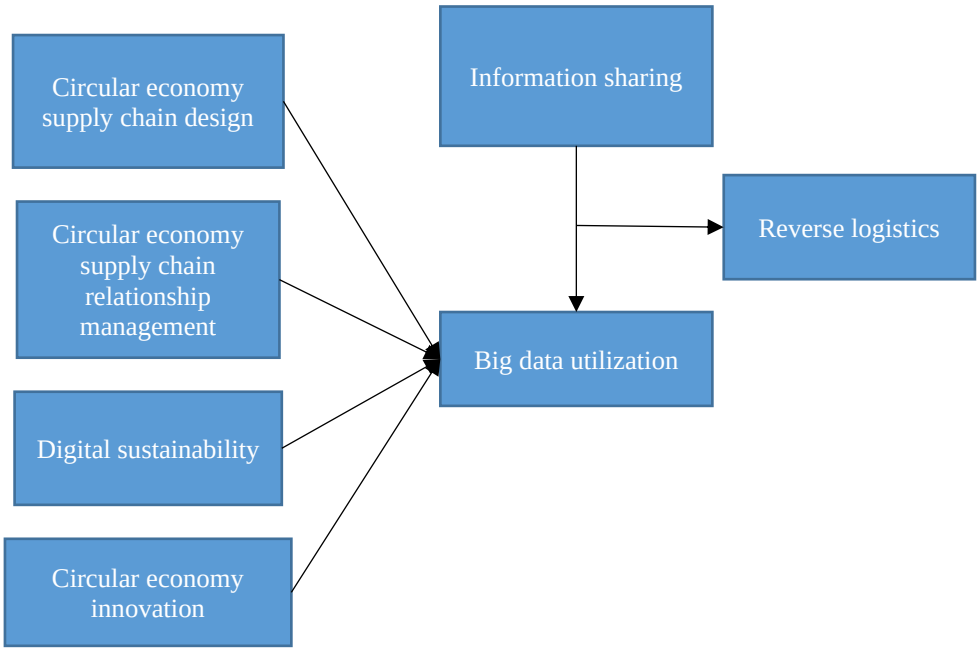

Figure 2.1: Conceptual Framework

3. METHODOLOGY

3.1. Research Strategy

The researcher has used the quantitative research strategy with primary data collection and has used the survey method for data collection.

3.2. Data Collection and Sampling

The researcher employed a self-administered approach to collect quantitative data from the selected respondents within the target population for this study. Furthermore, the researcher has employed the non-probability purposive sampling method, specifically focusing on employees as the central group of participants for this study. The researcher has deliberately chosen the hotel sector as the focus of their study and has designed the data collection process to specifically target employees working in various hotels and restaurants in Saudi Arabia. However, they have intentionally excluded the participation and input of hotel management in the data collection process.

3.3. Measurement of the Variables details

The survey instrument utilised in this study was organised into distinct sections, with the initial section comprising inquiries pertaining to the demographic characteristics of the participants. The second section of the questionnaire constituted the primary component, encompassing inquiries and scale items pertaining to all the variables targeted in the study. The variables were assessed using a 5-point Likert scale, where a score of 1 indicated strong disagreement and a score of 5 indicated strong agreement among the respondents regarding the concept being measured in each scale item. The researcher has identified and compiled all the items corresponding to the variables of interest from the empirical studies found in the existing literature. These items are described in detail. The table presented below exhibits the names of the variables along with their corresponding sources of scale items.

Name of Variables	Circular economy supply chain design CESCD	Circular economy supply chain relationship management CESCRM	Digital sustainability	Circular economy innovation	Big data utilization	Reverse logistics	Information Sharing
Source of the items	(Del Giudice et al., 2021)	(Del Giudice et al., 2021)	(Chen, Zhang, & Wu, 2018)	(Chiappetta Jabbour et al., 2020)	(Benzidia, Makaoui, & Bentahar, 2021)	(Bor, 2020)	(Lin & Wang, 2020)

The following table has been included to illustrate the quantity of items utilised for measuring the variables employed in the study. Additionally, a few representative items have been appended to elucidate the nature, concepts, and ideologies encompassed by the aforementioned items.

