

Assessing performance metrics for e-commerce reverse logistics and circular economy initiatives in supply chains: the five R's model approach

R. Naveen Kumar

School of Management, Kristu Jayanti College, Autonomous, Bengaluru, India

M. Janani

*Department of Professional Accounting and Finance,
Kristu Jayanti College, Autonomous, Bengaluru, India*

A. John William

School of Management, Kristu Jayanti College, Autonomous, Bengaluru, India, and

R. Pavithra

*Department of Computer Science,
Kongunadu Arts and Science College, Autonomous, Coimbatore, India*

Abstract

Purpose – The research explores the impact of e-commerce reverse logistics practices on the circular economy. It uses the Five R's model to evaluate these practices. The objectives are to assess the effectiveness of these strategies, identify areas for improvement and develop practical recommendations for e-commerce companies to integrate sustainable practices into their operations.

Design/methodology/approach – The study analyzes data on reverse logistics partnerships and recovery services in southern India using a Non-probabilistic sampling method. The data was collected from 208 samples, spanning from December 2023 to March 2024. Structural Equation Modeling (SEM) was used to validate the model and hypotheses. A structured questionnaire was created to explore reverse logistics practices and their connection to the circular economy.

Findings – The study found that circular economy principles, reverse logistics practices, technology information systems and supply chain design significantly impact productivity and sustainability. These factors account for 36% of performance metrics variation, with productivity standing at 38% and sustainability at 27%. To enhance sustainability, e-commerce businesses should adopt comprehensive strategies, including consumer education, optimizing reverse logistics systems, investing in technology and collaborating across the supply chain. Expanding research, benchmarking against industry best practices and addressing consumer behavior challenges can also contribute to a circular economy.

Originality/value – The research explores the integration of circular economy principles into e-commerce, focusing on reverse logistics and circular economy initiatives. It introduces the Five R's model for developing customized sustainability strategies and validates these frameworks through factor analysis and statistical modeling.

Keywords E-commerce, Reverse logistics, Business sustainability, Performance metrics

Paper type Research paper



1. Introduction

The rapid expansion of e-commerce has reshaped global retail, offering consumers convenience and accessibility while simultaneously intensifying environmental challenges, particularly concerning product returns and end-of-life disposal. The increasing volume of returned goods and inefficient disposal practices contribute to resource depletion, waste accumulation and higher carbon emissions, necessitating the urgent adoption of sustainable solutions (Agrawal, Singh, & Murtaza, 2016). Businesses are increasingly implementing green supply chain strategies in response to environmental concerns, regulatory requirements and competitive market pressures. A circular economy approach has emerged as a key strategy to mitigate the environmental footprint of e-commerce operations by integrating reverse logistics and sustainable supply chain practices to enhance resource efficiency and minimize waste. While traditional brick-and-mortar retailers have long invested in infrastructure for repair, refurbishment and material recovery to reduce waste, e-commerce businesses face unique challenges in managing returned products, necessitating innovative sustainability frameworks. This study applies the Five R's model—refuse, reduce, reuse, repurpose and recycle—to assess the effectiveness of circular economy initiatives in e-commerce reverse logistics, focusing on key areas such as return management, packaging optimization, sustainable transportation and consumer engagement. The findings will offer insights into how businesses can enhance sustainability through eco-friendly packaging, optimized logistics, strategic collaborations with recycling partners and the integration of emerging technologies like AI and blockchain for greater supply chain transparency. Furthermore, this research examines the role of regulatory frameworks, technological advancements and consumer awareness in driving sustainable practices, emphasizing the importance of continuous innovation, strategic partnerships and performance indicators (KPIs) to track sustainability progress. By bridging theoretical circular economy models with practical business applications, the study provides actionable recommendations for fostering environmental responsibility in e-commerce. The core research problem lies in the inefficiencies and environmental costs associated with managing returned products, as the rising volume of online shopping has led to an unprecedented increase in returns, often resulting in excessive waste and resource consumption that contradicts consumer and regulatory demands for sustainability. Without a strategic shift toward circular economy practices, e-commerce companies risk exacerbating environmental damage and failing to meet evolving sustainability standards. The research evaluates the effectiveness of the five R's model in reverse logistics, establishes key performance metrics and identifies areas for improvement. It addresses the critical need for e-commerce businesses to integrate circular economy principles into their supply chains to mitigate environmental impacts while optimizing cost savings, inventory management and revenue opportunities from repurposed or recycled products. Through an in-depth analysis of circular economy applications in e-commerce, this study contributes to academic discourse while also raising consumer awareness about sustainable e-commerce practices. The primary objectives include assessing how the five R's model can enhance sustainability in e-commerce reverse logistics, exploring how circular economy adoption can drive business efficiency and competitiveness and identifying innovative technologies and best practices that support the implementation of sustainability principles. Research questions focus on how the five R's model can be effectively integrated into e-commerce supply chains, which areas hold the greatest potential for waste reduction and resource reuse, and how businesses can proactively adopt sustainability practices to maintain long-term competitiveness. By structuring the study around these core themes, this research aims to provide strategic recommendations and practical insights for businesses seeking to integrate circular economy principles into their supply chains, ultimately driving a more sustainable e-commerce landscape.

2. Review of literature and hypotheses development

2.1 Supply chain management and circular economy

Transitioning from ownership to leasing in supply chains enhances structural flexibility, integrates open and closed material loops, fosters collaboration and leverages procurement strategies from both the public and private sectors. These factors play a crucial role in developing circular business models (De Angelis, Howard, & Miemczyk, 2018). Circular economy (CE) initiatives are transforming production and consumption patterns across different regions. By applying a CE perspective to supply chain management (SCM), this study explores strategies for transitioning from linear to circular models. Additionally, it provides a conceptual framework and research agenda to guide practitioners and researchers in adapting existing supply chain processes (Hazen, Russo, Confente, & Pellathy, 2021). Packaging significantly influences product movement while also generating waste. The increasing complexity of global supply chains has resulted in excessive packaging layers. A review of sustainable packaging in supply chain management (SPSCM) over 18 years highlights its alignment with circular economy principles but lacks consideration of product interaction with packaging systems (Meherishi, Narayana, & Ranjani, 2019). Food waste reduction in supply chains can be achieved using a two-stage model. The primary chain produces, utilizes and discards waste, while the secondary chain collects and recycles it into livestock products. This model circulates waste efficiently and demonstrates cost reduction through sensitivity analysis (Sarkar, Debnath, Chiu, & Ahmed, 2022). Organizations are adopting sustainable practices to address environmental, social and economic challenges. Transitioning to a circular economy optimizes resource use, energy efficiency and waste management. Analyzing supply chain transformation from linear to circular models, this study emphasizes six key principles—recover, reuse, remanufacture, recycle, redesign and reduce—while exploring Industry 4.0 opportunities (Manavalan & Jayakrishna, 2019). Successful CE transitions require integrating product design with SCM decisions. Insights from 15 interviews in New Zealand highlight four key factors: end-of-life product design, circular SCM, business model innovation and sustainable organizational values (Burke, Zhang, & Wang, 2021). The link between sustainability and circular economy practices in supply chains is analyzed through structural equation modeling using UAE-based supply chain data. The study develops a framework emphasizing process facilitators and persuasive organizational narratives in circular supply chains (Hussain & Malik, 2020). Environmental commitment, social pressure and green economic incentives shape SCM, sustainable design and circular economy capabilities. A study of 212 SMEs confirms that green incentives and environmental commitment positively impact SCM, with social pressure playing a crucial role (Centobelli, Cerchione, Esposito, Passaro, & Shashi, 2021). Green Supply Chain Management (GSCM) is essential for optimizing resources in a circular economy, addressing environmental concerns and shifting consumption patterns. Companies must balance environmental, economic, logistical, organizational and marketing performance indicators (Kazancoglu, Kazancoglu, & Sagnak, 2018). The circular economy initiative in agriculture and agro-based industries supports waste-to-energy (WTE) conversion. However, efficient energy supply chain systems are necessary for success. This study examines key enablers such as life cycle assessment, economic potential cycles and value chain analysis, with survey data from Malaysian companies confirming their impact on WTE practices (Fernando, Tseng, Aziz, Ikhsan, & Wahyuni-TD, 2022).

