10 Reverse Logistics and Circular Economy Practices in E-Commerce Startups: Challenges, Opportunities, and Strategic Implications for Sustainable Growth

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Abstract

Global e-commerce has dramatically transformed retail over the past few years, but it has brought along a number of environmental and social challenges, not least in the area of product returns and waste. In this study, the authors explore the possibility of combining RL and CE practices into the ecosystem of e-commerce startups, where managing resources is difficult, while being operationally agile is necessary. The research uses the systematic literature review (SLR) methodology to explore and analyze the latest academic research and industry practices over the period of 2019-2025. According to key findings, the return rates of e-commerce startups are relatively high; as high as 30% in some cases, and that can cause a significant loss of profits if the return process is not handled in a sustainable way. The research shows that Industry 4.0 technologies such as Artificial Intelligence (AI), Blockchain and the Internet of Things (IoT) play a key role in optimizing reverse logistics networks and enable product refurbishment and recycling. The practical implications for start-up founders are related to the implementation of circular business models, including second-hand resale and product-as-a-service, as ways of sustaining the growth and build customer loyalty. This study is original in its multi-dimensional approach toward sustainability focusing on the startup context and pointing to strategic pathways for making the transition from linear to closed-loop supply chains.

Keywords: Reverse Logistics, Circular Economy, E-Commerce Startups, Sustainable Supply Chain, Product Returns, Ecommerce, Technology Adoption.

Introduction

E-commerce has revolutionized the retail landscape with its unparalleled convenience and choice. Sectors such as apparel (with returns frequently exceeding 50%) and electronics are particularly high-cost, environmentally, due to the high rates.High return rates, such as apparel (and often 50% and higher in that sector)

and electronics, are extremely high-cost from an environmental and financial perspective(Parvizi et al., 2025). Return logistics is therefore very important, as it is the process of moving products back through the supply chain to the consumers. Reverse logistics (RL) has been defined as the “process of planning, implementing and controlling the efficient and cost-effective flow of raw materials, in-process inventory, finished goods and related information from point of consumption to point of origin in order to recover value or properly dispose of the goods” (Pellicer et al., 2025). RL in practice encompasses product return handling, remanufacturing, recycling and remarketing.

At the same time, the circular economy (CE) paradigm, which is based on the principles of reduce, reuse, and recycle, is changing the way in which the supply chain operates(Howard et al., 2018). The CE approach is different from the traditional ‘take-make-dispose' model, it closes material cycles. It is based on key principles like resource efficiency, reduction of waste and extension of the product life (reuse, repair, remanufacturing)(Russell & Nasr, 2022). McKinsey & Company define CE as “Reliance and reuse of natural capital in the most efficient manner, and deriving value during the entire lifecycle of products and services”. The benefits of adopting CE strategies can be great, such as EU researchers' calculations of up to 50% reduction in greenhouse-gas emissions in the manufacturing sector, and hundreds of billions of dollars in cost savings(Yang et al., 2022). Companies in the e-commerce sector are especially well placed to make a step for the circular economy as they are responsible for handling product returns properly and have the opportunity to develop secondary markets to resell or recycle products(Candela et al., 2020).

Although the literature is emerging on the field of sustainable logistics, the specific issues and effectiveness of CE networks in the e-commerce start-up context are still not well researched. The majority of current research is on established giants such as Amazon or Alibaba, and there are gaps in the knowledge around how the smaller, resource-poor businesses can effectively implement closed-loop systems.

Research Objectives

- To understand the key practices of reverse logistics and circular economy that are being implemented by the e-commerce startups.
- To understand and examine the operational, financial and technological barriers that are blocking the path of CE adoption in the start-up ecosystem.
- To determine how Industry 4.0 technologies can be used to optimize reverse logistics to support sustainable growth.
- To provide strategic insight and implications to the founders, policy makers and investors to build a more resilient e-commerce environment.

