International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 01 January 2026
DOI: 10.47191/ijcsrr/V9-i1-06, Impact Factor: 8.048
IJCSRR @ 2026
www.ijcsrr.org

Optimizing Reverse Logistics in Manufacturing Production Processes

Quach Bao Duy
Hanoi Metropolitan University, Hanoi, Vietnam

ABSTRACT: This study investigates the optimization of reverse logistics in manufacturing enterprises, emphasizing its role as an essential component of modern supply chain management and a strategic instrument for sustainable development. The paper first reviews and systematizes the theoretical foundations of reverse logistics, clarifying its concepts, characteristics, and scope of application, as well as its linkages with supply chain management and the circular economy. On this basis, an analytical framework is developed to evaluate the level of reverse logistics implementation in manufacturing firms in Vietnam, with a focus on product return management, reverse material flow handling, internal coordination mechanisms, and the integration of environmental objectives into production and business strategies.

The analysis of empirical evidence highlights several key challenges in the adoption of reverse logistics, including limitations in managerial capabilities, infrastructure, financial and technological resources, and insufficient awareness of the long-term economic and environmental benefits. In response, the study proposes a set of comprehensive and feasible solutions aimed at improving internal governance, enhancing coordination across supply chain stages, and promoting the adoption of management models consistent with circular economy principles. These measures are expected to improve operational efficiency, reduce environmental impacts, and strengthen the competitive position of manufacturing enterprises in the context of economic integration and increasing sustainability requirements.

KEYWORD: Circular economy, manufacturing enterprises, reverse logistics, supply chain management, sustainable development.

1. INTRODUCTION

In the context of an economy undergoing a strong transition toward sustainable development and efficient resource utilization, reverse logistics has increasingly been recognized as an essential component of supply chain management systems in manufacturing enterprises. The importance of reverse logistics stems not only from the objectives of cost optimization and the enhancement of reuse and recycling efficiency, but also from the growing need to comply with increasingly stringent legal requirements on environmental protection. The combination of economic pressures and the evolving regulatory framework has shifted reverse logistics from a supportive function to a strategic activity in corporate management.

In Vietnam, according to Vietnam National Assembly Publishing House(2020), Law on Environmental Protection, particularly Articles 54 and 55, for the first time established the Extended Producer Responsibility (EPR) mechanism. Under this mechanism, enterprises are required to organize the collection and recycling of post-consumer products and packaging, or alternatively fulfill corresponding financial obligations for waste treatment. These provisions are further specified in Decree No. 08/2022/ND-CP, which clearly defines the categories of products and packaging subject to mandatory recycling, minimum recycling rates, and mechanisms for monitoring and controlling corporate responsibilities. This policy framework imposes a fundamental requirement on manufacturing enterprises: they are no longer responsible only for the production stage, but must manage the entire product life cycle after consumption, including collection, sorting, recycling, and waste treatment activities.

Within this context, reverse logistics is no longer a voluntary or auxiliary activity, but has become a mandatory legal requirement closely associated with corporate compliance and reputation. However, practical implementation in Vietnam indicates that most enterprises still approach reverse logistics in a fragmented and non-standardized manner, with limited application of technological tools for forecasting return flows, organizing collection systems, and managing reverse material streams. These limitations not only increase processing costs and resource inefficiencies, but also create significant barriers to meeting EPR recycling targets and pose potential risks of non-compliance with environmental regulations.

Against this backdrop, the study entitled "Optimization of Reverse Logistics in the Production Process of Manufacturing Enterprises" is conducted to systematize the theoretical foundations of reverse logistics, analyze its current application in enterprises, and propose highly feasible solutions aligned with circular economy principles and Vietnam's EPR implementation roadmap. The expected outcomes aim not only to improve operational efficiency in manufacturing enterprises, but also to strengthen legal compliance capacity and enhance competitiveness in a rapidly changing regulatory and market environment.

