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Developing a Circular Economy-Based Operational Efficiency Model for the Retail Sector: An Integrated PESTEL and Value Stream Mapping Approach

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ABSTRACT

The Indonesian retail sector's dominant linear economic model leads to high operational waste, cost inefficiency, and low competitiveness, making the transition to a circular economy (CE) a strategic urgency for resource optimization. However, academic studies on CE implementation in Indonesian retail are limited, particularly those integrating external factor analysis and systemic operational value stream mapping (VSM). This research aims to develop a model for optimizing retail operational efficiency based on CE principles by integrating the PESTEL framework and the VSM method. A qualitative approach was employed, using on-site field visits, interviews, and field observations at four retail entities across Jakarta, Bandung, Bali, and Padang. Current waste management is fragmented and linear, hindered by technological limitations, a lack of sectoral regulation, low consumer awareness, and supplier dependency. VSM analysis identified key inefficiencies, including overstock, delayed detection of expiring products, and limited reverse logistics. The proposed future-state model emphasizes digital integration, multi-actor collaboration, demand-data-driven planning, and proactive reverse logistics schemes. This model offers the potential to significantly reduce waste and carbon emissions, enhance cost efficiency, and strengthen industrial competitiveness. The research contributes an integrative PESTEL–VSM analysis framework and provides relevant implementation strategies for Indonesian industrial policy and practice.

1. INTRODUCTION

The linear economic model that still dominates the retail industry in Indonesia poses serious problems, such as high operational waste generation, waste of resources, and low-cost efficiency. This conventional production–consumption–disposal practice also has an impact on increasing carbon emissions and reducing the competitiveness of the retail sector in the long run. The concept of the circular economy (CE) emerged as an alternative solution by emphasizing regenerative strategies such as recycling, reuse, repair, and remanufacturing to minimize waste and optimize the product life cycle [1]. Globally, the shift towards a CE has proven to have a significant impact on sustainability. The Ministry of National Development Planning or Bappenas projects that the implementation of the CE model can reduce carbon emissions by 40% by 2050 [2] and reduce waste generation by 14.54% [3]. In Indonesia, the challenges of this transition are becoming increasingly urgent. Plastic is the second largest component in national waste generation, which reaches 19.69% [4]. Most waste management in the retail sector still relies on linear approaches such as collection, transportation, and disposal to landfills without a systematic reuse process.

In addition, the retail sector itself has a strategic role in the national economy, with a contribution to Gross Domestic Product reaching 10.92 in 2024 [5]. The growth of e-commerce and the increase in people's purchasing power have also expanded the scale of product distribution, but have also increased the volume of operational waste. Leftover packaging, damaged products, and excess stock are problems that have not been handled efficiently. Although some large companies have embarked on sustainability initiatives, most small and medium-sized businesses still face structural, technological, and financial constraints in adopting CE principles. The government has prepared Indonesia's Circular Economy Roadmap 2025–2045 as part of the green industry transformation agenda, but specific policies for the retail sector are still limited.

Unfortunately, academic studies on the implementation of the CE in the retail sector are still rare. Previous research has generally focused on the manufacturing sector [6-8], macro-scale waste management [9-11], or the conceptual relationship between circularity and sustainability [12, 13]. Few studies have integrated macro-environment analysis through the PESTEL approach with mapping operational inefficiencies using VSM in a single analytical framework [14, 15]. In fact,

this kind of approach is important to identify political, social, and technological barriers, as well as map potential process improvements at the operational level [16].

Based on these gaps, this study aims to develop a model for optimizing the operational efficiency of the CE-based retail sector that is relevant to the Indonesian context. The analysis was carried out using the PESTEL framework to map external factors influencing the implementation of the CE, as well as the VSM method to identify points of inefficiency in the supply chain. Data were obtained through on-site field visits, interviews, and field observation in four representative cities—Jakarta, Bandung, Bali, and Padang—to capture social, regulatory, and operational diversity. This research is expected to make a theoretical contribution to the CE literature while offering practical strategies for retailers in increasing efficiency, reducing environmental impact, and strengthening competitiveness during the transformation towards a green economy.

