Analysis of Reverse Logistics in Brazil

Vanessa Aparecida Valadares de Sá.

Faculty of Civil Engineering, Federal Center for Technological Education of Minas Gerais, dec@cefetmg.br

In an increasingly competitive and complex business environment, logistics has evolved considerably, expanding to encompass all activities related to physical and information flows within the supply chain. In this context, Reverse Logistics emerges as a crucial strategy for companies to address challenges such as increasing volumes of solid waste and raw material shortages, offering significant opportunities to add value to customers and promote sustainable practices. This article aims to elucidate fundamental concepts of reverse logistics and highlight key recycled materials in Brazil through a thorough literature review. Thus, reverse logistics plays an essential role in manufacturing various products, supported by promising technologies that aid recycling efforts in the country, integrating logistics networks across all business stages from planning to final disposition, which is critical for implementing sustainable and efficient waste reduction projects.

Keywords: reverse logistics, sustainability, economy.

1. Introduction

In a context of increasing competitiveness, logistics has evolved its conceptual foundation to systematically consider all activities related to physical and information flows within the supply chain. The sophisticated logistics management adopted by companies has become crucial for the implementation of promising marketing strategies aimed at meeting an increasingly demanding demand for deadlines and quality.

Despite the predominant focus on efficient distribution channels, there is a growing attention towards reintegrating products into the production cycle, known as Reverse Logistics. This concept is driven by the increasing volume of solid waste, scarcity of raw materials, and rising environmental awareness among the population.

In this scenario, modern companies see Reverse Logistics as an opportunity to add noticeable value to customers and end consumers. This work aims to present different approaches to Reverse Logistics, including its definition, reasons for adoption, reverse flows, reverse distribution network, system challenges, and trends in this logistic flow.

2. Benefits of reverse logistics

The following subtopics aim to discuss the main themes for a better understanding of the topics covered, seeking to clarify the step-by-step process to be implemented to achieve the objectives of the reverse logistics and cost control methodology.

2.1 Strategic Reasons for Reverse Logistics

Reverse logistics is driven by several important reasons. Growing environmental awareness and concern for sustainability contribute to low recycling rates of disposable products and the pursuit of organic material reuse (Cabral, 2001). Legal pressures, such as Extended Producer Responsibility (EPR), shift environmental accountability to manufacturers (Leite, 1998). Additionally, shorter product life cycles due to technological advancements increase waste generation, necessitating alternatives to minimize environmental impact (Leite, 1998). Companies also seek differentiation and recognition for their environmental practices (Glosa, 1997). Recycling materials like aluminum saves energy compared to producing virgin materials (ABAL). Using recycled plastics reduces production costs without compromising quality (PEGN, 2002). These factors underscore the strategic importance of reverse logistics for environmental sustainability and organizational economic efficiency.

2.2 Organizational Logistics

Modern logistics, as highlighted by Ballou (2006), has become strategic, emphasizing the crucial planning to continuously meet customer needs and ensure operational efficiency. Integrated into the supply chain, logistics management aims to ensure the efficient flow of goods, services, and information, including recycling to fully meet customer requirements (CSCMP, 2018). This approach underscores the importance of logistics in operational excellence and sustainability, playing a crucial role in maximizing profit and efficient resource management in organizations.

implementation of collaborative processes.

2.3 Reverse logistics

The Reverse Logistics (RL) is an innovative approach focused on environmentally sustainable solutions, configuring itself as a intricate system that enables the return of products to their origin. This return not only enables practices such as recycling, reuse, and remanufacturing, but also drives significant improvements in the company's overall environmental performance, as highlighted by Carter & Ellram (1988).

Although it initially emerged as a specific area within business logistics, Reverse Logistics has evolved considerably, now assuming a broader strategic position. This new role involves managing and optimizing product return flows, as discussed by Silva and Leite (2010). Its importance is noteworthy, being frequently mentioned in contemporary works on business logistics, as well as in national and international articles.

According to Leite (2009), Reverse Logistics is a discipline that not only plans, operates, and controls the flow of post-sale and post-consumer goods, but also adds value in various dimensions, including economic, legal, logistical, and corporate image aspects.

