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Managing the supply chain in a close loop: a review of the basics

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Abstract
The aim of this article is to familiarize the reader with the concept of closed-loop supply chains from a business standpoint, which emphasizes the profitable recuperation of value from products that have been returned. Academics and practitioners have shown interest in reverse logistics and closed-loop supply chain issues due to various factors including environmental, legal, social, and economic considerations. In today's context, supply chains have become increasingly intricate, partly because of the environmental and economic challenges that we confront. As a result, there is a need for greater efficiency, recuperation of energy and materials, and cost reduction within the supply chains. The concerns regarding sustainability have prompted numerous industries to adopt closed-loop supply chains (SCs), resulting in a more intricate process that involves multiple vulnerabilities because of the close loop or multi-circular configuration, involving various reverse movements of goods, parts, and materials.

1. Introduction

The concept of a closed-loop supply chain (CLSC) has become more significant due to the rise in waste volume, the stricken of environmental regulations, and the emphasis on recycling used products to benefit the economy. The CLSC involves designing, operating, and managing a system to extract the highest value from various types and amounts of returned products over time [1]. A closed-loop supply chain network integrates both forward and reverse supply chain operations to optimize economic and environmental benefits. As defined by Guide and Van Wassenhove (2003, a forward supply chain follows the traditional flow of materials from suppliers to manufacturers, retailers, and finally to customers. In contrast, reverse logistics involves redirecting goods from their original destination to extract value or dispose of them responsibly. This definition may also encompass remanufacturing and refurbishing processes. Raw materials, parts, and components sourced from suppliers are processed at production

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facilities to create new products, which are then distributed to customers. The traditional supply chain refers to a production process where the supplier provides the manufacturer with either raw materials or partially completed products, which are then transformed or assembled into finished products. These finished products are then transported to the wholesaler, followed by the retailer, and eventually delivered to the end customer. The entire process is closely linked and integrated.
As the economic aspects and environmental conditions of supply chains evolve over time, new methods emerge to manage them. One such approach is the Closed Loop Supply Chain (CLSC) concept, which is gaining increasing significance each year. Now a days, environmental pollution and depletion of natural resources have become increasingly pressing issues. Governments and international organizations are placing greater emphasis on protecting the environment and conserving energy. Manufacturing, as a major user of energy, has a crucial role to play in adopting sustainable practices. Sustainability generally means the utilization of natural resources in a way that fulfills current needs and does not endangering the availability of same resources for future generations to meet their own needs [2].
Businesses actually employ a range of strategies that are linked to one or more stages in the life cycle of a product. These may include methods like combining production planning with policies that control remanufacturing[3] promoting product recovery[4], integrating backward logistics to establish Closed-Loop Supply Chains (CLSCs)[5], and working towards reducing carbon emissions on a larger scale[6].

2 Closed-loop supply chains (CLSC)

Over the last decade, there has been a significant focus on the management of closed-loop supply chains (CLSC). This is evident in various reviews such as those conducted by Fleischmann et al [7]. Manufacturing companies are motivated to reduce their wastage due to governmental rules and regulations enforced by many countries [8]. Schultmann et al. [9] conducted research on reverse logistics in the automotive industry, specifically focusing on end-of-life vehicles in Germany. They utilized the Tabu Search Algorithm to create a closed-loop supply chain model. Meanwhile, Kumar and Yamaoka [10] explored the Japanese automotive sector by implementing a system dynamics approach to analyze the reverse flow of cars and identify optimal recovery options. According to JUMVA's report in 2003, the majority of Japanese used cars exported, which accounted for 55% of the total, were sent to four countries: New Zealand (23%), UAE (13%), England (10%), and Russia (9%). These nations played a crucial role in establishing an effective closed loop supply chain for Japanese vehicles.
Yang et al. [11] created a comprehensive CLSC (closed-loop supply chain) network model that incorporated various components such as raw material suppliers, manufacturers, retailers, customers, and recovery centers. The purpose of their research is to enhance the equilibrium state of the network by applying the principles of variational inequalities. The article employs the theory of variational inequalities to create and enhance the equilibrium condition of the network. Numerous illustrations and diagrams are included to illustrate how parameters, such as the return ratio, raw material conversion rate, and recyclable product conversion rate, impact the equilibrium shipments and net profits.