2. RESEARCH METHODOLOGY

This study uses a qualitative approach with descriptive analysis to develop a model for optimizing retail operational efficiency based on CE principles. This approach was chosen to gain an in-depth understanding of the internal and external dynamics that affect the implementation of the CE in the retail sector in Indonesia.

The research process is carried out through three main stages. The first stage is a literature review that aims to identify relevant theories, concepts, and findings of previous research, as well as formulate a framework for analysis and research gaps. The second stage is the collection of field data through on-site field visits, semi-structured interviews with owners, managers, and operational staff, as well as direct observations on four retail entities operating in Jakarta, Bandung, Bali, and Padang. These four cities were selected because they represent different levels of market maturity, regulatory environments, and waste-handling infrastructure. Jakarta and Bandung illustrate highly urbanized retail ecosystems with advanced digital systems and high transaction volumes, while Bali and Padang reflect contrasting regional contexts with different operational capacities and waste management challenges. This combination ensures that the sample captures the heterogeneity of Indonesia's retail industry. Secondary data is obtained from policy documents, industry reports, academic publications, and official statistical sources. A total of eight respondents participated in this study. In Jakarta, four retail entities were visited, each represented by one informant (two store managers, one owner, and one inventory supervisor). In Bandung, one store manager participated; in Bali, two informants participated (one owner and one waste-handling staff member); and in Padang, one operational staff member was interviewed. All respondents were individuals directly involved in store operations, inventory processes, or waste-handling activities. This study did not use any self-administered questionnaires, and therefore, no questionnaire distribution, recovery, or response rate applies. All primary data were collected exclusively through on-site field visits and structured interviews conducted using a predefined question list.

The third stage is data analysis, which is carried out using two main approaches. The interview and observation data were analyzed using thematic analysis. Key patterns and operational issues were identified by reviewing the transcripts and field notes repeatedly, and these were grouped into broader themes that reflected the study's analytical framework. To ensure reliability, the interpretations were discussed among the research team to maintain consistency. Validity was strengthened through triangulation between interviews, observations, and secondary documents, as well as reconfirming key points with selected informants. First, the PESTEL framework is used to map external factors that affect the implementation of the CE, covering political, economic, social, technological, environmental, and legal dimensions. The PESTEL analysis was carried out by identifying relevant external factors through literature review, policy documents, and insights from field interviews. Each factor was then assessed based on its relevance and influence on CE adoption as reflected in the field data. Factors that appeared consistently across different sources or were repeatedly highlighted during interviews were classified as key external drivers. This process ensures that the PESTEL results are grounded in actual operational conditions rather than purely theoretical descriptions. This analysis helps identify barriers and opportunities from the macro environment that affect the readiness of CE adoption. Second, the VSM method is applied to map value streams in supply chain processes and identify points of inefficiency that contribute to resource wastage and increased waste generation. The VSM analysis was conducted by observing the flow of products and information from procurement to waste handling at each retail site. During the visits, key operational details such as process sequences, waiting points, stock movement, and handling of unsellable products were documented. These observations were then translated into a current-state value stream map to visualize the end-to-end process. Inefficiencies were identified by examining points where delays, excess inventory, repeated handling, or unused materials accumulated.

The results of the two analyses are used as a basis for designing a conceptual model for optimizing retail operational efficiency based on the CE. This model is designed to be relevant to the operational context of the Indonesian retail industry and can be used as a reference in strategic decision-making and future sustainability policy formulation.

3. RESULTS AND DISCUSSION

This study confirms that waste management in the retail sector in Indonesia is currently still dominated by a linear approach that focuses on final disposal. The management process generally starts from the occurrence of waste due to overstock, mispredicted demand, or damaged and expired products. These products are then recorded manually or semi-digitally, a small portion is returned to the supplier through a return mechanism, while the rest is sold at a discounted price or managed internally through unstandardized reuse activities. Unhandled waste is eventually handed over to a third party or directly sent to the final disposal site (TPA).

This study, which was conducted on four retail entities in Jakarta, Bandung, Bali, and Padang, shows that most business actors do not have an integrated waste management system. Recording practices are still limited to the point-of-sales (POS) function and are not yet connected to waste management modules that are able to provide data in real-time. In addition, the product return mechanism is still negotiated on a case-by-case basis and has not been formalized in a long-

term agreement. As a result, the volume of damaged products that can be returned only ranges from 60-70% of the total unsaleable products, while the rest has the potential to become unusable waste.