The comprehensive concept of Reverse Logistics, as proposed by Guarnieri (2013), encompasses the planning, implementation, and control of the entire cycle involving raw materials, work-in-process inventory, and finished products, with the primary purpose of recovering value or ensuring proper disposal.

2.3 Environmental Sustainability

Environmental sustainability, as highlighted by Philippi Jr. et al. (2002), aims to balance human development with the preservation of natural resources, extending beyond mere economic growth to include biodiversity preservation and ecosystem conservation. Responsible resource management, according to Wittmann et al. (2017), involves efficient resource use and waste reduction. The promotion of recycling and the circular economy, as emphasized by Gontijo et al. (2010), contributes to waste reduction and material utilization. Biodiversity preservation, noted by Leite (2009), requires protecting ecosystems and adopting sustainable agricultural practices. Finally, environmental sustainability is linked to ecological awareness and education, as discussed by Bursztyn et al. (2018), promoting sustainable behaviors and respect for the environment.

2.5 Logistics costs

Logistic costs play a crucial role in business management, essential for efficiency and profitability. However, the comprehensive approach to these costs has been underexplored in the literature, with few studies considering the entire logistics process, from sourcing to final customer delivery (Reeve, 1998). Reeve emphasizes the concept of Total Delivery Cost, tracking costs such as storage, transportation, and Supply Chain Logistics Costs and Distribution Costs. However, Faria (2003) highlights practical challenges in identifying and collecting logistics cost data across supply chains, making it difficult to associate costs with products to determine their total cost.

a) Storage costs: Warehousing involves activities to physically maintain stocks, including location, sizing, physical arrangement, allocation, dock design, warehouse configuration, internal movement technology, storage, and systems. Warehouse costs encompass invested capital, personnel expenses, occupancy costs (rent, taxes, insurance, utilities, security, cleaning, etc.), as well as maintenance costs for logistics assets and depreciation of equipment and facilities.

b) Transport cost and logistics costs: The cost of short-distance logistics transportation involves expenses associated with moving goods over short distances. This includes costs related to fuel, vehicle maintenance, and driver salaries. Efficiency in this transportation is crucial for cost reduction and quick delivery, directly impacting profitability and customer satisfaction in local logistics operations. Strategies such as route optimization and tracking technologies are essential for effective management.

c) Distribution logistics cost: Calculating distribution logistics costs involves a detailed analysis of elements such as transportation, storage, and order processing. This includes expenses related to fuel, vehicle maintenance, driver salaries, storage facilities, and inventory management costs. Strategies like route optimization and the implementation of tracking technologies are essential for cost reduction, ensuring more efficient and economical logistics operations. Precise focus on these variables is crucial for accurate calculation.

Reeve (1998) emphasizes the importance of measuring logistical efficiency through a profound understanding of logistics processes and flows. Identifying and quantifying logistical costs at every stage, from supply to delivery, is essential for optimizing operational costs and enhancing customer service quality. This approach proves valuable for effective supply chain management.

3. Methodology

The present methodology adopted a bibliographic research approach for conducting this study. This research consisted of an extensive review of academic sources, including books, dissertations, theses, scientific journals, and conference papers. Access to these materials was obtained through electronic databases and visits to specialized libraries. The main objective of this literature review was to identify relevant key points to be addressed in developing a proposal for applying the concept of reverse logistics.

4. Brazilian logistics systems

Brazil needs to implement reverse logistics systems for post-consumer products and packaging in various sectors, aiming to redirect these materials into a new cycle of utilization. This article discusses the evolution of implemented reverse logistics systems, highlighting significant results and publicly available information.

4.1 Electronics recycling

The electronics logistics industry is characterized by unique challenges, including volatile demand patterns, compact product sizes, and disposal complexities. Araújo et al. (2013) stress the significance of effective logistics planning, encompassing precise inventory management and reverse logistics to uphold customer satisfaction. Timely and efficient reverse logistics is critical to mitigate potential losses resulting from delays, impacting both repairable and non-repairable products. E-commerce firms place particular importance on reverse logistics, given its direct link to marketing strategies and customer satisfaction during sales (Araújo et al., 2013). Moreover, these companies encounter ongoing legal hurdles, aiming to harmonize logistics with legal requirements to achieve their organizational objectives. According to the Brazilian Association for the Recycling of Electronics and Appliances (ABREE), global electronic waste production reached 53.6 million metric tons (mt) in 2019, with only 17.4% undergoing proper disposal. This article seeks to explore the outcomes of reverse logistics specifically within the Brazilian context.