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Literature Review

- **Reverse Logistics Concepts and Evolution**

Reverse Logistics (RL) has grown from being an operational function to an integral component of sustainable supply chains. RL was originally about the processing of returns, and now includes returns, repairs, refurbishment, recycling and disposal(Adesoga et al., 2024). Product returns are becoming a major concern in the supply chain management of an e-commerce company because of its exponential rise due to the growth of e-commerce(Nel & Badenhorst, 2020; Karl, 2024). Recent research focuses on value recovery, waste reduction and incorporating reverse flows into closed loop supply chain systems for better sustainability and operational efficiency(Akram, 2026).

- **Circular Economy Theories and Principles**

The Circular Economy (CE) is the sustainable use of resources based on the fundamental principles of reduce, reuse and recycle(Jawahir & Bradley, 2016). It promotes innovative business models like leasing, sharing and product-as-a-service that reduce the number of resources taken from the earth and waste produced(Langley, 2022). In eCommerce start-ups, CE practices involve the design of products for reusability, refurbishment of returned products and the setting up of end-of-life product recovery system(Ghosh et al., 2023). These efforts contribute to environmental sustainability, benefit the economy, and prolong the product life.

- **Sustainable Supply Chain Management**

Reverse logistics and circular economy practices are closely related with Sustainable Supply Chain Management (SSCM). Through SSCM, environmental and social issues are incorporated into the processes and activities in a supply chain, with the aim of meeting long-term sustainability objectives(Carter & Easton, 2011). The main topics are eco-design, circular supply network and the measuring of sustainability performance. Although a lot of work has been done on large organizations, little has been done on startups and this is where the knowledge is needed about how new ecommerce companies embrace and implement sustainable activities in the supply chain.

- **Product Return Management in E-Commerce**

Product return management is a crucial aspect of reverse logistics in e-commerce. It includes a set of processes for effectively handling customer returns: collection, transportation, inspection and disposition(De Araújo et al., 2017). Good return management minimizes waste, manages costs and provides for greater customer satisfaction. For eCommerce companies, sustainability is becoming a key element of their operations, with more and more companies taking steps to optimise their supply chains with eco-friendly transport and return policies, as well as

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automated tracking systems (Nagy & Szentesi, 2024). The right return policies can help incentivize exchanges, repair or recycling and minimize the negative environmental footprint of product returns.

- **Resource Recovery and Circular Practices**

Resource recovery is concerned with recovering more value from returned products or product used. Refurbishment, remanufacturing, recycling and re-commerce via re-commerce platforms are some common activities(Levchenko, 2025). Returned products are usually refurbished and resold, or even materials are retrieved from damaged items or recycled along with partners(Frei et al., 2025). The practices address the reduction of waste generation, extension of product life and support circular supply chains. Resource recovery offers businesses the opportunity to achieve a number of benefits, including the environmental benefit, and the ability to generate extra income(Zaman, 2016).

- **Technology-Enabled Reverse Logistics**

The reverse logistics operations are undergoing a transformation due to advanced technologies. The Artificial Intelligence (AI) and Machine Learning enhance the return forecasting and automate product inspection, optimising the sorting process(Schlüter et al., 2021). With Internet of Things (IoT) devices, products can be tracked in real time during the entire reverse supply chain and their condition can be monitored(Fang et al., 2015). By offering secure and transparent records of the history and movement of products, blockchain technology helps to increase transparency and traceability. Combined these technologies can enhance efficiency, boost resource recovery and help achieve circular economy goals in e-commerce companies(Carlos et al., 2024).

Methodology

The method used in the current study was Systematic Literature Review (SLR) to analyze the issues of reverse logistics and circular economy practices in E-commerce startups. Structured search of major academic database (Scopus, Web of Science and Google Scholar) was used to identify relevant literature. The following words were utilized: reverse logistics, circular economy, e-commerce, startups, sustainability, returns management and re-commerce. The review took into account reputable industry reports, conference papers and peer-reviewed journal articles from the years 2019 to 2025. Publication prior to 2019, non-English studies and sources that did not contain much analysis were not included. After screening according to the PRISMA guidelines, around 60 studies were located that were relevant to the title and abstract as well as the full text. The context in which the industry operates, the reverse logistics practices and the circular economy practices were gathered as were technological applications, challenges, outcomes and theoretical perspectives.