This condition shows that Indonesia's retail sector is still in the early stages of the transition to a CE, this is also the case in the United Kingdom [17]. Waste management has not yet become part of the core operational strategy, but is still seen as a complementary activity [18]. This leads to high operational waste generation, resource waste, and cost inefficiencies that have an impact on overall retail competitiveness.

3.1 Key obstacles and challenges to CE implementation

The findings of this study confirm that the obstacles to the implementation of the CE in the Indonesian retail sector are multidimensional and systemic. The unpreparedness of internal systems, such as the absence of SOPs for waste management, the lack of documentation of reuse and upcycling, and the lack of integration of the recording system show that the CE is still considered an additional activity, not a core strategy in retail business operations. This is in line with findings that stated that failure to internalize the principle of circularity into business processes is a major obstacle in the early phases of the transition to a CE [19-21].

The limitations of infrastructure and technology reinforce these findings. The unavailability of waste treatment facilities, especially outside big cities, as well as fragmented information systems, hinders the timely decision-making process. In this context, technological readiness is not only a supporting factor but is a major prerequisite for the circular value chain to run effectively [22]. Gong et al. [17] showed that the adoption of digital technology and integrated information systems can reduce up to 57% of operational waste through improved supply chain visibility and process efficiency. Indonesia's condition, which is still lagging in this case, indicates the need for strategic investment in digital infrastructure as the foundation of circular transformation.

The high dependence on suppliers reflects the still-strong asymmetric relationship in the retail supply chain. The absence of a structured reverse logistics mechanism hinders efforts to reuse damaged or unsold products, thus shortening the product life cycle. This shows the importance of shifting from a transactional relationship model to a collaborative partnership in the supply chain. In line with the findings by Witjes and Lozano [23], long-term collaboration between retailers and suppliers can be a key driver of successful CE implementation through the sharing of responsibility for post-consumer products.

External factors such as unspecified regulations and limited government incentives are further slowing down the transformation. Although Indonesia already has a CE roadmap for 2025–2045, the absence of policies that directly target the retail sector results in businesses lacking the structural impetus to invest in the circular system. This is in line with the results by Takacs et al. [24] and Alonso-Almeida and Rodríguez-Antón [25], which show that the clarity of the legal framework has a significant effect on the level of CE adoption in the services and trade sectors.

Low consumer awareness is also an important structural barrier. Weak demand for circular products and low participation in packaging return programs indicate that transition strategies cannot focus solely on the supply side. Changes in consumption patterns need to be supported by continuous education, behavioral incentives, and effective communication strategies. This is consistent with the findings of Bag and Pretorius [7], which state that consumer participation is one of the determinants of the success of the implementation of the CE, especially in the retail sector.

Conceptually, these findings suggest that barriers to CE implementation cannot be overcome through a single intervention. A holistic and systemic approach is urgently needed, including strengthening internal capacity through operational standards and technology adoption, restructuring supply chain relationships through more balanced collaboration, and external support in the form of regulations, incentives, and increasing consumer awareness. The integration of these various aspects will be an important foundation to accelerate the transition of Indonesia's retail sector towards an efficient, inclusive, and sustainable CE.

3.2 External factor analysis (PESTEL)

PESTEL's analysis in this study reveals that the six external dimensions—political, economic, social, technological, environmental, and legal—have a crucial role in determining the direction and speed of Indonesia's retail sector's transition to a CE. These factors do not work in isolation but rather interact with each other and form a systemic framework that can accelerate or even inhibit change.

3.2.1 Political and regulatory factors

Regulations have proven to be the main driver of the successful implementation of the CE. The Government of Indonesia has released the Circular Economy Roadmap 2025–2045, but specific policies governing the retail sector are still not available. Existing regulations tend to be general and do not target important operational aspects such as product returns, post-consumer packaging management, or management of unsold goods. This condition creates policy uncertainty and limits the initiatives of industry players. Previous research has shown that the clarity of the regulatory framework has a significant positive correlation with the rate of circular adoption in the services and trade sectors [26]. Therefore, the formulation of more targeted sectoral policies—including the implementation of extended producer responsibility (EPR) in the retail sector—is a strategic step to create an enabling environment that encourages changes in industrial behavior.