2.2 E-commerce reverse logistics

Effectively managing e-commerce returns is crucial for businesses integrating circular economy principles. A structured three-stage circular reverse logistics framework has been developed, incorporating hierarchical clustering, a circular economy network and a mixed-integer linear programming model. Validated through a consumer electronics case study, this

framework supports firms in optimizing reverse logistics networks and improving sustainability (Nanayakkara, Jayalath, Thibbotuwawa, & Perera, 2022). Reverse logistics is essential for the efficiency and expansion of B2C e-commerce, particularly in China. A proposed IoT-based system enhances operational effectiveness by establishing regional consortia led by local governments and fostering collaboration between businesses and policymakers. Cost and responsiveness are key factors in designing reverse logistics networks for the fashion e-commerce industry. A model integrating initial collection centers and warehouses has been developed, assigning each customer index to a specific collection center. Sensitivity analyses provide managerial insights for optimizing decision-making (Das, Kumar, & Rajak, 2020). The increasing volume of returned products in India's e-commerce sector calls for a sustainable reverse logistics model. A weighted goal programming approach balances economic, environmental and social objectives, aiding facility location decisions and the adoption of efficient processing technologies (Dutta, Mishra, Khandelwal, & Katthawala, 2020). Managing online returns presents significant challenges due to rising costs. A conceptual framework has been introduced to streamline return tracking and management, improving overall business performance (Nel & Badenhorst, 2020). The COVID-19 pandemic has intensified product returns, necessitating robust reverse logistics strategies. A decision support system evaluates third-party reverse logistics providers using a hybrid fuzzy multicriteria decision-making approach. This model considers economic, environmental, social and risk factors, emphasizing key criteria such as lead time, customer feedback, cost, service quality and delivery (Wang, Dang, & Nguyen, 2021). A sustainable closed-loop supply chain (CLSC) framework for e-commerce electronics aligns with circular economy principles. Utilizing a mixed-integer nonlinear programming model, it optimizes both forward and reverse logistics, reducing costs while maximizing revenue. Sensitivity analysis with LINGO 19 software offers insights for policymakers (Prajapati, Pratap, Zhang, & Huang, 2022). To enhance e-commerce supply chains and manage high return rates, a reverse logistics network model leveraging hierarchical clustering and mixed-integer linear programming has been introduced. In the consumer electronics sector, this model has achieved a 39.9% average cost reduction (Thibbotuwawa *et al.*, 2023). The courier, express and parcel (CEP) industry has experienced rapid growth during the Covid-19 pandemic, with projected annual expansion rates of 10.8% in Asia-Pacific, 5.2% in South America, 5.1% in Europe and 7–8% in Poland. Key challenges include managing higher order volumes, meeting customer expectations and reducing direct contact. Further research is needed on e-customer expectations, enhanced collaboration between CEP companies and online retailers and automation in reverse logistics. In Internet direct sales, customers cannot physically inspect products before purchasing, leading to dissatisfaction and increased returns. A well-defined and generous return policy can drive demand and boost manufacturer revenue, though it also raises costs. A profit-maximization model has been proposed to determine the optimal balance between pricing and return policies (Mukhopadhyay & Setoputro, 2004).

2.3 Performance metrics in circular economy

Creating products within a circular economy (CE) framework requires assessing sustainability performance (PSP) during design while considering production changes over time. Existing methods often assume stable production, leading to inaccuracies. To address this, a metrics-based framework for forecasting PSP across multiple production periods with closed-loop flows has been developed. A numerical analysis reveals significant PSP variations influenced by demand shifts, reinforcing PSP as a dynamic measure (Hapuwatte, Seevers, & Jawahir, 2022). Measuring product performance under CE principles involves selecting appropriate indicators and assessment methods. A prototype evaluation tool, developed using a points-based questionnaire, provides a straightforward result within set limits. While user-friendly and efficient, it may oversimplify decision-making and rely on contextual assumptions. The tool was tested in the chemical processing industry (Cayzer, Griffiths, & Beghetto, 2017).

Similarly, a review of CE assessment methods highlights the complexity of measuring circularity performance. Testing three existing approaches in an industrial case study revealed limitations in their practical application (Saidani, Yannou, Leroy, & Cluzel, 2017). Developing CE indicators is crucial for bridging research, policy and practice. A novel framework incorporating expert and participatory practices identifies seven key indicators focusing on environmental regeneration, resource efficiency and minimizing negative externalities (Nika *et al.*, 2021). Addressing the need for simplified assessment tools, an alternative set of indicators was tested in Spanish companies, proving applicable across industries and economic scales (Rincón-Moreno, Ormazábal, Álvarez, & Jaca, 2021). The shift from a linear to a circular economy aligns with global sustainability goals, requiring effective monitoring. A review highlights gaps in waste metrics and suggests that adopting CE strategies improves efficiency, reduces costs and meets green consumer expectations (Voukkali *et al.*, 2023). However, the absence of a standardized CE measurement framework results in varied methodologies. A structured analysis groups existing metrics into three clusters: resource efficiency, material flows and product-centric approaches (Parchomenko, Nelen, Gillabel, & Rechberger, 2019). While numerous tools exist for planning and evaluating CE strategies, confusion remains over what aspects to measure. A review of CE's environmental impact across micro, meso and macro levels highlights challenges in integrating indicators and assessing long-term effects (Harris, Martin, & Diener, 2021). To enhance assessment, a new Circular Economy Performance Assessment (CEPA) methodology combines Life Cycle Assessment and Costing with KPIs, addressing both positive and negative impacts in manufacturing transitions (Sassanelli & Terzi, 2023).

2.4 5R's model & sustainability

The European Union is prioritizing sustainability, and a framework combining TRIZ methodology with the 5Rs of sustainability can aid in designing innovative solutions. Applied to an Italian SME, this approach reduces virgin material consumption, eliminates high-impact materials and establishes a circular economy (CE) business model. Its adoption could increase sustainability awareness and encourage broader implementation (Carrara, Morandi, & Tandoi, 2021). Water scarcity has driven interest in water reuse, reclaimed water and recycled wastewater. The European Union and IWA recognize treated wastewater as a potential solution to this issue, offering economic, social and environmental benefits while attracting private-sector investment (Timofti & Pienaru, 2022). Similarly, managing water consumption in the oil and gas industry aligns with sustainability goals. The Water Closed-Loop System (WCLS), developed under UNESCO's Water Reuse initiative, integrates wastewater treatment with circular principles, reducing water use by 28.66% and wastewater generation by 46.33% in an oil refinery (Sarrafzadeh, 2022). Young adults in Finland primarily associate CE with recycling, waste sorting and second-hand shopping. However, adopting the 5R framework highlights overlooked roles such as upcycling and maintenance, broadening citizen engagement in CE. The evolution of CE principles from the 3R to the 10R framework has enhanced waste management efficiency. Stochastic Frontier Analysis (SFA) of OECD data (2000–2017) finds a recovery rate efficiency of 0.84, indicating progress but also highlighting the financial challenges municipalities face in implementing recovery processes. Digitalization plays a crucial role in CE, particularly in waste management and sustainability. Digital solutions could enhance resource efficiency, cut waste management budgets by up to 35% and contribute USD 15.7 trillion to the global economy by 2030 while reducing CO₂ emissions by 15% (Kurniawan *et al.*, 2023). Additionally, blockchain technology can improve CE performance monitoring by enhancing traceability, transparency and security in supply chains (Kouhizadeh, Zhu, & Sarkis, 2024). Reverse logistics is vital for reducing fast fashion's environmental impact, explored through interviews with SMEs and global companies (Nguyen, 2023). Similarly, traditional food value chains like geographically indicated (GI)

cheeses integrate CE principles but require further innovation to enhance sustainability (Habli, Dumitras, Schmitt, Maglietti Smith, & Barjolle, 2023).