4.2 Lubricating oil packaging

The reverse logistics program of Instituto Jogue Limpo operates in 18 Brazilian states and the Federal District, covering 4,310 municipalities. It has 47,452 registered generators, with 28,147 currently active. From 2010 to 2019, the recycling of plastic packaging from lubricating oil saw a significant increase, rising from 1,149 tons to 5,036 tons, equivalent to over 100 million packages. The recycling rate reached 98.5% in 2019. The system includes 177 Points of Voluntary Delivery (PEVs), including 65 opened in 2019, spread across 13 of the 19 serviced federative units. It also conducts itinerant collections in municipalities with fewer than 15,000 inhabitants to facilitate proper disposal of the packaging.

4.3 Used tires

In recent years, Brazil has witnessed remarkable advancements in the management of reverse logistics for waste, particularly concerning used tires and fluorescent lamps. The Reciclanip program, since its inception in 1999, has successfully collected and properly disposed of approximately 5.23 million tons of used tires, equivalent to over 1 billion passenger car tires. Concurrently, the RECICLUS Association, established in 2016, has taken on the responsibility for the reverse logistics of fluorescent lamps, expanding its presence to 254 cities with over 1,390 collection points across Brazil. In 2018, around 2.46 million lamps were disposed of in an environmentally sound manner through this system. These efforts demonstrate a growing commitment to environmental sustainability and the circular economy in the country, although challenges remain to maximize the positive impact of these practices on a national scale.

4.4 Packaging in general

The Sector Agreement for Reverse Logistics of Packaging, established in 2015, involved the participation of 20 associations representing over 3,700 companies in the paper, plastic, and aluminum sectors. These companies committed to implementing actions aimed at circular economy and reverse logistics of packaging in general, setting goals for the use of recyclable and compostable materials in packaging production, according to guidelines from the Ministry of the Environment (MMA).

4.5 Medicines

Expired or unused medications are classified as hazardous waste - Class 1, with the potential to contaminate the environment and pose risks to public health if improperly disposed of. Despite Brazil being one of the world's top consumers of medications, the implementation of reverse logistics for these waste materials has faced challenges since the enactment of the National Solid Waste Policy in 2010. In response to this issue, the Federal Government issued Decree No. 10,388 in June 2020 to regulate the proper disposal of expired or unused household medications. This decree mandates the establishment of collection points in all Brazilian capitals and in municipalities with a population exceeding 500,000 within a two-year period, and within five years for municipalities with over 100,000 inhabitants.

4.6 Lead-acid batteries

The lead-acid batteries used in vehicles pose environmental challenges due to components such as lead plates and sulfuric acid. Reverse logistics measures for these batteries were already in place before Law 12,305/2010, according to CONAMA

Resolution No. 401/2008. In 2019, a sectoral agreement was established to implement collection, transportation, and proper disposal sites for these batteries, aiming to recover materials like lead and plastic and reuse the electrolyte solution. Data from the National System of Solid Waste Management Information (SINIR) indicates that in 2019, 275,250 tonnes out of 372,986 tonnes of batteries sold were collected, which is equivalent to 74% of the total

5. Final considerations

Reverse logistics plays a crucial role in the manufacturing of various products, with certain technologies in Brazil showing potential to assist in recycling efforts. To effectively implement sustainable projects and reduce waste, it's essential to integrate logistic networks that encompass all stages of business ventures, from planning to final disposition.

The adoption of reverse logistics not only promotes a sustainable image for companies but also leads to economic benefits through cost reduction. Companies that have embraced these practices have seen added value in terms of clean, sustainable, and eco-efficient production.

Through practical experiences, it becomes evident that integrating reverse logistics principles into the organizational culture mobilizes employees to take on environmental and social responsibilities, recognizing gains beyond financial aspects. The future of the market is likely to adopt an integrated model of reverse logistics management, covering the entire supply chain and customer service.