3.2.2 Economic factors

Economically, the potential efficiency of the CE is clear. Waste reduction, resource optimization, and reduced operational costs are benefits that have been proven in many global studies [17]. However, the main obstacle lies in the high initial investment required for digital technologies, waste treatment facilities, and reverse logistics systems. The lack of fiscal incentive schemes and financing support has made many retail players, especially MSMEs, reluctant to transform. This is in line with findings that state that economic factors are often a variable inhibiting the adoption of circular economies in developing countries [27]. Fiscal strategies such as tax cuts or investment subsidies can act as a catalyst for transformation in this context.

3.2.3 Social factors

Consumer awareness is an external factor that is often

ignored, even though it has a significant influence on the success of the implementation of the CE. The results show that most consumers have not made sustainability a key consideration in purchasing decisions. Low participation in packaging return programs or the purchase of recycled products indicates that a market has not yet been formed that supports circularity. Previous research has also confirmed that consumer engagement is one of the strongest determinants of the success of circular strategies [7]. Therefore, transformation cannot only rely on the supply side; Intensive communication strategies, public education programs, and behavioral incentives are needed to shift consumption preferences towards a more sustainable direction.

3.2.4 Technology factors

Technology is the main lever in accelerating circular transformation. However, technology adoption in Indonesia's retail sector is still low. Unintegrated recording systems and the absence of real-time technologies such as the Internet of Things (IoT) hinder the detection of expired products and effective waste management. Previous research has also stated that technology integration can extend the product life cycle and optimize material flow in the supply chain [16]. Without investment in digitalization and data infrastructure, the implementation of circular principles will remain partial and not have a significant impact.

3.2.5 Environmental factors

The environmental impact of retail activities cannot be ignored. Plastic waste, spoiled products, and excess stock ending up in landfills increase carbon emissions and exacerbate environmental degradation. In an Ellen MacArthur Foundation report [28], the global adoption of a CE can reduce emissions by up to 39%. However, these benefits can only be achieved if there are adequate waste treatment systems and recycling facilities. In Indonesia, infrastructure gaps, especially outside big cities, are the main obstacle. Therefore, state investment in regional waste treatment facilities and public-private partnerships is essential to drive this transformation.

3.2.6 Legal factors

From a legal aspect, the absence of regulations that expressly regulate the responsibility of producers and retailers for post-consumption products is the main obstacle. The non-application of the principle of EPR limits industrial accountability in managing waste. Previous research has shown that the consistent application of EPR can significantly increase the rate of waste collection and processing [23]. Therefore, the establishment of a firm and binding legal framework is crucial to strengthening cross-supply chain collaboration and ensuring the involvement of all actors in the circular cycle.

Conceptually, as seen in Table 1, PESTEL's analysis shows that the transformation of the CE in the retail sector cannot depend solely on internal changes in the company. Successful implementation requires structural interventions that include sharper sectoral policymaking, progressive economic incentive schemes, consumer behaviour change strategies, investment in technological and environmental infrastructure, and a binding legal framework. Synergy from all these dimensions will determine the sustainability and effectiveness of Indonesia's retail sector's transition to a CE.