2. THEORETICAL FRAMEWORK

Reverse logistics, also referred to as recovery logistics, is the process of planning, implementing, and controlling the efficient flow of raw materials, work-in-process, finished goods, and related information from the point of consumption back to the point of origin, with the objective of recovering residual value or ensuring appropriate disposal. According to Rogers and Tibben-Lembke (1999), reverse logistics encompasses a set of activities such as product returns, reuse, repair, remanufacturing, and recycling. In a broader sense, reverse logistics includes all activities related to the collection, maintenance, upgrading, and recycling of products or materials that no longer meet quality requirements, are defective or damaged, or are misaligned with customer needs.

In operational practice, according to Brito, M. P., & Dekker, R. (2003) the reverse logistics process is typically implemented through four fundamental stages. The first stage is collection, which involves retrieving unsold products, defective or faulty items, and post-consumer packaging, as well as organizing their transportation to designated collection points or centralized processing facilities. The second stage is inspection and sorting, during which returned products are assessed in terms of quantity, technical condition, and quality, and subsequently classified according to criteria established by the enterprise. This stage plays a critical role, as the outcomes of inspection and sorting determine the subsequent handling strategy for each category of returned products. The third stage is processing, in which inspected products may undergo repair, remanufacturing, disassembly for component recovery, restoration of functional value, or material recycling. For products that are no longer suitable for reuse or recycling, enterprises are required to treat them as waste using methods that minimize negative environmental impacts. The final stage is redistribution, whereby refurbished or recovered products are reintroduced to the market through the forward logistics system, including warehousing, transportation, and distribution activities similar to those applied to new products.

Overall, reverse logistics is not merely a technical process but a vital component of modern supply chain management. It contributes to improved resource efficiency, waste reduction, and the achievement of economic objectives aligned with sustainable development goals.

3. DISCUSSION RESULTS

3.1. Current Status of Reverse Logistics Implementation in Manufacturing Enterprises in Vietnam

In recent years, alongside the transition toward a circular economy model and the introduction of new environmental protection regulations, reverse logistics has gradually attracted attention from manufacturing enterprises in Vietnam and has been implemented to varying degrees. However, from a macro perspective, reverse logistics remains underdeveloped, fragmented, and has yet to become a strategic component of supply chain management in most enterprises.

In practice, the majority of manufacturing firms currently implement reverse logistics in a reactive manner, primarily to handle defective products, unsold inventory, or to meet minimum environmental compliance requirements. Post-consumer product return activities are often carried out in an ad hoc fashion, lacking effective coordination among internal departments and not being fully integrated into the overall production–logistics process. Many enterprises have not established formal return systems and instead rely on unstable channels such as dealers, distributors, or external collection agents.

From a technological and information systems perspective, the application of digital solutions in reverse logistics remains limited. Most enterprises have yet to invest adequately in technologies such as reverse warehouse management systems, product traceability tools, or data analytics for forecasting return flows. Inspection, sorting, and processing of returned products are still largely performed manually, resulting in high handling costs, prolonged processing times, and limited quality control. These shortcomings significantly reduce value recovery efficiency and constrain the long-term scalability of reverse logistics activities.

Financial capacity also constitutes a major barrier to systematic reverse logistics implementation. Many enterprises, particularly small and medium-sized ones, face difficulties in investing in collection infrastructure, dedicated storage facilities, and recycling or remanufacturing technologies. Given the substantial initial investment costs and long payback periods, reverse logistics is often not prioritized in corporate development strategies, especially under increasing price competition pressures.

From a managerial standpoint, reverse logistics in many enterprises has not been organized as an independent management function. Responsibilities related to product returns and processing are typically dispersed across departments such as production, logistics, sales, or customer service, leading to fragmented decision-making and weak control. Moreover, return policies remain unclear in many firms, reducing customer participation and cooperation in product recovery programs.

In the context of implementing the Extended Producer Responsibility (EPR) mechanism according to OECD (2023) reverse logistics faces both new opportunities and significant challenges. While regulatory requirements compel enterprises to restructure their collection, sorting, and recycling systems, insufficient preparation in terms of technology, resources, and managerial experience has made compliance difficult for many firms, increasing costs and the risk of regulatory violations.

In summary, the current state of reverse logistics implementation in Vietnamese manufacturing enterprises reveals a substantial gap between policy requirements and actual operational capabilities. Reverse logistics is still largely perceived as a compliance-oriented activity rather than a value-creating tool, underscoring the urgent need for integrated solutions to enhance its effectiveness and strategic integration into supply chain management and sustainable development agendas.