Notable Examples:

- **Apple Inc.** has successfully implemented CLSCs by introducing trade-in and recycling programs, allowing customers to return old devices for refurbishment or recycling. These practices reduce e-waste and recover valuable materials like aluminum and rare earth metals for new products.
- **HP** employs hardware recovery initiatives where used printers and cartridges are collected, recycled, or remanufactured, contributing to sustainability and cost-efficiency.
- **Automotive Industry:** Companies like Toyota and BMW have established CLSC frameworks for end-of-life vehicle recovery, dismantling, and material reuse to meet environmental standards and reduce production costs

The main focus of our article is to examine the contributions that have been made towards the development of reverse logistics theory. Since there are no established sources of information regarding reverse logistics theory, we occasionally refer to literature from related fields that have indirectly contributed to the growth of this theory. Furthermore, we provide a brief overview of how the content framework presented in this paper relates to this existing literature, as well as highlighting any differences or divergences. The closed-loop supply chain model encompasses suppliers of raw materials, manufacturers, retailers, customers, and facilities involved in the recovery and recycling of products. As globalization becomes more widespread, competitive markets intensify, demand becomes less predictable, and economic challenges arise. As a result, there is a greater emphasis on sustainability within supply chains.[12]

2.1. Circular Economy

The worldwide trends of manufacturing, usage, and commerce persist to be alarmingly unsustainable. If there are no alterations in the sourcing, production, delivery, usage, reclamation, and regeneration of products, the world will exhaust a significant number of its natural resources in the near future, given its present consumption rate. Circular supply chain management refers to the incorporation of circular principles into the administration of the supply chain and its associated industrial and natural ecosystems. This involves implementing innovative business models and supply chain functions, from product and service design to end-of-life and waste management, to achieve a zero-waste vision.

The concept of Circular Economy (CE) was initially developed in the 1970s with the aim of decreasing the usage of raw materials in industrial production processes. However, it has been discovered that this approach has the potential to be applied to any type of resource [13]. According to Pearce and Turner [14], there is a difference between exhaustible and renewable resources. Exhaustible resources will diminish in stock with any use, while renewable resources can replenish themselves. If renewable resources are used within their capacity, they will not diminish and may even grow, which weakens the argument for a circular economy based on a "finite resource base," as proposed by Stahel [15].

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2.2 Traditional supply chain management & Reverse logistics

The roots of supply chain management can be traced back to the 1940s and 1950s when there was a focus on using mechanization to improve labor-intensive processes in logistics. However, the 1980s marked a significant shift in the history of supply chain management, with consultants introducing the term "supply chain management" for the first time during this period.[16]

The conventional approach to supply chain management is inflexible and revolves around the production of goods. In this approach , the team responsible for managing the supply chain procures raw materials, which are then handed over to a manufacturer for product creation. The finished products are then transferred to a retailer or other sales outlet for delivery to the end customer. When a product reaches the end of its life cycle, it has the potential to cause environmental pollution, but it also contains parts, components, and materials that can be reused or reintroduced into the production process. Therefore, the recovery of end-of-life products is a crucial stage in the product's life cycle.

According to Stock [17] reverse logistics is commonly defined as the function of logistics that deals with the process of product returns, reduction of sources, recycling, substitution of materials, reusing materials, disposal of waste, as well as refurbishing, repairing and remanufacturing A closed-loop supply chain's reverse flow variability results in increased variation in serviceable inventory. Nonetheless, an appropriate design of the reverse flow can significantly enhance the overall performance [18].