Table 1. PESTEL's analysis

Dimension	Research Findings	Literature Analysis & Support	Strategic Implications
Politics & Regulation	CE regulations already exist [3] but have not specifically targeted the retail sector. There are no clear rules regarding product returns, post-consumer packaging, and management of unsold goods.	Clear regulation has a significant effect on the rate of circular adoption [26]. The absence of EPR reduces the accountability of industry players.	The government needs to draft sharper sectoral regulations, implement EPR in the retail sector, and ensure operational policies support circular implementation.
Economics	The potential for efficiency is high, but the initial cost of investment in technology, infrastructure, and reverse logistics is still an obstacle, especially for MSMEs. No fiscal incentives or financing schemes.	Economic factors are the main obstacles in developing countries [27]. Investments in data systems and reverse logistics can reduce waste by up to 30% [17].	It is necessary to create fiscal incentive schemes, low-interest financing, or investment subsidies to encourage circular adoption.
Social	Consumer awareness and participation in circular products is low. Education programs and incentives from retailers are still minimal.	Consumer engagement is a key determinant of the success of the CE [7]. Low participation slows down the establishment of circular markets.	Public communication strategies, educational campaigns, and behavioral incentives are needed to increase demand for circular products.
Technology	The waste recording system has not been integrated and the use of digital technologies such as IoT is still low. There is no real-time system for product and waste tracking.	Technology integration extends product life cycle and improves supply chain efficiency [16].	Investments are needed in the digitalization of supply chains, the implementation of real-time inventory, and the use of predictive technologies for early detection and waste management.
Environment	Plastic packaging waste, excess stock, and damaged products still end up in landfills. Waste treatment infrastructure is inadequate, especially outside big cities.	CE can reduce carbon emissions by up to 39% [28], but requires a strong processing infrastructure.	The government needs to encourage public-private partnerships for the development of regional waste treatment facilities and strengthen recycling systems.
Law	There are no regulations governing the obligations of manufacturers and retailers towards post-consumer products. EPR has not been implemented thoroughly.	EPR has been shown to improve waste collection and processing rates [29].	The establishment of a robust legal framework, including obligations and sanctions, is needed to strengthen cross-supply chain collaboration.

3.3 Value stream analysis: Current state

The value stream analysis using the VSM method provides a comprehensive overview of the existing conditions of waste management in the retail sector and uncovers the critical points that hinder the application of CE principles. The mapping results show that waste management flows are still linear and oriented towards end-of-pipe, rather than prevention, reduction, or reuse. This condition is consistent with findings of Hedlund et al. [16] and Ahmad et al. [30], which mention that many retail organizations fail to optimize value streams due to a lack of continuous process integration and data-driven decision-making mechanisms.

One of the main root causes is inaccurate demand prediction and overstock. When inventory planning is not supported by an adequate analytics system, the risk of overstock increases, resulting in a significant volume of unsold products. This was also confirmed in previous research showing that inaccuracies in demand forecasting can increase operational waste by up to 25%, especially in the fast-moving consumer goods (FMCG) sector [17]. In the Indonesian context, this problem is exacerbated by the limited implementation of data-driven planning systems, which make procurement decisions reactive and non-adaptive to fluctuations in market demand.

The fragmentation of information systems is another significant point of inefficiency. The disintegration between POS systems, stock management, and waste management causes important information, such as the status of products approaching expiration, to not be detected in a timely manner. As a result, many products lose their selling value before they can be reused. Previous research has also emphasized that information system integration is a key foundation in circular value stream design as it allows for more immediate and accurate visibility of material movements and decision-making [31].

In addition, the high reliance on suppliers in return mechanisms limits the retailer's ability to manage defective products independently. When the supplier does not provide a return or repurposing option, the product is held in the warehouse for a long time until it is finally discarded. This condition demonstrates the need for a shift in supply chain relationships from mere transactions to collaborative partnerships, as suggested by da Costa Fernandes et al. [29], which emphasizes the importance of redesigning value chain relationships so that responsibility for post-consumption products is shared equitably.

Another important finding is the lack of reverse logistics practices and reuse strategies. Despite the significant economic potential of waste, most companies have not adopted a systematic strategy for remanufacturing, upcycling, or closed-loop recycling. As a result, the potential economic value of waste is not utilized, and the environmental impact remains high. Previous research confirms that the application of reverse logistics can increase material utilization by up to 40% and extend the life of products in the value chain [32].

The absence of a special SOP for waste management further worsens the situation. Ad hoc waste management practices make it difficult to monitor, evaluate, and continuously improve processes. This condition shows that there is no strategic commitment to integrate CE principles into core business operations. In line with previous studies, the success of circular implementation is highly dependent on the extent to which organizations internalize the principles into standard policies and procedures [27].