3.2. Factors Affecting Reverse Logistics in Manufacturing Enterprises

Internal Factors

Technological capability and information systems: The level of technological capability and the degree of sophistication of information systems are considered key determinants of the effectiveness of reverse logistics implementation in manufacturing enterprises. The application of technological solutions such as Enterprise Resource Planning (ERP), Warehouse Management Systems (WMS), Transportation Management Systems (TMS), RFID technology, barcodes, and the Internet of Things (IoT) according to Newcastle Systems (2025) enhances data quality, improves traceability, and supports decision-making in handling returned products. In addition, automation and big data analytics help reduce errors, shorten processing time, optimize reverse material flows, and strengthen coordination among departments within the supply chain. Integrated information systems also enable real-time data sharing between enterprises, suppliers, and logistics partners, thereby improving coordination capacity and reducing costs arising from information disruptions. Therefore, technology and information systems not only support operational activities but also play a decisive role in ensuring the efficiency, transparency, and sustainability of reverse logistics operations.

Financial capability: Financial capacity is a critical internal factor that directly influences a manufacturing enterprise's ability to implement reverse logistics. Compared to forward logistics, reverse logistics often involves higher costs due to the complexity of collection, sorting, processing, and recycling activities. Enterprises with strong financial resources are better positioned to invest in collection infrastructure, dedicated storage facilities, automated sorting technologies, and in-house recycling or remanufacturing centers. Moreover, stable financial capacity allows firms to sustain long-term product take-back programs, implement customer incentive schemes for returns, and proactively manage risks arising from cost fluctuations during reverse logistics operations.

Customer relationships and return policies: Customer relationships and return policies significantly affect the performance of reverse logistics in manufacturing enterprises. The transparency, clarity, and accessibility of return policies directly influence the volume of returned products and associated processing costs. Well-designed return policies, with clear regulations on return periods, acceptance conditions, and customer support mechanisms, encourage voluntary returns, thereby increasing collection rates and enhancing the efficiency of circular value chains. Furthermore, effective customer relationship management facilitates two-way information flows, enabling enterprises to identify return causes, assess product quality, and gradually improve reverse logistics programs over the long term.

External Factors

Policy and regulatory framework: In the context of the circular economy becoming a dominant development orientation, reverse logistics increasingly plays a strategic role in manufacturing enterprises. However, its effectiveness depends heavily on the policy framework established by the government as well as internal corporate governance regulations. Policies not only guide corporate behavior but also directly affect cost structures, technology choices, and the level of legal responsibility throughout the processes of product collection, recycling, and reuse.

In recent years, environmental, tax, trade, and technical standard policies have exerted significant impacts on reverse logistics implementation. Notably, Law on Environmental Protection (2022) and the enforcement of the Extended Producer Responsibility (EPR) (2024) require enterprises to establish systems for collecting, sorting, and recycling post-consumer products. In addition, tax and investment incentives for recycling technologies contribute to reducing operating costs, at the same time, quality inspection requirements, safety standards for recycled products, and trade regulations related to waste imports compel enterprises to increase investment in processing technologies and improve the management of reverse logistics flows.

Market dynamics and customer demand: Market conditions and customer demand are important external factors shaping the scale and modes of reverse logistics implementation in manufacturing enterprises. Changes in consumer behavior, particularly the rise of green consumption and higher expectations regarding environmental responsibility, have encouraged enterprises to expand product take-back, recycling, and remanufacturing activities to meet market requirements. Customers today are concerned not only with price and product quality but also with product life cycles and transparent, convenient, and environmentally friendly return mechanisms.

These changes create significant competitive pressure, prompting enterprises to view reverse logistics as a strategic tool for enhancing brand image, increasing customer value, and strengthening market positioning. Consequently, the development of reverse logistics is increasingly linked to enterprises' ability to adapt to evolving consumption trends and market expectations.

Social and environmental factors: Acorrding to Salas-Navarro, K. (2024) social and environmental factors increasingly influence enterprises' efforts to expand and improve reverse logistics. Growing public awareness of environmental protection, sustainable consumption, and waste reduction has generated substantial social pressure, compelling enterprises to enhance collection, recycling, and remanufacturing processes to meet stakeholder expectations. In this context, reverse logistics serves not only as a technical solution but also as a means of demonstrating corporate social responsibility.