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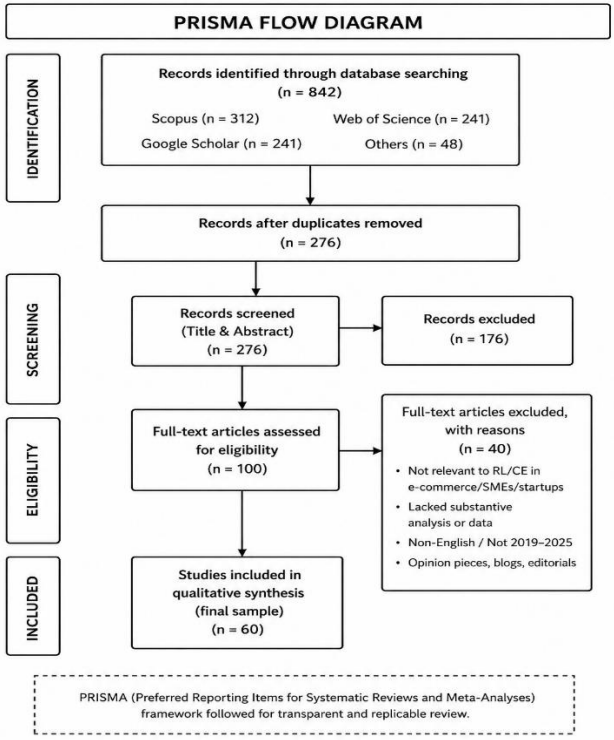
Thematic analysis was used to synthesize the findings and reveal key trends, opportunities and barriers to the operations of sustainable ecommerce.



Analysis and Findings

- **Reverse Logistics Practices in E-Commerce Startups**

The review shows that e-commerce startups are increasingly implementing reverse logistics practices to handle the product returns in a sustainable manner and recover the value from returned products. A wide range of startups have adopted AI and automation to examine, categorize and handle products efficiently as they're returned. Items that are returned and still in good condition are routinely refurbished, repaired or reconditioned for resale to help prolong product life within the manufacturing system and minimize the amount of waste. Another approach that has come to light is re-commerce, which allows startups to resell their returned or pre-owned materials in the secondary marketplace at a lower price. Also, the buy back, trade-in and warranty programs provide incentives to customers to return used products, which allows for re-use and resource recovery opportunities. To facilitate the return process, many startups will team with logistics partners, parcel lockers, and drop-off networks to enhance convenience and minimize transportation

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emissions. Others are also opting for reusable or recycled packaging for reducing waste during the product return process.

- **Circular Economy Strategies in Startups**

In addition to reverse logistics, many startups now have a new approach to the circular economy, which encourages sustainable business practices. Different strategies for the extension of product life such as repair, refurbishment and product-as-a-service options contribute to maximizing the useful life of products while minimizing resource use. Recycling and material recovery programs can extract valuable materials and minimize landfill wastes for products that are not repairable. Re-commerce and the secondary market platforms also contribute towards the circularity by extending the lifespan of the products. Furthermore, some start-ups are trying new ways to operate such as rental, subscription and sharing business models, which boost product usage and cut down on new production needs. These strategies, used together, are beginning to establish closed-loop systems in e-commerce startups, which help to make resources more efficient, less polluting and more sustainable.

Industry 4.0 Technologies in Optimizing Reverse Logistics for Sustainable Growth

Overall, the industry 4.0 technologies are playing a transformative role in the field of improving reverse logistics, which has a significant impact on making business operations more efficient, waste-free, and sustainable. Artificial Intelligence (AI), Internet of Things (IoT), Blockchain and Big Data Analytics are technologies that help to streamline and optimise the return of products and encourage circular economy practices.