Conceptually, the results of this VSM analysis show that retail waste management is still trapped in a linear paradigm that prioritizes disposal over prevention and reuse. The transformation towards a future state requires fundamental changes in the design of value streams, including the implementation of data-driven planning to prevent overstock, the integration of comprehensive information systems to increase supply chain visibility, the development of collaborative reverse logistics mechanisms, and the drafting of SOPs that explicitly adopt the principle of circularity. With this approach, the value stream no longer ends up at the landfill but instead recirculates back into the system as a new raw material, additional economic value, or a resource whose life cycle is extended.

3.4 Future state design and operational implications

The results of the VSM analysis of the current state of conditions show that the waste management flow in the Indonesian retail sector is still dominated by a linear paradigm oriented towards final disposal (Figure 1).

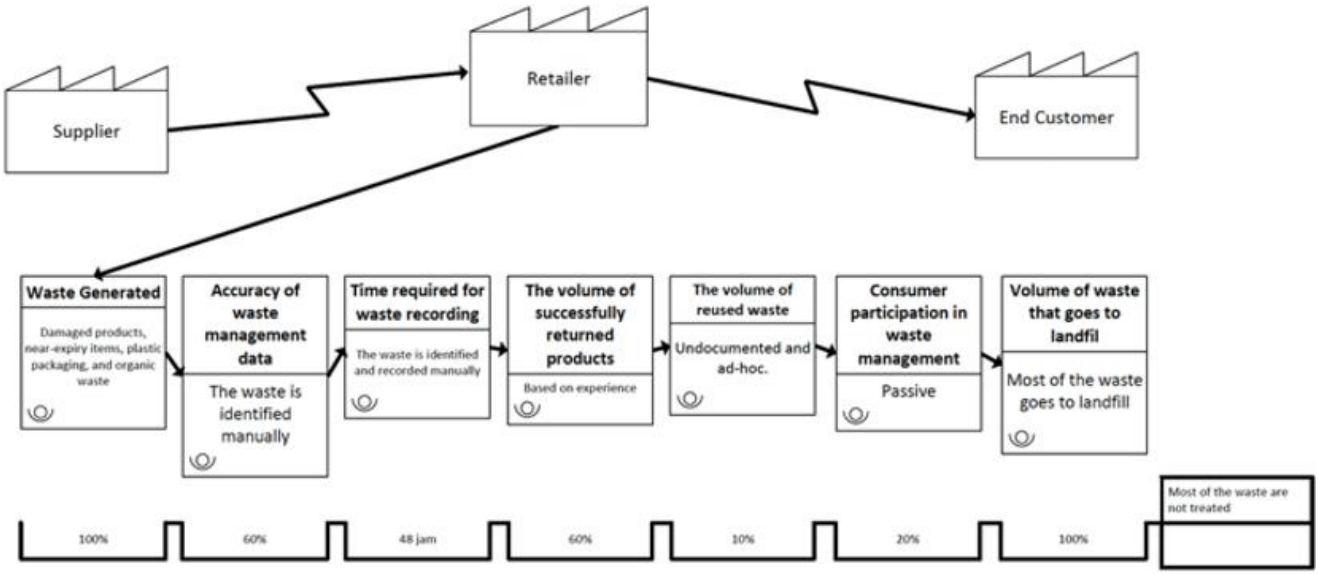

Figure 1. Current state mapping

To overcome the various points of inefficiency identified, this study designed a future state model based on CE principles and oriented towards system integration, cross-actor collaboration, and the use of digital technology. This model aims to create a more efficient, adaptive, and sustainable value stream, while strengthening the competitiveness of the retail industry in the long term.

(1) Data-driven planning and procurement

The initial stage in the design of the future state focuses on strengthening the planning and procurement process through the integrated use of historical data and POS systems. This approach allows for more accurate demand predictions, so the risk of overstock and accumulated unsold products can be significantly reduced. This strategy is in line with the findings of Gong et al. [17], which suggest that the integration of demand data can reduce waste generation by 25–30%. Furthermore, collaborative planning with suppliers that covers the entire product lifecycle—from procurement to post-consumption—is an important foundation in creating a circular supply chain.