2.5 Hypothesis development

The implementation of a circular economy follows three primary modes: reinvent and rethink, restore, reduce and avoid and recirculate. Environmental orientation and digital supply chain platforms drive these approaches. While reinvent and rethink, along with restore, reduce and avoid, positively impact financial performance, recirculating does not show a significant relationship (Li *et al.*, 2022). Corporate green commitment plays a crucial role in adopting circular economy practices, which in turn enhance sustainability performance. Additionally, corporate green efficacy moderates the relationship between green commitment and circular economy adoption (Ho & Lin, 2024).

H1. Does the implementation of a circular economy have a significant impact on productivity?

Industrialization has increased raw material consumption, raising environmental concerns. Integrating ecological modernization and environmental laws can help mitigate these issues, particularly in developed economies (Waqas *et al.*, 2021). Reverse logistics (RL) positively influences operational performance and organizational culture further strengthens this effect, contributing to knowledge of RL practices in emerging markets (Saruchera and Asante-Darko, 2021). AI-based RL adoption is driven by factors such as trust, top management support, environmental regulations and government backing, which positively correlate with performance (Mukherjee *et al.*, 2024). Compliance with government policies also enhances environmental performance by fostering RL practices, though firm-specific policies influence this relationship (Kalubanga & Mbekeke, 2023).

H2. Do reverse logistics practices significantly impact productivity?

Trust and system quality are key drivers of e-commerce success (Tam, Loureiro, & Oliveira, 2020). Organizational, technological and information ecology factors shape e-commerce adoption in developing economies (Herzallah *et al.*, 2015). While ICT-based workplace connectivity can increase work stress, maintaining social ties can reduce it (Chesley & Johnson, 2015). IT investment correlates strongly with GDP growth but not directly with productivity, highlighting a paradox (Hajli, Sims, & Ibragimov, 2015).

H3. Do technology and information systems significantly impact productivity?

Cost competitiveness is critical for Indonesia's e-commerce supply chains (Febransyah & Camelia Goni, 2022). Delivery performance is essential for e-commerce success, emphasizing convenience, quality and customization (Bragin, Panasenکو, Nikishin, Pankina, & Aleksina, 2020). Sustainable supply chain management (SSCM) has a positive relationship with social sustainability but not economic or environmental factors. However, when productivity is included as a mediator, all relationships become significant (Razzak, 2022). Sustainable procurement and investment recovery improve cost performance, while sustainable distribution negatively affects it (Khanam & Ghosh, 2022).

H4. Does supply chain design significantly impact productivity?

A sustainable framework for multi-echelon electronics supply chains maximizes revenue within a circular economy model (Prajapati *et al.*, 2022). The circular economy contributes to GDP and employment in the digital era, with businesses needing to address environmental, social and governance (ESG) concerns (Fatimah, Kannan, Govindan, & Hasibuan, 2023). Challenges in CE implementation include poor government policies, technological limitations and lack of awareness (Sharma, Mangla, Patil, & Liu, 2019). Business analytics capability

significantly enhances sustainable performance and circular economy implementation, acting as a partial mediator between the two (Tetteh, Atiki, Kyeremeh, Degbe, & Apanye, 2024).

H5. Does the implementation of a circular economy have a significant impact on sustainability?

Reverse logistics positively influences environmental, economic and social performance in FMCG industries (Ali, Zalavadia, Barakat, & Eid, 2018). In Slovakia, green and reverse logistics practices are primarily led by large automotive firms, though financial constraints and environmental challenges persist (Richnák & Gubuva, 2021). A mediated model suggests that resource commitments enhance sustainable RL capabilities, reducing environmental impact (Morgan, Tokman, Richey, & Defee, 2018).

H6. Do reverse logistics practices significantly impact sustainability?

Green IT investments improve energy conservation and profitability in India, with operations-focused implementations yielding better results. ICT adoption is driven by management, quality and information culture, significantly impacting sustainability, though ICT expenditure alone does not (Ziemba, 2018). Environmental sustainability in IS implementation faces gaps between design and deployment, necessitating operational research techniques (Haigh & Griffiths, 2008).

H7. Do technology and information systems significantly impact sustainability?

Overproduction and overconsumption contribute to environmental degradation. Sustainable supply chains aim to encourage green consumer behavior and improve economic and socio-environmental outcomes (Taghikhah, Voinov, & Shukla, 2019). Sustainable supply chain management enhances business performance, making it essential for operational and financial success (Fu, Rahman, Jiang, Abbas, & Comite, 2022). Performance assessment in supply chains increasingly incorporates sustainability metrics, covering economic, environmental and social dimensions (Varsei, Soosay, Fahimnia, & Sarkis, 2014).

H8. Does supply chain design significantly impact sustainability?

2.6 Conceptual model

To test the impact of reverse logistics on the circular economy in the e-commerce industry, the proposed conceptual model is directed from the author self.

3. Methodology

This research gathered data from businesses engaged in reverse logistics partnerships and recovery services using a non-probabilistic sampling approach that combined convenience and snowball sampling techniques. The study surveyed 208 respondents from southern India, covering Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, with participant distribution as follows: 109 from Karnataka, 104 from Tamil Nadu, 83 from Andhra Pradesh and 93 from Kerala. The data collection period spanned from December 2023 to March 2024. To analyze multiple dependent and independent relationships simultaneously, the study employed Structural Equation Modeling (SEM) to validate the conceptual model and hypotheses. The SEM analysis was conducted using the maximum likelihood estimation method with AMOS 21. A structured questionnaire was designed to assess reverse logistics practices and their integration with circular economy principles. It covered key aspects such as reverse logistics operations, circular economy adoption, technology and information systems, supply chain design and respondent demographics. All measurement items were adapted from existing validated scales and refined to align with the objectives of this study.

4. Data analysis

This section evaluates the research instrument used in the study, assessing the reliability, validity, total variance explained by the performance metric factor, and overall model fit using SEM analysis. Measures like Cronbach's Alpha and Composite Reliability are used to assess internal consistency, convergent validity and discriminant validity. The performance metric factor is analyzed through its eigenvalue and percentage of variance explained, with a high eigenvalue and large percentage explaining the underlying concept. Model fit indices like Chi-Square, NFI, CFI and RMSEA are used to evaluate the overall fit. Hypothesis path analysis is conducted based on the hypothesized relationships between constructs. The data is indicated for factorization and loadings using the KMO measure of sampling adequacy and Bartlett's test of sphericity. The total variance explained by the factors is reported, providing an overview of the variance in the data.

4.1 Empirical results

The test results in [Table 1](#) show that 52.5% of businesses over 10 years have low reverse logistics practices, 36.7% have moderate practices and 10.7% have high practices. 44.7% of businesses aged 5–10 years have moderate practices, 39.7% have low practices and 15.6% have high practices. The reverse logistics practices range from 29 to 92 for businesses over 10 years, 52.68 for those under 5 years and 50.47 for those under 5 years. There was a significant relationship at 5% level of significance, between the Age of the Business and the level of reverse logistics practices ($\chi^2 = 8.49$, $df = 2$, $p = 0.04$). Hence, H01 was not supported.

The test results in [Table 2](#) show a significant relationship between business location and reverse logistics practices. The table showed that 44.8% of businesses adopt low, 41.7% moderate and 13.4% high levels of reverse logistics practices. The financial literacy ranges for urban and rural businesses were 26–93 and 21–92, respectively. Therefore, H02 was rejected.