Modern consumers are increasingly attentive to the environmental impacts of the entire product life cycle, from production and consumption to post-use treatment. As a result, reverse logistics has become a critical factor in building corporate image, strengthening brand reputation, and contributing to the achievement of long-term sustainable development objectives.

3.3. Solutions for Optimizing Reverse Logistics in the Production Process of Manufacturing Enterprises

Optimizing reverse logistics enables enterprises to reduce warehousing and transportation costs associated with returned products, while increasing material reuse rates and ensuring compliance with environmental regulations. To achieve these objectives, solutions should focus on the application of advanced technologies and the promotion of supply chain collaboration, thereby supporting sustainable production models and the circular economy.

Digitalization and process automation: Enhancing digitalization and automation in reverse logistics through the application of technologies such as IoT sensors, RFID, artificial intelligence, and blockchain allows enterprises to monitor return flows in real time and automate sorting and decision-making regarding appropriate treatment options. Transportation management systems integrated with reverse logistics functions enable continuous monitoring of collection activities, route optimization, and resource allocation, thereby reducing operating costs and shortening processing times. According to Tiwari et al. (2018), the adoption of technologies such as big data analytics, IoT, RFID, and artificial intelligence significantly improves forecasting capabilities, enhances monitoring, and supports effective decision-making throughout the processes of product recovery, sorting, and recycling.

Centralized collection and sorting systems: Establishing shared collection and processing centers for multiple enterprises within the same industry helps distribute infrastructure costs and improve operational efficiency. For example, the Duales System Deutschland (DSD) model in Germany and eco-industrial parks applying Resource Efficiency and Cleaner Production (RECP) principles

research by Nisasia Ekafitrina and Charles Arthur (2023) enable firms to jointly develop collection and processing infrastructure. This approach optimizes transportation routes for returned materials, reduces redundant investments, and increases recycling rates through standardized and centralized recovery processes. An optimal collection networks should be designed based on the coordination of collection point locations, processing capacities, and transportation costs to minimize total system costs while maintaining recovery speed and material quality. The integration of optimization models is therefore essential for determining the number, location, and scale of collection points to maximize value recovery.

Intelligent return management systems: The development of intelligent return management systems based on standardized processes and specialized software enables enterprises to automate return intake, classify return reasons, and assess product conditions. On this basis, appropriate treatment options—such as repair, refurbishment, remanufacturing, or recycling—can be automatically activated. This approach reduces errors associated with manual handling, shortens processing times, and enhances the utilization of valuable components and materials. Moreover, intelligent return management systems facilitate the integration of

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 09 Issue 01 January 2026
DOI: 10.47191/ijcsrr/V9-i1-06, Impact Factor: 8.048
IJCSRR @ 2026
www.ijcsrr.org

return cycle data into enterprise-wide reporting systems, thereby improving transparency and supporting compliance with policy and regulatory requirements related to reverse logistics.

Strengthening take-back and reuse policies: Promoting policies that encourage the return of post-consumer products and packaging—such as refund mechanisms, product exchange programs, or customer incentives—plays a crucial role in increasing collection rates. From a circular economy perspective, systematic product take-back not only reduces waste generation but also enables the effective recovery of components and materials with residual value. As a result, enterprises can reduce their dependence on virgin materials and optimize long-term production costs.

*Transparent monitoring and regulatory compliance***:** The application of blockchain technology in combination with IoT enables continuous tracking of material and product life cycles throughout collection and recycling processes. When integrated with Measurement, Reporting, and Verification (MRV) standards, this solution ensures data transparency, consistency, and reliability in relation to recovery and recycling activities. Consequently, enterprises are better positioned to demonstrate compliance with environmental regulations and Extended Producer Responsibility requirements, while also improving access to green finance and sustainability-oriented support programs.

4. CONCLUSION

The findings of this study on optimizing reverse logistics in the production process indicate that reverse logistics has moved beyond the role of a purely supportive activity to become a strategic component of supply chain management and a key driver of corporate sustainable development. Both theoretical and empirical analyses confirm that reverse logistics generates multidimensional benefits, including the optimization of material costs through recovery and reuse, improvements in operational efficiency, enhanced compliance with environmental regulations, and contributions to the realization of circular economy models.