Strategies for handling returned products, transparency in return policies, and adaptation to regulations represent challenges and opportunities for businesses and governments. In summary, reverse logistics offers substantial benefits by promoting cost reductions in the supply chain and fostering socio-environmental responsibility.

6. References

Alves, G. (2010). "Use of frying oils for biodiesel production." Araçatuba Technology College. Biofuels Technology Course. Araçatuba.

Baldasso, E., Paradela, A. L., & Hussar, G. J. (2010). "Reuse of frying oil in soap manufacturing." Environmental Engineering: Research and Technology, 7(1).

Ballou, R. H. (2006). "The evolution and future of logistics and supply chain management."

Berto, R. M. V., & Nakano, D. N. (1999). "Scientific production in the proceedings of the National Meeting of Production Engineering: a survey of methods and types of research." Production, 9, 65-75.

Buller, L. S., Bergier, I., Ortega, E., & Salis, S. M. (2013). "Dynamic emergy valuation of water hyacinth biomass in wetlands: an ecological approach." Journal of Cleaner Production, 54, 177-187.

Bursztyn, M. A. (2018). "Fundamentals of environmental policy and management: paths to sustainability." Garamond Publisher.

Carter, CR and Ellram, LM (1998). "Reverse logistics: a literature review and framework for future research." Journal of Business Logistics, 19(1), 85.

Chaves, G. D. L. D., & Batalha, M. O. (2006). "Do consumers value the collection of recyclable packaging? A case study of reverse logistics in a hypermarket chain." Management & Production, 13, 423-434.

Costa Neto, P.R.; Rossi, L. F. S.; Zagonel, G. F.; Ramos, L. P. (2000). "Production of alternative biofuel to used soybean oil in frying." New Chemistry, v. 23, n.4, p. 531-537.

Dib, F. H. (2010). "Biodiesel production from recycled residual oil and comparative tests with other types of biodiesel and blending ratios in a power generator."

Godinho, P., Dias, J. M., & Costa, J. P. (2017). "Logistics (2nd edition)." Coimbra University Press.

Gontijo, F. E. K., Dias, A. D. P., & Werner, J. (2010, August). "Closed-loop reverse logistics for PET packaging." In the National Congress of Excellence in Energy Management, Innovation, Technology, and Complexity for Sustainable Management, Niterói, RJ, Brazil (Vol. 6).

Guarnieri, P., Hass, D., & Monteiro, G. (2013). "Measurement of the financial and economic effects of reverse logistics through environmental accounting." Journal of Environment and Sustainability, 4(2), 202-225.

Junior, O. P., Neto, M. N., Sacomano, J. B., & Lima, J. L. A. (2009). "Recycling of used cooking oil: a contribution to increasing the productivity of the process." In International Workshop Advances In Cleaner Production (Vol. 2, pp. 1-10).

Lago, S. M. S. (2013). "Reverse logistics, legislation, and sustainability: a model for collecting residual frying oil as raw material for biodiesel production."

Leff, E. (2001). "Globalization, environment, and sustainability of development In.: _ Environmental knowledge: sustainability, rationality, complexity, power." Petrópolis, 5, 310-314.

Leite, P. R. (2002). "Reverse logistics: a new area of business logistics." Technologística Magazine, 78, 102-109.

Leite, P. R. (2009). "Reverse logistics." Pearson. São Paulo.

Lopes, R. C., & Baldin, N. (2009). "Environmental education for reusing cooking oil in soap production – 'Ecolimpo' Project." In EDUCERE-National Congress of Education (Vol. 9, No. 83, pp. 3322-

3222).

Martins, G. D. A., & Theóphilo, C. R. (2009). "Scientific research methodology." São Paulo: Atlas, 143-164.

Moura, B. (2006). "Logistics: concepts and trends." Atlantic Center.

Neto, L. (2010). "Use of used cooking oil as an alternative source in renewable energy production, seeking to reduce environmental impacts."

Daher, Cecílio E., Silva, Edwin P. S., Fonseca, Adelaida P.. Reverse Logistics: Opportunity for Cost Reduction Through Integrated Value Chain Management. Erthal, Jacir A.. Indicators for Product Physical .