The test results in [Table 3](#) factor analysis performed to minimize the factors involved, KMO value and Bartlett's test of sphericity indicate the suitability of data used for analysis, KMO Value has indicated 0.764 and the significant value is 0.00 at 1% Level of significance, which shows the data used for analysis is valid. The factors have been extracted using principal component analysis, and Varimax rotation has been used for the rotation of indicators. The factors were extracted with the eigenvalue of more than a unit, four factors have been extracted from the twenty statements, the first factor is named as Implementation of circular economy which is loaded into the third component, the third component named reverse logistics practice which is loaded in a first component, third factor named as Technology and information systems is loaded into the fourth component, fourth factor supply chain design is loaded into the second component. From [Table 1](#) factor analysis, all indicators with a loading more than

Table 1. Age of the business and level of reverse logistics practices in business

Age of the business	Mean	Range	Reverse logistics practice			Total
			Low	Moderate	High	
Less than 5 years	50.4706	21–90	24	33	11	68
			35.3%	48.5%	16.2%	17.6%
5–10 Years	52.6809	21–93	56	63	22	141
			39.7%	44.7%	15.6%	36.5%
Above 10 years	57.9774	29–92	93	65	19	177
			52.5%	36.7%	10.7%	45.9%
Total	54.7202	21–93	173	161	52	386
			44.8%	41.7%	13.5%	100.0%
Chi-square = 8.492			P value = 0.045			
Source(s): Primary Data, 2024						

Table 2. Location of the business and level of reverse logistics practices adopted by the business

Location of the business	Mean	Range	Reverse logistics practice			Total
			Low	Moderate	High	
Urban	55.6359	26–93	96 46.6%	90 43.7%	20 9.7%	206 53.4%
Rural	53.6722	21–92	77 42.8%	71 39.4%	32 17.8%	180 46.6%
Total	54.7202	21–93	173 44.8%	161 41.7%	52 13.5%	386 100.0%
Chi- square = 5.371			P value = 0.038			
Source(s): Primary Data, 2024						

Table 3. Indication of factorization and factor loadings

Indicators	Communalities	Factor loadings – rotated component matrix	
ICE1	0.675		0.743
ICE2	0.765		0.799
ICE3	0.698		0.748
ICE4	0.595		0.679
ICE5	0.678		0.762
RLP1	0.687	0.780	
RLP2	0.652	0.760	
RLP3	0.686	0.810	
RLP4	0.740	0.823	
RLP5	0.772	0.838	
TIS1	0.480		0.627
TIS2	0.753		0.828
TIS3	0.513		0.629
TIS4	0.686		0.811
TIS5	0.671		0.793
SCD1	0.730	0.792	
SCD2	0.638	0.749	
SCD3	0.650	0.761	
SCD4	0.585	0.702	
SCD5	0.632	0.681	
SCD6	0.290	0.036	
Source(s): Primary Data, 2024			

0.40 is considered, while one indicator SCD6 with a factor loading less than 0.40 was removed from the factor.

The test results in Table 4 indicate that the factors reduced to 4, shows that the Implementation of the circular economy shows 36% of the variation, Reverse logistics practice shows 12% of the variation and Technology and information systems show 8% of the variation and supply chain design show 7% of the variation in the factors.

The test results in Table 5 factor analysis has resulted in two factors, the first factor is named productivity and the second factor is named sustainability, the factors are extracted in principal component analysis and varimax rotation has been used. From the Factor analysis, all indicators with loading more than 0.40 is considered.

The test results in Table 6 factors reduced to 2, shows that the Productivity standalone brings a variation of 38% and the sustainability factor shows 27% variation in the performance metrics.

Table 4. Total variance of the factor analysis

S. No	Factors	Eigenvalue	% variance explained	Cumulative %
1	Implementation of circular economy	3.597	36.634	36.634
2	Reverse logistics practice	2.676	12.741	49.374
3	Technology and information systems	1.716	8.174	57.548
4	supply chain design	1.490	7.093	64.642

Source(s): Primary Data, 2024

Table 5. Performance metrics

Indicators	Communalities	Factor loadings – rotated component matrix	
PRO1	0.619	0.785	
PRO2	0.790	0.885	
PRO3	0.759	0.867	
PRO4	0.591	0.768	
PRO5	0.727	0.843	
SUS1	0.727		0.846
SUS2	0.662		0.814
SUS3	0.534		0.719
SUS4	0.666		0.810
SUS5	0.578		0.690

Source(s): Primary Data, 2024

Table 6. Total variance explained by performance metric factor

S. No	Factors	Eigenvalue	% variance explained	Cumulative %
1	Productivity	3.821	38.208	38.208
2	Sustainability	2.732	27.321	65.530

Source(s): Primary Data, 2024

The test results in [Table 7](#) show that each construct is measured with the variables, and the reliability and normality of the data are measured with the Skewness, kurtosis and Cronbach's alpha and composite reliability. The data is found to be normally distributed, and the multi-collinearity issue is also not found, and the loadings of the factors are also above 0.70, and hence all the indicators are considered for the SEM analysis, the Cronbach's alpha value is also more than 0.70 indicating that the data are reliable.

The test results in [Table 8](#) HTMT ratio measure the discriminant validity, as the values are less than the threshold limit of 0.85, the discriminant validity of the constructs has been established.

The test results in [Table 9](#) model's fit indices show a statistically significant result, with a P value below the recommended threshold of 0.05. The Chi-square value to degrees of freedom ratio is 2.634, indicating an acceptable fit. The CFI value is above the recommended threshold of 0.90 and the IFI value falls within the range of 0 to 1.0. The TLI value is above the recommended threshold of 0.90 and the RMSEA value is below the recommended threshold.

Table 7. Reliability and validity of constructs

Constructs	Item	Skewness	Kurtosis	Loading	VIF	CA	CR	AVE
Implementation of circular economy	ICE1	0.614	−0.46	0.775	1.406	0.896	0.789	0.745
	ICE2	0.706	0.861	0.879	1.184			
	ICE3	0.797	0.447	0.942	1.732			
	ICE4	0.558	0.229	0.867	1.773			
	ICE5	0.579	0.558	0.751	1.517			
Reverse logistics practices	RLP1	0.771	0.854	0.755	1.218	0.769	0.856	0.732
	RLP2	0.864	0.625	0.931	1.296			
	RLP3	0.669	−0.551	0.809	1.932			
	RLP4	0.572	0.336	0.973	2.014			
	RLP5	0.645	0.572	0.772	1.628			
Technology and information systems	TIS1	0.736	−0.803	0.881	1.403	0.865	0.734	0.821
	TIS2	0.805	0.663	0.829	1.519			
	TIS3	0.593	0.864	0.705	1.936			
	TIS4	0.841	0.833	0.883	1.441			
	TIS5	0.634	0.569	0.942	1.854			
Supply chain design	SCD1	0.845	0.861	0.848	1.533	0.763	0.729	0.867
	SCD2	0.714	0.792	0.778	1.934			
	SCD3	0.691	0.447	0.879	2.103			
	SCD4	0.522	0.258	0.781	2.139			
	SCD5	0.669	0.522	0.831	1.628			
Productivity	PRO1	0.853	0.319	0.75	1.609	0.854	0.865	0.698
	PRO2	0.603	0.099	0.713	1.843			
	PRO3	0.794	0.663	0.886	1.895			
	PRO4	0.807	0.469	0.849	1.362			
	PRO5	0.854	0.643	0.775	1.817			
Sustainability	SUS1	0.703	0.538	0.664	1.628	0.765	0.734	0.687
	SUS2	0.772	0.614	0.728	1.845			
	SUS3	0.836	0.539	0.883	1.406			
	SUS4	0.755	0.534	0.771	1.239			
	SUS5	0.614	−0.46	0.775	1.406			

Source(s): Primary Data, 2024

Table 8. HTMT ratio

	Sustainability	Productivity	SCD	TIS	RLP	ICE
Sustainability						
Productivity	0.764					
SCD	0.567	0.567				
TIS	0.732	0.648	0.756			
RLP	0.645	0.572	0.567	0.691		
ICE	0.756	0.738	0.689	0.592	0.716	

Source(s): Primary Data, 2024

The test results in Table 10 examine the impact of circular economy, reverse logistics practice, technology information systems and supply chain design on productivity and sustainability. The results show positive and significant impacts on productivity, with 73.5% of the variance explained by these factors. The impact on sustainability is also positive, with 56.7% of the variance explained by these factors. The study supports and accepts hypothesis H1, H2, H3, H4, H5, H6, H7 and H8, indicating that these factors significantly contribute to the overall productivity and sustainability of the economy.