Nevertheless, the study also reveals that the implementation of reverse logistics in many manufacturing enterprises remains constrained by several limitations. These include a lack of standardized recovery processes, fragmented capabilities in sorting and recycling, limited application of digital technologies, and insufficient coordination among stakeholders within recovery networks. Such shortcomings hinder the full exploitation of the value potential of reverse logistics and reduce the overall effectiveness of supply chain operations.

In response, the proposed solution framework—comprising the acceleration of digital transformation in reverse logistics processes, optimization of collection networks, strengthening of recycling and reuse activities, enhancement of supply chain collaboration, and improvement of internal governance mechanisms—is considered both feasible and well aligned with the practical conditions of contemporary manufacturing enterprises. The integrated implementation of these solutions is expected to enhance reverse logistics performance, reduce production costs, and enable enterprises to better meet increasingly stringent environmental and social responsibility requirements.

Overall, the study affirms that optimizing reverse logistics is an inevitable strategic direction for enterprises in a market environment that increasingly prioritizes sustainability and transparency. Strategic investment in reverse logistics not only delivers direct economic benefits but also supports the development of circular production systems, thereby establishing a solid foundation for long-term growth and enhancing enterprises' integration into global supply chains.

REFERENCES

1. Brito, M. P., & Dekker, R. (2003). A Framework for Reverse Logistics. https://www.researchgate.net/publication/4781717_A_Framework_for_Reverse_Logistics. (accessed December 30, 2025).
2. Newcastle Systems (2025). Top Reverse Logistics Challenges in 2025 and How Smart Warehouses Solve Them. https://www.supplychain247.com/article/top-reverse-logistics-challenges-in-2025-and-how-smart-warehouses-solve-them/newcastle_systems (accessed December 30, 2025)
3. Nisasia Ekafitrina and Charles Arthur (2023). Eco-industrial parks: resource efficiency and industrial symbiosis. https://www.unido.org/stories/eco-industrial-parks-resource-efficiency-and-industrial-symbiosis (accessed December 29, 2025).
4. OECD (2023). New Aspects of EPR and Challenges. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/ https://www.oecd.org/content/dam/oecd/en/publications/reports/2023/11/new-aspects-of-epr-extending-producer-

responsibility-to-additional-product-groups-and-challenges-throughout-the-product-lifecycle_84483c40/cfdc1bdc-en.pdf. (accessed December 30, 2025).
5. Rogers, D. S., & Tibben-Lembke, R. (1999). Going backwards: Reverse logistics trends and practices. https://www.scirp.org/reference/referencespapers?referenceid=2925453. (accessed December 29, 2025).
6. Salas-Navarro, K. (2024). Reverse Logistics and Sustainability: A Bibliometric Analysis. MDPI. https://www.mdpi.com/2071-1050/16/13/5279 (accessed December 30, 2025).
7. Tiwari, S., Wee, H.M. & Daryanto, Y. (2018), Big data analytics in supply chain management: Insights to industries, Computers & Industrial Engineering.https://www.scirp.org/reference/referencespapers?referenceid=4160546. (accessed December 29, 2025).
8. Vietnam National Assembly Publishing House, Law on environmental protection, Decree No. 72/2020/QH14 (2020), h.ttps://english.luatvietnam.vn/law-on-environmental-protection-no-72-2020-qh14-dated-november-17-2020-of-the-national-assembly-195564-doc1.html. (accessed December 29, 2025).
9. Vietnam National Assembly Publishing House Law on Environmental Protection, Decree No. 08/2022/ND-CP(2022) https://english.luatvietnam.vn/decree-no-08-2022-nd-cp-detailing-a-number-of-articles-of-the-law-on-environmental-protection-215632-doc1.html. (accessed December 29, 2025).

Cite this Article: Duy, Q.B. (2026). Optimizing Reverse Logistics in Manufacturing Production Processes. International Journal of Current Science Research and Review, 9(1), pp. 42-47. DOI: https://doi.org/10.47191/ijcsrr/V9-i1-06