Name of Variables	CESCD	CESCRM	Digital sustainability	Circular economy innovation	Big data utilization	Reverse logistics	Information Sharing
No of items and exemplary items	3 The firm designs/optimizes ways to recycle waste materials and spare parts	3 The firm helps existing supplier establish rules and regulations related to the circular economy principles	19 Pursue to simple transaction activities of equipment maintenance services.	8 My company faces behavioural barriers (people do not perceive sustainability as important and are against change).	4 Deployment of dashboard applications/information in communication devices (e.g., smart phones, computers) of the GSC process	6 The firms supply chain framework provides for product Returns	3 I plan to continue sharing information on SNS frequently.

4. ANALYSIS

4.1 Descriptive Statistics

The examination of descriptive statistics serves to present, condense, and showcase the fundamental and significant characteristics of the dataset during the course of an empirical research inquiry. The analysis of descriptive statistics is presented in a concise manner, providing an overview of the sample data and its corresponding measurements. The descriptive statistics tests encompass the examination of key statistical measures "minimum, maximum, mean, and standard deviation" values across all observed variables within the study. The results of the descriptive statistics are presented in Table 4.1.

Table 4.1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
RL	197	1.00	4.83	3.1954	.98271
CEI	197	1.00	5.00	3.1904	.95152
DS	197	1.00	4.64	2.8477	.79622
CESCD	197	1.00	5.00	3.0914	1.15106
BDU	197	1.00	5.00	3.8236	.93659
IS	197	1.33	5.00	3.7208	.93762
CESRM	197	1.00	5.00	3.5127	1.01210
Valid N (listwise)	197				

"BDU = Big data utilization, DS = digital sustainability, RL = reverse logistics, CESCD = circular economy supply chain design, CESRM = circular economy relationship management, CEI = circular economy innovation, IS = Information sharing."

From the table above it can be seen that for RL, CEI, DS, CESCD, BDU, IS, and CESRM the values of minimum are 1, 1, 1, 1, 1, 1.33 and 1, the maximum values are 4.83, 5.00, 4.64, 5.00, 5.00, 5.00 and 5.00, their mean values are 3.19, 3.19, 2.84, 3.09, 3.82, 3.72 and 3.51 and the standard deviation values are 0.98, 0.95, 0.79, 1.15, 0.93, 0.93 and 1.01 respectively.

4.2 KMO and Bartlett's Test

The researcher has employed factor loadings as a means of assessing the sustainability of the measurement scales that have been adopted. The KMO and Bartlett tests are utilised to assess the suitability of the collected dataset in relation to the observed constructs, as well as to validate the significance of the factor loadings analysis (Cudeck & O'dell, 1994; Shevlin & Miles, 1998). The cut-off value of KMO is 0.7 and above, and for Bartlett's Test the significance level is 0.01, 0.05 and 0.10. Table 4.2 presents the results of KMO & Bartlett's test, the value of KMO is 0.836 is significant, and Bartlett's test is 0.000, thus significant.

Table 4.2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.836
Bartlett's Test of Sphericity	Approx. Chi-Square	4666.253
	df	780
	Sig.	.000

Table 4.3: Rotated Component Matrix

	Component						
	1	2	3	4	5	6	7
DS1				.780			
DS2				834			
DS3				853			
DS4				783			
DS5				809			
DS6				793			
DS7				712			
DS8				830			
DS9				704			
DS10				784			
RL1		804					
RL2		843					
RL3		788					
RL4		.750					
RL5		.737					
RL6		.779					
CEI1			.651				
CEI2			.763				
CEI3			.709				
CEI4			.606				
CEI5			.571				
CEI6			.715				
CEI7			.599				
CEI8			.657				
CESCD1						.861	
CESCD2						.820	
CESCD3						.648	
BDU1	.775						
BDU2	.703						
BDU3	.733						
BDU4	.694						
IS1				.610			
IS2				.646			
IS3				.766			
CESRM1							.676
CESRM2							.606
CESRM3							.528

"BDU = Big data utilization, DS = digital sustainability, RL = reverse logistics, CESCD = circular economy supply chain design, CESRM = circular economy relationship management, CEI = circular economy innovation, IS = Information sharing."