The concept of reverse logistics (RL) has gained significant attention from researchers and practitioners around the world due to various reasons such as the growing emphasis on sustainability, intense global competition, potential future regulations, rising product returns, environmental awareness among customers, and other related factors. Organizations are striving to enhance their supply chain efficiency due to the intensified competition brought about by globalization and swift technological advancements. To maintain and expand their market share, businesses are focusing on improving their reverse logistics processes, including the recovery of returned products and proper disposal of end-of-life products. Manufacturers, retailers, and service providers are expected to provide better return policies by customers, and companies are trying to maximize the value they get from returned products [19].

2.3 Global supply chain management

Global Supply Chain Management (GSCM) refers to the systematic process of organizing and coordinating the movement of products and services from the point of origin to the point of consumption. The activities involved in this process include strategizing, procuring raw materials, producing goods, distributing them to customers, and handling any product returns.

Globally recognized companies exemplify decentralized production systems, which are further complicated by a supply chain that links multiple countries with varying currencies, import tariffs, fiscal policies, and so on. In order for companies to achieve maximum efficiency and productivity, it is necessary to connect the supply chain management system with an enterprise resource planning database to facilitate

collaboration between different departments.
Rapid changes are taking place in all types of businesses and industries. This is due to the intense competition, financial constraints, fluctuating market demand, and constantly evolving demand patterns of today's market. Consequently, supply chains cannot be easily adjusted overnight to purchase, produce, transport, or distribute goods and services in the appropriate quantities and locations [20]. Global suppliers must have knowledge of their customers' demand. Bowersox [21] emphasizes that achieving demand integration necessitates companies to establish comprehensive long-term agreements to enhance relationships with particular customers and suppliers. David characterized an international supply chain within the transportation sector as a multifaceted and constantly changing system in which disruptions and extended shipping and lead times result in expenses [22].
Managing the flow of goods, information and money across borders is a highly complex, regulated and dynamic process. All companies, large and small, eventually reach a decision point with regard to global trade management. This is the core competency that justifies a continuous investment in people, technology and resources, or it is a process best managed by a partner whose primary focus and business is achieving excellence in global trade management (GTM)[23]. The design of the supply chain by the global logistics operator involves multiple countries and could cover a vast distance spanning from Australia/China/India/Malaysia to Europe and North America, as well as in the opposite direction. As consumers' demand for environmentally sustainable practices in the fashion industry supply chain has grown, the amount of academic literature on the topic has also increased. The majority of this literature concentrates on enhancing the internal processes of forward-oriented supply chains [24.]

2.4 Market and competitions
Market is defined as a system where resources in their initial form, partially-processed items, and final goods are transported towards buyers, while money flows in the opposite direction towards the manufacturers and suppliers, and information is exchanged in both directions.
From a long past time when marketing is comes in process, all the market works on forward supply chain. In which market focus on supply chain that include factors like raw material source, its processing towards manufacturing units and toward production units for making some useful products which have demand in public, society. This products once go outside from company in the society or between public it never comes back. This end product go in disposal materials in a world of waste material , where this product become danger for humans , for environment, and create many bad effect in the environment with creating pollution in the nature and creating diseases for living birds(human ,birds, animal vegetation). Due to this problems a term reverse supply chain comes in progress which create second hand of market in which end product again comes in industry, where it again become part of supply chain. This used product remanufacture, reuse and recycle in the chain. This reverse chain helps to reduce pollutions and health related problems.