Table 9. Model fit indices

	Recommended value	Source	Model value
P value	>0.05	Bagozzi and Yi (1988)	0.000
CMIN/DF	<5	Schumacker and Lomax (2004)	2.634
CFI	Above 0.90	Hair <i>et al.</i> (2009)	0.913
IFI	0–1.0	Bentler (1990)	0.924
TLI	Above 0.90	Bentler (1990)	0.956
RMSEA	<0.08	Hu and Bentler (1998)	0.781
SRMR	<0.05	Hu and Bentler (1998)	0.068

Source(s): Primary Data, 2024

Table 10. Hypothesis pathway analysis

	Hypothesis	P Value	
H1	Implementation of circular economy → productivity	***	Significant
H2	Reverse logistics practice → productivity	***	Significant
H3	Technology information systems → productivity	***	Significant
H4	Supply chain design → productivity	***	Significant
H5	Implementation of circular economy → sustainability	***	Significant
H6	Reverse Logistics Practice → sustainability	***	Significant
H7	Technology information systems → sustainability	***	Significant
H8	Supply chain design → sustainability	***	Significant

Note(s): ***- Significant at 1% Level of Significance

Source(s): Primary Data, 2024

Figure 1 depicts that Reverse logistics practices involve planning and controlling the efficient return of consumable products, by-products, waste materials and used products for safe and environmentally friendly disposal. Information technology (IT) is crucial in enabling a circular economy, tracking products throughout their life cycle, optimizing resource use and designing products for easy disassembly and remanufacture. Supply chain design helps businesses maintain product and material use, enhancing productivity and sustainability.

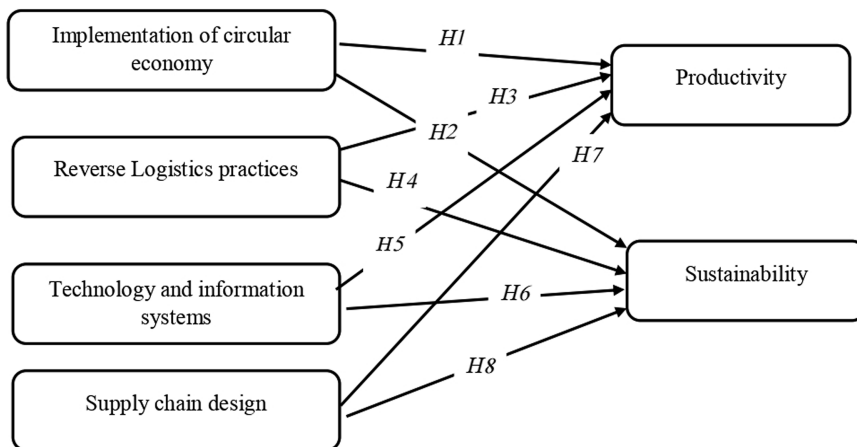
**Figure 1.** Conceptual model. Source: Authors' own construct from the literature review, 2024

Figure 2 is a Structural Equation Model (SEM) used in supply chain management research to illustrate the complex relationships between factors like circular economy principles, reverse logistics practices, technology and supply chain design, highlighting the inherent uncertainty in real-world scenarios.

4.2 Discussions

The study analyzed the impact of circular economy principles, reverse logistics practices, technology information systems and supply chain design on productivity and sustainability.

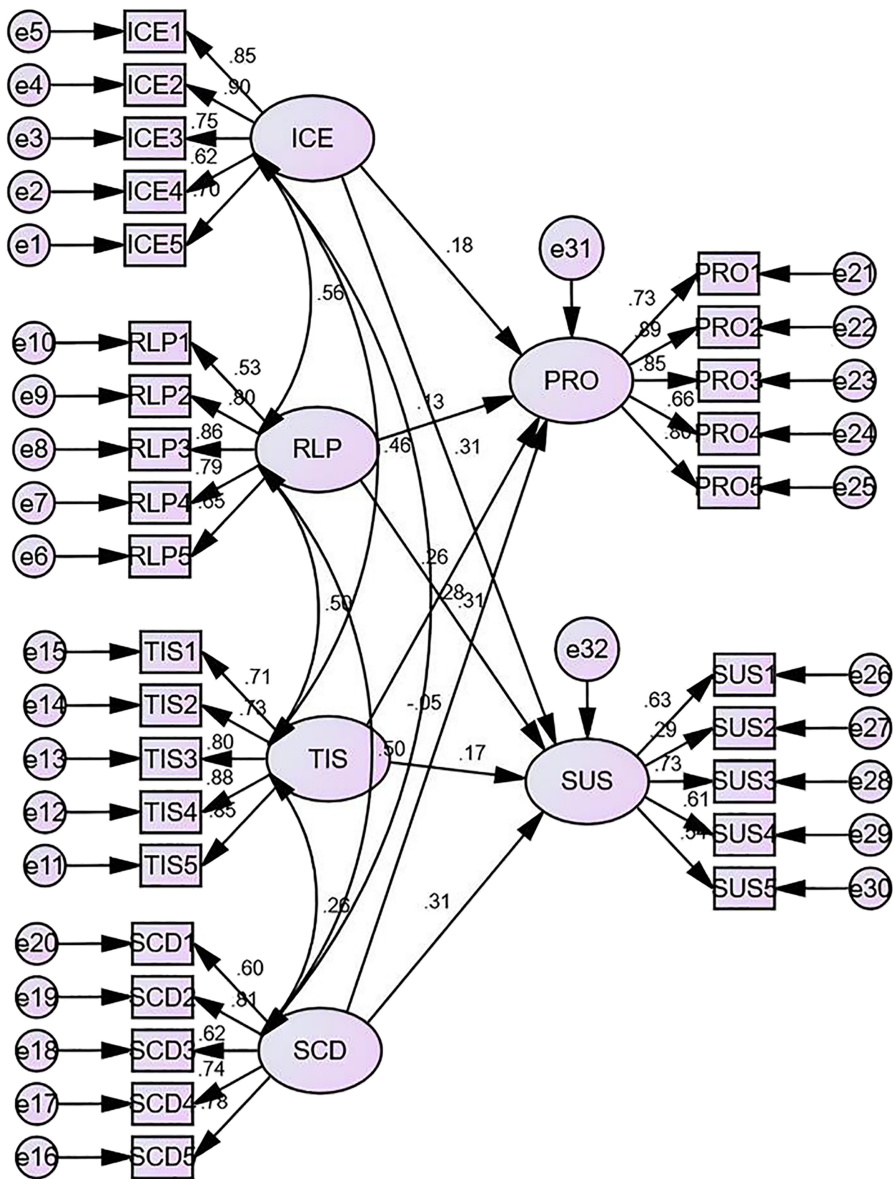


Figure 2. SEM diagram of the constructive variables. Source: Authors' own construct based on data validation, 2024

Factor analysis revealed that these factors accounted for 36% of the variation in performance metrics, while “productivity standalone” contributed 38% and “sustainability” accounted for 27%. The data was found to be normally distributed and had a Cronbach’s alpha value above 0.70. The model’s fit indices were statistically significant, with a P value below 0.05. The results showed positive and significant impacts on productivity, explaining 73.5% of the variance and sustainability, explaining 56.7% of the variance. To enhance sustainability, e-commerce businesses should adopt comprehensive strategies aligned with circular economy principles, including consumer education, optimizing reverse logistics systems, investing in technology and collaborating across the supply chain.