4.3 Factor Loadings

The utilisation of the rotated component matrix (Peterson, 2000) is employed to assess the absence of cross-loadings and item duplication. According to the findings presented in Table 4.2, the outcome of the KMO and Bartlett's test demonstrates statistical significance. Consequently, it is anticipated that the analysis of factor loadings would similarly produce significant outcomes. The results of factor loadings in the form of a rotated component matrix are presented in Table 4.3. All the factors listed in the table exhibit values greater than 0.40, while those factors with values below 0.40 have been excluded from subsequent analysis. Furthermore, it is worth noting that each variable was clearly delineated in distinct columns, thereby indicating the absence of any instances of cross-loadings or duplications. The study employed a measurement scale consisting of 10 items to assess DS, 6 items to assess RL, 8 items to assess CEI, 3 items to assess CESCD, 4 items to assess BDU, 3 items to assess IS, and 3 items to assess CESRM. Nine items of the data set were excluded from analysis as a result of their low factor loading values.

4.4 Direct Hypotheses Analysis

With the help of SPSS, the researcher has analysed the direct hypotheses of the study. Results of direct hypotheses analysis is given in table 4.4 below. The relationship between digital sustainability and reverse logistics has been rejected (t = -.491, p-value = 0.624), association between circular economy supply chain design and reverse logistics has been supported (t = -2.33, p-value = 0.021), relationship between circular economy relationship management and reverse logistics has been accepted (t = -1.936, p-value = 0.054), and the association between circular economy innovation and reverse logistics has not been accepted (t = -.161, p-value = 0.872).

Table 4.4: Rotated Component Matrix

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.323	.397		5.851	.000
	DS	-.043	.088	-.035	-.491	.624
	CESCD	.142	.061	.166	2.333	.021
	CESRM	.172	.089	.177	1.936	.054
	CEI	-.015	.093	-.014	-.161	.872

a. Dependent Variable: RL

"DS = digital sustainability, RL = reverse logistics, CESCD = circular economy supply chain design, CESRM = circular economy relationship management, CEI = circular economy innovation."

4.5 Mediation Analysis

The study has examined the mediation of big data utilization. Table 4.5 presents the results of mediating analysis. From the table below, it can be observed that the mediating impact of big data utilization is significant on the association between circular economy innovation and reverse logistics (lower-bound =-.0523, upper-bound =.2383), it is also supported on the

relationship between digital sustainability and reverse logistics (lower-bound =--.2018, upper-bound =.1467), big data utilization significantly mediates the relationship between circular economy supply chain design and reverse logistics (lower-bound =.0439, upper-bound =.2807), and it also significantly mediates the association between circular economy relationship management and reverse logistics (lower-bound =.0413, upper-bound =.3110).

Table 4.5: Mediation Analysis

Relationship	Total effect	Direct effect	Indirect effect	Confidence Interval		T statistics	P value	Conclusion
				Lower-bound	Upper-bound			
CEI → BDU → RL	.0930	-.2070	.3000	-.0523	.2383	1.2627	.2082	Supported
DS → BDU → RL	-.0276	-.0416	.0140	-.2018	.1467	-.3119	.7554	Supported
CESCD → BDU → RL	.1623	.0366	.1257	.0439	.2807	2.7041	.0075	Supported
CESRM → BDU → RL	.1762	-.2382	.4143	.0413	.3110	2.5766	.0107	Supported

"BDU = Big data utilization, DS = digital sustainability, RL = reverse logistics, CESCD = circular economy supply chain design, CESRM = circular economy relationship management, CEI = circular economy innovation."

4.6 Moderation Analysis

The study examined the moderating impact of information sharing on the association between big data utilization and reverse logistics. Table 4.6 shows the moderating impact is found to be significant (LLCI = -.4076, ULCI = -.1458, t statistics = -4.1682, p-value = 0.0000).