With the help of AI and Big Data analytics, decisions can be taken in a predictive manner to anticipate return volumes and recognize return patterns. These technologies enable businesses to optimise their use of resources and minimise returns via customised suggestions, accurate product information, virtual fitting rooms, and dynamic pricing. This can help to reduce returns and stock losses, if that is the case.

In addition, Industry 4.0 improves the optimization of the logistics network. The use of advanced algorithms and mathematical models optimizes routes, optimizes the location of facilities, and optimizes transportation management, resulting in fuel savings, reduced carbon emissions, and substantial cost savings. Smart logistics systems and automated routing help to accelerate and facilitate return operations in a sustainable way.

Blockchain and IoT technologies contribute to making processes more transparent and traceable. With the blockchain, companies can create an immutable record of a product's lifecycle, which can be used to track products back to the owner

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for refurbishment, reuse, or recycle, and to validate sustainability claims. IoT devices enable real-time tracking of goods and stock, to enhance coordination between manufacturers, retailers and consumers. These technologies also help in effective e-waste management by increasing transparency and accessibility of the return processes.

Challenges: Operational, Technological, Financial, and Regulatory

Several interrelated challenges have been mentioned in the literature that prevent the implementation of reverse logistics and circular economy in e-commerce start-ups. On the operational side, many startups do not have a separate infrastructure, including sorting centers, repair shops and storage, and returns management is difficult to manage. The fluctuating number of returns also makes workforce and capacity planning challenging. Lack of technological capabilities is another challenge - startups may not have access to sophisticated IT systems, AI-driven inspection solutions, IoT-enabled tracking systems or integrated return management systems, as a result of limited technical expertise and high implementation costs. Another big challenge is the financial aspect, with reverse logistics activities often perceived as cost centres, not revenue sources. The handling, transport and refurbishment costs can eat into profit margins and the return volumes can be low, limiting startups to not reap economies of scale. The regulatory complexity adds to the problems already exacerbated in areas where regulations favour product take-back, recycling and Extended Producer Responsibility (EPR). This, in turn, poses a challenge to startups to keep sustainability in balance with day-to-day and financial realities.

Benefits and Performance Outcomes

However, the benefits of implementation of reverse logistics and circular economy practices are immense for e-commerce startups in spite of these challenges. Efficient reverse logistics systems allow companies to generate extra value from products by refurbishing, selling, recycling or remanufacturing their returned products, thus generating additional sources of revenue. Better return management helps to lower waste disposal expenses and optimise inventory utilisation. The fact that returns are transparent and easy for customers to make can also lead to increased satisfaction, trust in the brand, and customer loyalty. A startup is on a better footing in the market when it is practicing sustainable activities, as the green consumers who are concerned about the environment are inclined to buy products that are eco-friendly. Environmental benefits include reduction of waste in landfill, the reduction of resources use and carbon emission reduction by reusing and recycling products. These combined results lead to more efficient operations, to the long-term profitability of businesses, to an overall sustainable impact and to connecting business growth with circular economy principles.

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Emerging Trends and Innovations

Technological innovation and developments are giving forward a step towards implementing reverse logistics and circular economy in e-commerce. The use of data-driven decision making and predictive analytics is increasingly gaining traction to predict return trends, optimize inventory management and offer product design insights. There are also packaging solutions that come into use like reusable and biodegradable packaging to curb packaging waste which plays a vital role in the present scenario. Collaborative reverse fulfillment networks are also becoming popular with startups, which are working with specialized logistics companies to process returns, refurbish, and resell. In addition, a multi-channel approach, combining online channels with offline return points, lockers and retail partnerships is improving customer convenience and operational efficiency. New technologies like artificial intelligence, Internet of Things (IoT) based tracking systems, computer vision, and blockchain are helping to enhance transparency, traceability, and automation in reverse supply chains. The innovations are anticipated to be a key element in making the reverse logistics more efficient, scalable and sustainable for the future e-commerce business models.