E-commerce businesses should adopt comprehensive sustainability strategies, integrating the five R’s model to align with circular economy principles. This involves promoting consumer education and participation, optimizing reverse logistics systems, investing in advanced technologies, collaborating across the supply chain and continuously monitoring and evaluating sustainability initiatives. Expanding research on circular economy practices, benchmarking against industry best practices and establishing partnerships with external organizations can further enhance sustainable initiatives. Addressing challenges in consumer behavior through marketing campaigns, loyalty programs and incentives can influence positive attitudes and actions. Educating internal stakeholders, including employees and management and regularly updating sustainability policies based on industry standards and consumer expectations can foster a shared commitment to environmentally responsible practices. By implementing these recommendations, e-commerce businesses can enhance their environmental impact and contribute to the broader goals of a circular economy.

4.3 Theoretical implications

The true saying of this study aims to enhance the five R’s model for e-commerce reverse logistics, contribute to the understanding of circular economy principles in e-commerce, and provide insights into sustainable competitive advantage. It will also explore how integrating circular practices into reverse logistics can lead to cost reduction, brand differentiation and improved customer loyalty. The study will also contribute to business model innovation in e-commerce, focusing on sustainability-driven technologies and practices. It will also offer insights into supply chain optimization and resource management, contributing to sustainable supply chain management theories. The proposed strategic sustainability framework will help e-commerce businesses stay ahead of sustainability trends and build resilience.

4.4 Practical implications

This study emphasizes the importance of reverse logistics and circular economy practices in enhancing sustainability and operational efficiency in the e-commerce and supply chain sectors. It suggests that businesses should integrate the five R’s model into reverse logistics, which can lead to cost savings, better inventory control and additional revenue streams. Technology-driven solutions like AI and blockchain can streamline reverse logistics processes, enhance tracking and improve transparency. Investing in digital technologies like AI-driven automation, IoT and blockchain can optimize returns and minimize environmental impact. Compliance with evolving regulations and standards is crucial for businesses to meet environmental standards. Consumer awareness and sustainable branding can enhance brand reputation and customer loyalty. Policymakers can use this information to develop initiatives promoting circular economy adoption. Future-proofing business operations is essential for companies to remain competitive.

5. Conclusion

A study highlights the importance of reverse logistics and circular economy integration in e-commerce and supply chain management. It found that many businesses, especially those

over ten years old, lack these practices. The study also found a significant relationship between business age, location and reverse logistics adoption, highlighting the need for targeted strategies. Factor analysis identified four key components: circular economy implementation, reverse logistics practices, technology and information systems and supply chain design. Information technology plays a crucial role in enabling circular economy practices, optimizing resource utilization, enhancing traceability and facilitating sustainable supply chain design. The study suggests that businesses adopting sustainable supply chain practices can gain a competitive advantage through cost savings and stronger consumer loyalty.

5.1 Limitations and scope for future research

The study on reverse logistics and sustainability in e-commerce is limited by its specific context, cross-sectional nature, self-reported data and potential response preferences. Future research should consider a comprehensive range of variables, adopt a longitudinal approach, analyze consumer behavior, optimize reverse logistics processes and expand circular economy practices.

References

- Agrawal, S., Singh, R. K., & Murtaza, Q. (2016). Triple bottom line performance evaluation of reverse logistics. *Competitiveness Review*, 26(3), 289–310. doi: [10.1108/cr-04-2015-0029](https://doi.org/10.1108/cr-04-2015-0029).
- Ali, A. H., Zalavadia, S., Barakat, M. R., & Eid, A. (2018). The role of sustainability in reverse logistics for returns and recycling. *Archives of Business Research*, 6(7), 164–174. doi:[10.14738/abr.67.4893](https://doi.org/10.14738/abr.67.4893).
- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–94. doi:[10.1007/BF02723327](https://doi.org/10.1007/BF02723327).
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107(2), 238–246. doi:[10.1037/0033-2909.107.2.238](https://doi.org/10.1037/0033-2909.107.2.238).
- Bragin, L. A., Panasenko, S. V., Nikishin, A. F., Pankina, T. Y. V., & Aleksina, S. B. (2020). Supply chain management in delivery of goods to increase customer loyalty in electronic commerce. *International Journal of Supply Chain Management*, 9(4), 740–745.
- Burke, H., Zhang, A., & Wang, J. X. (2021). Integrating product design and supply chain management for a circular economy. *Production Planning and Control*, 34(11), 1097–1113. doi: [10.1080/09537287.2021.1983063](https://doi.org/10.1080/09537287.2021.1983063).
- Carrara, P., Morandi, W., & Tandoi, E. (2021). Building a green development roadmap using 5Rs and TRIZ. *Acta Technica Napocensis-Series: Applied Mathematics, Mechanics, and Engineering*, 64 (3), 375–380.
- Cayzer, S., Griffiths, P., & Beghetto, V. (2017). Design of indicators for measuring product performance in the circular economy. *International Journal of Sustainable Engineering*, 10(4-5), 289–298. doi: [10.1080/19397038.2017.1333543](https://doi.org/10.1080/19397038.2017.1333543).
- Centobelli, P., Cerchione, R., Esposito, E., Passaro, R., & Shashi (2021). Determinants of the transition towards circular economy in SMEs: A sustainable supply chain management perspective. *International Journal of Production Economics*, 242, 108297. doi: [10.1016/j.ijpe.2021.108297](https://doi.org/10.1016/j.ijpe.2021.108297).
- Chesley, N., & Johnson, B. E. (2015). Technology use and the new economy: Work extension, network connectivity, and employee distress and productivity. In *Work and Family in the New Economy* (Vol. 26, pp. 61–99). Emerald Group Publishing. doi: [10.1108/S0277-283320150000026003](https://doi.org/10.1108/S0277-283320150000026003).
- Das, D., Kumar, R., & Rajak, M. (2020). Designing a reverse logistics network for an e-commerce firm: A case study. *Operations and Supply Chain Management: An International Journal*, 13(1), 48–63. doi: [10.31387/oscm0400252](https://doi.org/10.31387/oscm0400252).
- De Angelis, R., Howard, M., & Miemczyk, J. (2018). Supply chain management and the circular economy: Towards the circular supply chain. *Production Planning and Control*, 29(6), 425–437. doi: [10.1080/09537287.2018.1449244](https://doi.org/10.1080/09537287.2018.1449244).