Table 4.6: Moderation Analysis

Model							
	Coeff	se	t	P	LLCI	ULCI	Conclusion
constant	-1.3470	.7126	-1.8902	.0602	-2.7525	.0585	
BDU	1.4966	.2099	7.1291	.0000	1.0826	1.9107	
IS	.7885	.2653	2.9717	.0033	.2652	1.3119	
Int_1	-.2767	.0664	-4.1682	.0000	-.4076	-.1458	Supported

"BDU = Big data utilization, IS = Information sharing."

5. DISCUSSIONS

5.1. Findings of the study

The initial hypothesis of the study investigated the correlation between digital sustainability and reverse logistics. The findings indicate that there is a lack of significant influence between these two variables. The findings presented align with the study conducted by Fernando, Shaharudin, and Abideen (2023), which indicates that sustainability is not a significant factor in determining the effectiveness of reverse logistics activities within an organisation. The study's second hypothesis revealed a significant relationship between circular economy supply chain design and reverse logistics. This finding suggests that key practices in the circular supply chain economy, such as waste material recycling, reduced logistics demand, efficient transportation modes, and overall supply chain optimisation, can effectively minimise waste

(Del Giudice et al., 2021).

The obtained findings suggest that the third hypothesis of the study supports the notion that circular economy relationship management has a significant influence on reverse logistics. The acceptance of this hypothesis demonstrates that the implementation of a well-executed and efficient relationship management strategy within the circular economy can yield significant outcomes in the realm of reverse logistics. The results of the study indicate that the fourth hypothesis, which pertains to the impact of circular economy innovation on reverse logistics, was found to be statistically insignificant. Therefore, the implementation of circular economy innovation does not contribute to the improvement of reverse logistics within supply chain operations.

Furthermore, the study's findings have indicated the acceptance of the fifth hypothesis, which posited that the utilisation of big data plays a significant mediating role in the relationship between circular economy innovation and reverse logistics. The proposition posits that the utilisation of big data-driven knowledge and methodologies can augment the overall efficacy of reverse logistics processes, thereby leading to improvements in the supply chain and fostering the development of a sustainable circular economy. The sixth hypothesis of the study was confirmed, indicating that the utilisation of big data serves as a mediator in the relationship between digital sustainability and reverse logistics. This implies that by employing advanced digital technologies, organisations can enhance their overall sustainability and subsequently improve the efficiency of reverse logistics processes.

In addition, the findings of the study indicate that the seventh hypothesis has been supported. This suggests that the utilisation of big data plays a significant role in mediating the relationship between circular economy supply chain design and reverse logistics. Consequently, integrating data-driven solutions can improve the effectiveness of reverse logistics and contribute to the development of a supply chain that facilitates waste minimization and enhances overall performance for the firm. Finally, the eighth hypothesis of the study suggests that the utilisation of big data mediates the relationship between circular economy relationship management and reverse logistics. This hypothesis posits that by effectively managing relationships in the circular economy and fostering collaboration with all stakeholders, overall supply chain performance and logistics can be improved.

The ninth hypothesis of the study, pertaining to the moderation of information sharing on the relationship between big data utilisation and reverse logistics, was also found to be supported. The importance of this relationship suggests that the application of sophisticated technology and data analytics can offer informed insights to the organization's leadership, aiding them in making effective decisions, especially when dealing with large volumes of data. Effective information sharing is a crucial component in the operations of businesses, particularly in the context of supply chain and reverse logistics. By effectively harnessing and utilising big data, significant enhancements and improvements can be achieved in reverse logistics operations.

6. CONCLUSION

This study investigates the role of the circular economy in waste minimization within the hotel industry's supply chain. The present study has conducted an examination of the effects of various factors on reverse logistics, including the utilisation of big data, digital sustainability, the design of circular economy supply chains, the management of circular economy relationships, circular economy innovation, and information sharing. The study's findings

primarily centre on the importance of effectively integrating big data-driven approaches, circular supply chain practices, and relationship management to enhance reverse logistics processes and operations. Additionally, these findings make a significant contribution to the overall sustainability of the circular economy. The aforementioned findings hold significant relevance for the restaurants and hotel industry situated in the geographical region of Saudi Arabia. Moreover, these findings also bear importance for the global hotel sector, particularly in terms of enhancing their reverse logistics and supply chain management within a circular economy framework.