(2) Integrated and responsive stock management system

At the storage and distribution stage, the future state design adopts an integrated stock management system that operates in real-time. This system allows for early detection of products that are approaching their expiration date, so that retailers can immediately implement mitigating strategies such as redistribution to alternative markets or the implementation of quick sales through discounts. This approach also supports the consistent implementation of first-expired, first-out (FEFO), which has been shown to be effective in reducing product waste [32]. The integration of this system is an important key in shifting the operational approach from reactive to proactive.

(3) Progressive reverse logistics scheme design

One of the innovative elements in the future state design is the strengthening of the post-consumption management stage through proactive reverse logistics design. Products that are not sold or damaged are not only returned to the supplier but are also directed to the process of remanufacturing, repurposing, or upcycling according to the characteristics of the material. This approach not only extends the product life cycle but also creates new economic value from waste. Previous research confirms that the success of reverse logistics relies heavily on collaboration between retailers, suppliers, waste processors, and creative industry players—a relationship that is at the heart of this model [29].

(4) Technology utilization and multi-actor collaboration

The integration of digital technology is the main foundation for designing a future state. The deployment of the IoT, cloud-based inventory systems, and predictive analytics enables end-to-end visibility of product and waste movements, improves strategic decision-making accuracy, and accelerates operational responses. Previous research has shown that supply chain digitalization can increase efficiency by up to 40% while accelerating the implementation of circular principles [31]. On the other hand, cross-actor collaboration—between retailers, suppliers, consumers, governments, and waste processors—ensures that waste management responsibilities are shared fairly and that the circular process runs seamlessly.

3.5 Strategic implications of future state

The implementation of the future state model has far-reaching implications for environmental, economic, and strategic dimensions.

From an environmental perspective, reducing the volume of operational waste, extending the product life cycle, and reducing carbon emissions are the direct impacts of more efficient value stream design (Figure 2). From an economic point of view, optimal stock management reduces storage and disposal costs, while reuse and remanufacturing strategies open new revenue opportunities. Strategically, the implementation of this model increases the competitiveness of the retail sector by strengthening compliance with environmental regulations and responding to changing consumer preferences that are increasingly oriented towards sustainability [27].

Furthermore, this draft shows that the transition to a CE requires not only technical changes at the operational level, but also systemic transformations involving policies, consumer behavior, market structures, and collaboration between actors. By adopting the future state model nationally, Indonesia's retail sector has the potential to become a major driver in achieving the Sustainable Development Goals (SDGs), especially Goal 9 (Industrial Innovation), Goal 12 (Sustainable Consumption and Production), and Goal 13 (Handling Climate Change).

The strategic implications outlined are directly based on fundamental changes in operational value streams, as detailed in Table 2, which compares current and proposed waste management processes.