- Dutta, P., Mishra, A., Khandelwal, S., & Katthawala, I. (2020). A multiobjective optimization model for sustainable reverse logistics in the Indian e-commerce market. *Journal of Cleaner Production*, 249, 119348. doi: [10.1016/j.jclepro.2019.119348](https://doi.org/10.1016/j.jclepro.2019.119348).
- Fatimah, Y. A., Kannan, D., Govindan, K., & Hasibuan, Z. A. (2023). Circular economy e-business model portfolio development for e-business applications: Impacts on ESG and sustainability performance. *Journal of Cleaner Production*, 415, 137528. doi: [10.1016/j.jclepro.2023.137528](https://doi.org/10.1016/j.jclepro.2023.137528).
- Febransyah, A., & Camelia Goni, J. I. (2022). Measuring the supply chain competitiveness of the e-commerce industry in Indonesia. *Competitiveness Review*, 32(2), 250–275. doi: [10.1108/CR-05-2020-0059](https://doi.org/10.1108/CR-05-2020-0059).
- Fernando, Y., Tseng, M. L., Aziz, N., Ikhsan, R. B., & Wahyuni-TD, I. S. (2022). Waste-to-energy supply chain management on circular economy capability: An empirical study. *Sustainable Production and Consumption*, 31, 26–38. doi: [10.1016/j.spc.2022.01.032](https://doi.org/10.1016/j.spc.2022.01.032).
- Fu, Q., Rahman, A. A. A., Jiang, H., Abbas, J., & Comite, U. (2022). Sustainable supply chain and business performance: The impact of strategy, network design, information systems, and organizational structure. *Sustainability*, 14(3), 1080. doi: [10.3390/su14031080](https://doi.org/10.3390/su14031080).
- Habli, K., Dumitras, D. E., Schmitt, E., Maglietti Smith, I., & Barjolle, D. (2023). Circular economy in mountain value chains: The case of three PDO cheeses. *Foods*, 12(21), 3954. doi: [10.3390/foods12213954](https://doi.org/10.3390/foods12213954).
- Haigh, N., & Griffiths, A. (2008). The environmental sustainability of information systems: Considering the impact of operational strategies and practices. *International Journal of Technology Management*, 43(1-3), 48–63. doi: [10.1504/ijtm.2008.019406](https://doi.org/10.1504/ijtm.2008.019406).
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* (7th ed.). Pearson Prentice Hall.
- Hajli, M., Sims, J. M., & Ibragimov, V. (2015). Information technology (IT) productivity paradox in the 21st century. *International Journal of Productivity and Performance Management*, 64(4), 457–478. doi: [10.1108/IJPPM-12-2012-0129](https://doi.org/10.1108/IJPPM-12-2012-0129).
- Hapuwatte, B. M., Seevers, K. D., & Jawahir, I. S. (2022). Metrics-based dynamic product sustainability performance evaluation for advancing the circular economy. *Journal of Manufacturing Systems*, 64, 275–287. doi: [10.1016/j.jmsy.2022.06.013](https://doi.org/10.1016/j.jmsy.2022.06.013).
- Harris, S., Martin, M., & Diener, D. (2021). Circularity for circularity's sake? Scoping review of assessment methods for environmental performance in the circular economy. *Sustainable Production and Consumption*, 26, 172–186. doi: [10.1016/j.spc.2020.09.018](https://doi.org/10.1016/j.spc.2020.09.018).
- Hazen, B. T., Russo, I., Confente, I., & Pellathy, D. (2021). Supply chain management for circular economy: Conceptual framework and research agenda. *International Journal of Logistics Management*, 32(2), 510–537. doi: [10.1108/IJLM-12-2019-0332](https://doi.org/10.1108/IJLM-12-2019-0332).
- Herzallah, A. T. F., & Mukhtar, M. (2015). Organization information ecology and e-commerce adoption: Effect on organizational SMEs performance. *Journal of Computer Science*, 11(3), 540–551. doi: [10.3844/jcssp.2015.540.551](https://doi.org/10.3844/jcssp.2015.540.551).
- Ho, Y. -H., & Lin, C. -Y. (2024). Circular economy implementation and sustainability performance of the textile industry in an emerging economy. *International Journal of Clothing Science and Technology*, 36(5), 887–906. doi: [10.1108/IJCT-02-2024-0048](https://doi.org/10.1108/IJCT-02-2024-0048).
- Hu, L. T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, 3(4), 424–453. doi: [10.1037/1082-989X.3.4.424](https://doi.org/10.1037/1082-989X.3.4.424).
- Hussain, M., & Malik, M. (2020). Organizational enablers for circular economy in the context of sustainable supply chain management. *Journal of Cleaner Production*, 256, 120375. doi: [10.1016/j.jclepro.2020.120375](https://doi.org/10.1016/j.jclepro.2020.120375).
- Kalubanga, M., & Mbekeka, W. (2023). Compliance with government and firm's own policy, reverse logistics practices and firm environmental performance. *International Journal of Productivity and Performance Management*, 73(5), 1427–1478. doi: [10.1108/IJPPM-09-2022-0463](https://doi.org/10.1108/IJPPM-09-2022-0463).

- Kazancoglu, Y., Kazancoglu, I., & Sagnak, M. (2018). A new holistic conceptual framework for green supply chain management performance assessment based on circular economy. *Journal of Cleaner Production*, 195, 1282–1299. doi: [10.1016/j.jclepro.2018.06.015](https://doi.org/10.1016/j.jclepro.2018.06.015).
- Khanam, Z., & Ghosh, R. (2022). Impact of sustainable supply chain management on cost performance: Empirical evidence from manufacturing companies of Bangladesh. *Journal of Economic and Administrative Sciences*, 41(2), 570–591. doi: [10.1108/JEAS-02-2022-0050](https://doi.org/10.1108/JEAS-02-2022-0050).
- Kouhizadeh, M., Zhu, Q., & Sarkis, J. (2024). Circular economy performance evaluation with blockchain technology. In *Environmentally Responsible Supply Chains in an Era of Digital Transformation* (pp. 58–78). Edward Elgar Publishing.
- Kurniawan, T. A., Othman, M. H. D., Liang, X., Goh, H. H., Gikas, P., Kusworo, T. D., & Chew, K. W. (2023). Decarbonization in waste recycling industry using digitalization to promote net-zero emissions and its implications on sustainability. *Journal of Environmental Management*, 338, 117765. doi: [10.1016/j.jenvman.2023.117765](https://doi.org/10.1016/j.jenvman.2023.117765).
- Li, Y., Hu, Y., Li, L., Zheng, J., Yin, Y., & Fu, S. (2022). Drivers and outcomes of circular economy implementation: Evidence from China. *Industrial Management & Data Systems*, 123(4), 1178–1197. doi: [10.1108/IMDS-05-2022-0267](https://doi.org/10.1108/IMDS-05-2022-0267).
- Manavalan, E., & Jayakrishna, K. (2019). An analysis on sustainable supply chain for circular economy. *Procedia Manufacturing*, 33, 477–484. doi: [10.1016/j.promfg.2019.04.059](https://doi.org/10.1016/j.promfg.2019.04.059).
- Meherishi, L., Narayana, S. A., & Ranjani, K. S. (2019). Sustainable packaging for supply chain management in the circular economy: A review. *Journal of Cleaner Production*, 237, 117582. doi: [10.1016/j.jclepro.2019.07.057](https://doi.org/10.1016/j.jclepro.2019.07.057).
- Morgan, T. R., Tokman, M., Richey, R. G., & Defee, C. (2018). Resource commitment and sustainability: A reverse logistics performance process model. *International Journal of Physical Distribution and Logistics Management*, 48(2), 164–182. doi: [10.1108/IJPDLM-02-2017-0068](https://doi.org/10.1108/IJPDLM-02-2017-0068).
- Mukherjee, S., Nagariya, R., Mathiyazhagan, K., Baral, M. M., Pavithra, M. R., & Appolloni, A. (2024). Artificial intelligence-based reverse logistics for improving circular economy performance: A developing country perspective. *The International Journal of Logistics Management*, 35(6), 1779–1806. doi: [10.1108/IJLM-03-2023-0102](https://doi.org/10.1108/IJLM-03-2023-0102).
- Mukhopadhyay, S. K., & Setoputro, R. (2004). Reverse logistics in e-business: Optimal price and return policy. *International Journal of Physical Distribution and Logistics Management*, 34(1), 70–89. doi: [10.1108/09600030410515691](https://doi.org/10.1108/09600030410515691).
- Nanayakkara, P. R., Jayalath, M. M., Thibbotuwawa, A., & Perera, H. N. (2022). A circular reverse logistics framework for handling e-commerce returns. *Cleaner Logistics and Supply Chain*, 5, 100080. doi: [10.1016/j.clscn.2022.100080](https://doi.org/10.1016/j.clscn.2022.100080).
- Nel, J. D., & Badenhorst, A. (2020). A conceptual framework for reverse logistics challenges in e-commerce. *International Journal of Business Performance Management*, 21(1-2), 114–131. doi: [10.1504/ijbpm.2020.106119](https://doi.org/10.1504/ijbpm.2020.106119).
- Nguyen, T. (2023). Implementing reverse logistics at return management in the fast fashion industry in the Vietnamese market. URN.fi. Available from: <https://urn.fi/URN:NBN:fi:amk-2023121135802>
- Nika, C.-E., Expósito, A., Kisser, J., Bertino, G., Oral, H. V., Dehghanian, K., ... Katsou, E. (2021). Validating circular performance indicators: The interface between circular economy and stakeholders. *Water*, 13(16), 2198. doi: [10.3390/w13162198](https://doi.org/10.3390/w13162198).
- Parchomenko, A., Nelen, D., Gillabel, J., & Rechberger, H. (2019). Measuring the circular economy—a multiple correspondence analysis of 63 metrics. *Journal of Cleaner Production*, 210, 200–216. doi: [10.1016/j.jclepro.2018.10.357](https://doi.org/10.1016/j.jclepro.2018.10.357).
- Prajapati, D., Pratap, S., Zhang, M., & Huang, G. Q. (2022). Sustainable forward-reverse logistics for multi-product delivery and pickup in B2C e-commerce towards the circular economy. *International Journal of Production Economics*, 253, 108606. doi: [10.1016/j.ijpe.2022.108606](https://doi.org/10.1016/j.ijpe.2022.108606).
- Razzak, M. R. (2022). Mediating effect of productivity between sustainable supply chain management practices and competitive advantage: Evidence from apparel manufacturing in Bangladesh. *Management of Environmental Quality: An International Journal*, 34(2), 428–445. doi: [10.1108/MEQ-01-2022-0022](https://doi.org/10.1108/MEQ-01-2022-0022).