6.1 Implications

On the basis of the findings obtained from the study, it offers a number of theoretical implications as well as practical implications, which has been discussed in detail below.

6.2 Theoretical Implications

The present study contributes novel insights to the existing literature, specifically in the field of sustainability. The observed constructs, namely circular economy, supply chain, reverse logistics, information sharing, and big data utilisation, have not been previously investigated in this manner. Furthermore, the present study has investigated the aforementioned variables within the context of the hotel supply chain and the food supply chain. Consequently, given the inherent characteristics of this industry, these variables can be readily implemented. The study's findings significantly contributed to the current body of literature by elucidating the explicit embodiment of circular economy practices within the supply chain network and their overarching impact on business performance. This study examines the potential impact of incorporating big data into supply chain management practices, with a specific focus on enhancing performance and reducing waste within the firm. The utilisation of big data in supply chain management has been shown to offer empirical evidence supporting its effectiveness in improving the performance of firms operating within the circular economy supply chain.

6.3 Practical Implications

This study recommends that supply chain managers in the hotel sector of Saudi Arabia should adopt and integrate circular economy practices into their supply chains in order to mitigate the issue of excessive waste generation. The study additionally emphasises significant elements that will assist supply chain managers in cultivating collaborative relationships within their supply chains. Furthermore, the results of this study have the potential to provide advantages to various parties involved in the firm, including managers, owners, suppliers, and other stakeholders. Additionally, policymakers can also benefit from these findings, as they can serve as a guide for understanding the importance of information sharing within the supply chain. It is crucial to recognise that any reluctance to share information can have a significant impact on the overall performance of the supply chain.

The adoption of data-driven solutions and the implementation of a circular economy supply chain are crucial for supply chain managers and overall firm management. This can be achieved by primarily emphasising innovative approaches. The study aims to provide a comprehensive understanding of human resource management practices in the hotel sector of Saudi Arabia, specifically focusing on the effective management of the supply chain. The study proposes that circular economy supply chain businesses can

enhance their performance by implementing initiatives focused on circular economy principles. This can be achieved through the integration of big data utilisation, which encourages both employees and management to adopt collaborative techniques and specific practices aimed at improving the overall performance of the supply chain. By implementing this strategy, the organisation would enhance its market competitiveness, attain a competitive edge, and achieve a higher level of performance.

6.4 Limitations

Despite the comprehensive nature of the study, it is important to acknowledge its limitations. The study has employed a relatively small sample size of 197 participants, potentially affecting the generalizability and acceptability of the findings. The study focuses on a specific industry, namely the hotel industry in Saudi Arabia. Therefore, the findings are only applicable within this particular industry and region. Furthermore, the present study has focused on a limited number of variables while neglecting other crucial factors that may exert a substantial influence on the circular economy within the supply chain, such as the examination of firm performance or relationship management in the context of the circular economy supply chain. Additionally, the study could explore various other variables related to the circular economy in HR management and thoroughly analyse their impact, thereby enhancing our understanding of the subject matter in a more comprehensive manner. One additional constraint of the study pertains to the temporal scope, which is limited by the cross-sectional design as a result of resource and time limitations.

6.5. Future Research

The study has identified certain limitations, which in turn offer valuable insights for future researchers to explore and address in their own research endeavours. Firstly, it is recommended that researchers increase the sample size by collecting data from a larger number of participants. This will improve the validity and generalizability of the study's findings. Additionally, it is recommended to include multiple industries in order to ensure that the study's findings are not limited to a single industry. It is also recommended that further research be conducted in various geographical regions worldwide, followed by a comparative analysis of the results with the findings of the current study. It is recommended that future researchers engage in longitudinal research endeavours to enhance their comprehension of the subject matter and optimise data collection methodologies.

ACKNOWLEDGEMENT

This work was supported through the Ambitious Funding track by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia [Grant 4589].

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