Discussion and Implications

This review revealed that the relationship of reverse logistics (RL) and circular economy (CE) practices in the E-commerce startups is very close and extended the current theoretical knowledge. Although the main theories of traditional closed-loop supply chains are operational, organizational factors like leadership commitment, innovation capability, and consumer participation are important to achieve circular outcomes, as emphasized in this review. The study also reveals that the CE principles, such as resource recovery, product life extension, and waste minimization, are being adopted more and more through a “start-up approach” like buy-back systems, re-commerce platforms, and refurbishment systems. In addition, the review recommends using specific RL performance metrics: return rates, recovery value, and reuse percentage to assess sustainability and operational efficiency of startups.

The management point of view: The startups should make reverse logistics as part of their business model instead of just a part-time activity. The adoption of low cost digital technologies, returns management and joint logistics agreements can make a large contribution to the efficiency. Startups can also look forward to additional revenue generating options like resale, refurbishment, rental and recycling programs and to build customer loyalty with clear, sustainable returns policies. Impacts to sustainability can be quantified and communicated to further enhance brand reputation and appeal to sustainability-minded consumers and investors.

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Finally, some key policy implications are emphasized in the review. Extended Producer Responsibility (EPR) regulations, financial incentives for recycling and refurbishment practices and investments in logistics infrastructure are all ways that governments can speed up the uptake of circular practices. Standardized processes for returns, coupled with digital documentation systems, can also help in advancing sustainable e-commerce growth. Investors and practitioners will see reverse logistics as a potential value creation opportunity, as both scalable and technology-driven solutions will have an economic and environmental value for them. In general, this research adds to the theoretical knowledge by bringing both the concepts of RL and CE together in the context of a startup and gives a base for further studies on entrepreneurial approaches to create circular supply chain innovation.

Limitations of the Study

This review has a number of limitations. First, we have perhaps overlooked the most recent and recent advances in startup practice; that's because we've just looked at published work (2019-2025). There are limited industry reports and case studies that are not published in journals. Second, the SLR approach produces broad trends, but doesn't necessarily reflect the differences in sectors or geographies; the trends in the fashion and electronics industries may be different or change in emerging markets. Third, because of language and database limitations (English, Scopus/WoS focus) some relevant work (e.g. regional studies, working papers) may be excluded. Last but not least, our conceptual framework has not been empirically validated, and needs to be verified in future surveys and/or case studies of startups.

Future Research Scope

The results of this review indicate a number of research opportunities. The trend toward digital technologies should engage more attention to the potential of the use of artificial intelligence, machine learning and predictive analytics in optimizing the reverse logistics operations and improving resource recovery. There is potential for further studies on innovative circular business models, such as product leasing, subscription services and modular product designs when it comes to the ways of startups developing them. Furthermore, studies are necessary on sustainable last-mile distribution, such as electric vehicles, intelligent distribution routes and alternate delivery models to minimize environmental effects. Consumer involvement is also a key factor, and analyzing consumer factors that affect acceptance of refurbished products and recycling programs can lead to an improvement in startups' circular practices. Furthermore, an increased number of empirical studies is needed from emerging economies that examine the context specific challenges and opportunities. Lastly, establishing standardized measures of circularity and sustainability performance and value recovery would aid decision making and performance measurement.

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Conclusion

The review has shown that the reverse logistics and circular economy practices are now increasingly becoming important tools for the strategic development of e-commerce startups aiming for sustainable development. Efficient returns management, refurbishment, re-commerce, recycling and product take-back are just a few of the initiatives that startups are implementing to recover value and reduce waste. These practices not only increase environmental performance, they also generate new revenue streams and increase satisfaction of the customers. There are however multiple challenges to be addressed, such as limited infrastructure, financial problems, technological road blocks and a lack of regulatory support. It will take innovation, collaboration and the use of technology solutions to overcome these obstacles. Policymakers can also facilitate this shift by incentivizing this change, enacting policies, and creating infrastructure. In summary, the adoption of reverse logistics and circular economy principles presents a promising opportunity for e-commerce startups to thrive in the long run, boost operational efficiency, and promote sustainability, while simultaneously making a positive impact on the environment and economy.

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