- Richnák, P., & Gubová, K. (2021). Green and reverse logistics in conditions of sustainable development in enterprises in Slovakia. *Sustainability*, 13(2), 581. doi: [10.3390/su13020581](https://doi.org/10.3390/su13020581).
- Rincón-Moreno, J., Ormazábal, M., Álvarez, M. J., & Jaca, C. (2021). Advancing circular economy performance indicators and their application in Spanish companies. *Journal of Cleaner Production*, 279, 123605. doi: [10.1016/j.jclepro.2020.123605](https://doi.org/10.1016/j.jclepro.2020.123605).
- Saidani, M., Yannou, B., Leroy, Y., & Cluzel, F. (2017). How to assess product performance in the circular economy? Proposed requirements for the design of a circularity measurement framework. *Recycling*, 2(1), 6. doi: [10.3390/recycling2010006](https://doi.org/10.3390/recycling2010006).
- Sarkar, B., Debnath, A., Chiu, A. S., & Ahmed, W. (2022). Circular economy-driven two-stage supply chain management for nullifying waste. *Journal of Cleaner Production*, 339, 130513. doi: [10.1016/j.jclepro.2022.130513](https://doi.org/10.1016/j.jclepro.2022.130513).
- Sarrafzadeh, M. H. (2022). Circular economy in petroleum industries: Implementing water closed loop system. In *Petroleum Industry Wastewater* (pp. 249–262). Elsevier.
- Saruchera, F., & Asante-Darko, D. (2021). Reverse logistics, organizational culture, and firm operational performance: Some empirical evidence. *Business Strategy and Development*, 4(3), 326–342. doi: [10.1002/bsd2.161](https://doi.org/10.1002/bsd2.161).
- Sassanelli, C., & Terzi, S. (2023). Circular economy and sustainable business performance management. *Sustainability*, 15(11), 8619. doi: [10.3390/su15118619](https://doi.org/10.3390/su15118619).
- Schumacker, R. E., & Lomax, R. G. (2004). *A beginner's guide to structural equation modeling* (2nd ed.). Lawrence Erlbaum Associates.
- Sharma, Y. K., Mangla, S. K., Patil, P. P., & Liu, S. (2019). When challenges impede the process: Circular economy-driven sustainability practices in food supply chain. *Management Decision*, 57(4), 995–1017. doi: [10.1108/MD-09-2018-1056](https://doi.org/10.1108/MD-09-2018-1056).
- Taghikhah, F., Voinov, A., & Shukla, N. (2019). Extending the supply chain to address sustainability. *Journal of Cleaner Production*, 229, 652–666. doi: [10.1016/j.jclepro.2019.05.051](https://doi.org/10.1016/j.jclepro.2019.05.051).
- Tam, C., Loureiro, A., & Oliveira, T. (2020). The individual performance outcome behind e-commerce: Integrating information systems success and overall trust. *Internet Research*, 30(2), 439–462. doi: [10.1108/INTR-06-2018-0262](https://doi.org/10.1108/INTR-06-2018-0262).
- Tetteh, F. K., Atiki, G., Kyeremeh, A., Degbe, F. D., & Apanye, P. (2024). Linking business analytics capability and sustainability performance: The mediating role of circular economy implementation. *Modern Supply Chain Research and Applications*, 6(3), 226–246. doi: [10.1108/MS CRA-12-2023-0049](https://doi.org/10.1108/MS CRA-12-2023-0049).
- Thibbotuwawa, A., Nanayakkara, P. R., Fernando, W. M., Jayalath, M. M., Perera, H. N., & Nielsen, P. (2023). A reverse logistics network model for handling e-commerce returns. *IFAC-PapersOnLine*, 56(2), 138–143. doi: [10.1016/j.ifacol.2023.10.1559](https://doi.org/10.1016/j.ifacol.2023.10.1559).
- Timofti, M., & Pienaru, A. M. (2022). The current state of water in the circular economy in Romania. *Scientific Papers. Series E. Land Reclamation, Earth Observation and Surveying, Environmental Engineering*, 11.
- Varsei, M., Soosay, C., Fahimnia, B., & Sarkis, J. (2014). Framing sustainability performance of supply chains with multidimensional indicators. *Supply Chain Management: An International Journal*, 19(3), 242–257. doi: [10.1108/SCM-12-2013-0436](https://doi.org/10.1108/SCM-12-2013-0436).
- Voukkali, I., Papamichael, I., Loizia, P., Rodríguez-Espinosa, T., Navarro-Pedreño, J., & Zorpas, A. A., Others (2023). Waste metrics in the framework of circular economy. *Waste Management and Research*, 41(12), 1741–1753. doi: [10.1177/0734242X231190794](https://doi.org/10.1177/0734242X231190794).
- Wang, C.-N., Dang, T.-T., & Nguyen, N.-A.-T. (2021). Outsourcing reverse logistics for e-commerce retailers: A two-stage fuzzy optimization approach. *Axioms*, 10(1), 34. doi: [10.3390/axioms10010034](https://doi.org/10.3390/axioms10010034).
- Waqas, M., Honggang, X., Khan, S. A. R., Ahmad, N., Ullah, Z., & Iqbal, M. (2021). Impact of reverse logistics barriers on sustainable firm performance via reverse logistics practices. *LogForum*, 17(2), 213–230. doi: [10.17270/j.log.2021.583](https://doi.org/10.17270/j.log.2021.583).
- Ziembra, E. (2018). The contribution of ICT adoption to sustainability: Households' perspective. *Information Technology and People*, 32(3), 731–753. doi: [10.1108/ITP-02-2018-0090](https://doi.org/10.1108/ITP-02-2018-0090).

Further reading

- Kravchenko, M., McAloone, T. C., & Pigosso, D. C. (2020). To what extent do circular economy indicators capture sustainability?. *Procedia CIRP*, 90, 31–36. doi: [10.1016/j.procir.2020.02.118](https://doi.org/10.1016/j.procir.2020.02.118).
- Younis, H. (2019). Why does quality matter? The impact of green supply chain management practices on corporate performance. In *Embedding Culture and Quality for High-Performing Organizations* (pp. 123–157). Productivity Press.

Corresponding author

R. Naveen Kumar can be contacted at: naveen.austin@gmail.com