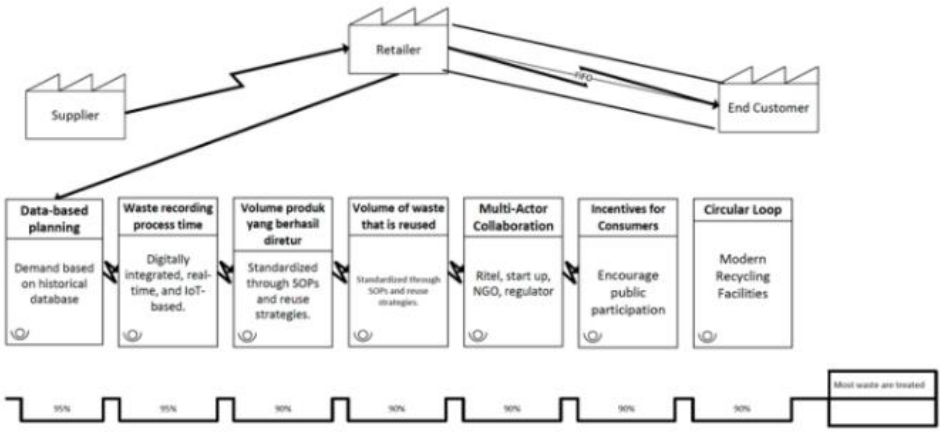

Figure 2. Future state mapping

Table 2. Comparisons of current and future state mapping

Key Aspects	Current State	Future State	Strategic Implications
Planning and Procurement	Planning is reactive and based on rough estimates; Not supported by demand data analytics. Overstock is frequent and is a major source of waste.	Historical data-driven planning and integrated POS systems, with more accurate demand prediction and product lifecycle collaboration with suppliers.	Reduce the risk of overstock, reduce waste generation from upstream, and improve resource use efficiency.
Storage and Distribution	There is no real-time stock monitoring system; products near expiration are often not detected in time. FEFO has not been implemented consistently.	Integrated and real-time stock management system with early warning, allowing for quick redistribution or discounts. FEFO is consistently applied.	Lowers unsold product waste and extends product life cycle.
Return and Handling of Defective Products	The return process is reactive and depends entirely on the supplier's policy. Most of the spoiled products are thrown away without being utilized.	Proactive reverse logistics schemes include returning, remanufacturing, repurposing, and upcycling. Collaboration is extended to waste processors and creative industry players.	Harnessing the economic value of waste, creating new revenue streams, and expanding circular ecosystems.
Information Systems and Technology	Fragmented information systems: POS, stock management, and waste management are not connected. Hard-to-use data for strategic decision-making.	An integrated digital system based on IoT and cloud that provides end-to-end visibility and supports data-driven decision-making.	Improve response speed, decision accuracy, and supply chain operational efficiency.
Final Waste Management	Waste is sent to landfills through third parties without a reuse process. Reuse and upcycling efforts are sporadic.	Waste is managed in a closed cycle through reuse, recycling, and integration into new value chains.	Reducing the volume of waste to landfills, reducing carbon emissions, and supporting national environmental targets.
Collaboration and Governance	Collaboration is limited to transactional relationships between retailers and suppliers. Other actors' roles have not been integrated.	Cross-actor collaboration involves retailers, suppliers, governments, consumers, waste processors, and creative industry players.	Creating a stronger circular ecosystem, expanding shared responsibility, and accelerating systemic transitions.

4. CONCLUSIONS

This study develops a model for optimizing the operational efficiency of the retail sector based on CE principles through the integration of PESTEL analysis and VSM. The results of the study show that the implementation of the CE in the Indonesian retail sector still faces various internal and external obstacles, ranging from the unpreparedness of operational systems, technological limitations, and the lack of reverse logistics mechanisms, to regulations that are not yet specific, low consumer awareness, and limited infrastructure. Value stream analysis reveals that waste management practices are still linear and land-based in landfills. In response, this study designed a future state model that is oriented towards information system integration, cross-actor collaboration, the application of digital technology, and a progressive post-consumption management strategy, which is conceptually able to reduce waste generation, reduce operational costs, extend product life cycles, and strengthen the competitiveness of the retail sector.

The novelty of this research lies in the combination of the PESTEL and VSM frameworks in one analytical model that has not been widely applied in the context of the retail industry in Indonesia, as well as the preparation of a future state design that is applicable and can be replicated nationally. However, this study has limitations in limited geographical coverage, a qualitative approach, and has not explored aspects of consumer behavior. Therefore, further research needs to be directed at empirical validation through real implementation, quantitative measurement of economic and environmental impacts, as well as further exploration of the role of consumers and cross-actor collaboration in creating a sustainable CE ecosystem.

5. IMPLICATIONS AND LIMITATIONS

This study, although it manages to comprehensively identify the linear nature and fragmentation of systems in Indonesia's retail waste management, is limited by the scope of the urban-focused geographic sample and the conceptual nature of the VSM future state design, without presenting ex-ante empirical validation or econometric modeling of policy impacts. These limitations require the reader to evaluate the generalization of the findings carefully, especially in the context of MSMEs. The main implication is the need for a strategic shift from compliance costs to core value strategies through the implementation of data-driven planning systems and end-to-end digital integration to create new revenue streams from circular practices. From a policy perspective, this study strongly urges the government's structural intervention through the formulation of binding EPR policies and the provision of fiscal incentives. Therefore, future research should focus on the post-implementation validation of the proposed model through dynamic simulation modeling and game theory analysis to test the sustainability of cross-actor collaboration, as well as conduct quantitative analyses of the elasticity of circularity adoption against policy interventions and changes in consumer behavior. This is important to transform qualitative findings into measurable and impactful action guides.

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