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Reverse supply chain create another market in the world. The reverse logistics sector is expected to grow as a result of advancements in technology and automation. Additionally, the expansion of transportation infrastructure, which has received increased government funding [25], is contributing to the growth of the reverse logistics industry. Reverse logistics involves utilizing discarded or obsolete products to create new value, rather than wasting them.
Further, a company's competitive edge can be attributed to their ability to lead in cost or differentiation. In several ways, the advantages of adopting a reverse logistics approach to competitiveness are apparent in how the company can obtain value by repurposing products that are returned, discarded, or no longer in use [26].
There is a lack of research that examines the competition between chains and channels that have varying power structures, particularly in the context of a reverse supply chain. As an example, *Apple offers their customers the option to recycle their outdated devices either through an Apple Store or an online collection platform. Similarly, **HP provides their customers with the opportunity to recycle their hardware from any brand via both in-store and online collection methods. Meanwhile, dominant electronics companies like *** Dell have recently opened physical stores for product sales, while relying solely on online channels for collecting outdated products.
Although various supply chains with similar businesses are operating in the same markets amidst a growing competitive environment, the majority of studies assess the issue of SCND (supply chain network design) in a non-competitive and monopolistic setting [27]. The undeniable importance of reverse logistics in the automobile industry is becoming increasingly prominent. This can be observed through the growing prevalence of the concept. There are several clear reasons for this growing dominance, including the need for consistent product recalls, adapting to changing legislative requirements, and prioritizing environmental sustainability [28].

2.5 Standards and Regulations
Regulations and standards play important role for growth of Reverse supply chain in closed loop supply chain system. The ISO 28000 standard provides guidelines to mitigate risks during goods transportation. It assists in the control and reduction of possible security threats that may arise during the movement of goods, addressing issues such as terrorism, piracy, and fraudulent activities. The government's involvement is crucial in facilitating and managing closed-loop supply chains, according to [29]. In a closed-loop supply chain that is regulated by the government, the choices made by companies are inevitably impacted by the policies put forth by the government. The concept of Extended Producer Responsibility (EPR), as outlined by policy, aims to tackle concerns related to the environment and the reuse of resources [30].
Governments have several ways. to encourage the adoption of closed-loop supply chains. For example, China has implemented the "old-for-new" policy for replacing automobiles and home appliances to promote domestic consumption, reduce pollution, and conserve resources. In 2009, this policy was launched as a pilot program in Beijing, Shanghai, and seven other cities. Customers who replace their old appliances with new

ones, such as televisions, refrigerators, washing machines, air conditioners, and computers, are eligible to receive a 10% subsidy on the sale price [30, 31]. While a number of papers have examined the effects of government subsidies in closed-loop or reverse supply chains, very few have taken into account the role of the government as an active participant.

3. Actionable Recommendations for Businesses Transitioning to CLSCs

For transition to a closed-loop supply chain, businesses can consider to incorporating these strategies by reducing waste, improve resource utilization, and achieve long-term sustainability goals. Following strategies can be implemented:

Assess Current Processes: Conduct a comprehensive evaluation of existing supply chain operations to identify areas where reverse logistics and sustainability can be incorporated.

Invest in Technology: Leverage tools like artificial intelligence and data analytics to optimize supply chain visibility, enhance recycling efficiency, and predict product lifecycles.

Develop Partnerships: Collaborate with suppliers, manufacturers, and recycling facilities to create an integrated network for material recovery and reuse.

Educate Stakeholders: Train employees and inform customers about the benefits and operational changes associated with CLSCs to ensure smooth implementation.

Adopt Circular Design Principles: Design products for durability, reparability, and recyclability to facilitate end-of-life recovery.

Engage in Policy Advocacy: Work with regulatory bodies to promote favorable policies and participate in industry standards development.

Monitor and Measure Progress: Establish clear metrics to track CLSC performance and ensure continuous improvement.

4. Conclusion

The article examined and clarified the definition of a closed-loop supply chain, with a particular focus on its value for the environment, and its importance in market and economic growth related to CLSC and RCS. It was discovered that closed-cycle supply chain management brings various benefits to companies, particularly in the recycling of production waste, leading to cost savings by eliminating wastage. Focusing on reverse logistics has the potential to be extremely advantageous for the world by making the most of the resources that are currently available. CLSC and RSC help for reducing global warming, by reducing waste products on earth.

References

1. Guide, V.D.R. and Wassenhove, L.N.V. (2003) Business Aspects of Closed-Loop Supply Chains. Carnegie Mellon University Press, Pittsburgh
2. WCED 1987, “World commission on environment and development. report of the world commission on environment and development: our common future internet,” 1987].
3. V. Jayaraman, “An efficient heuristic procedure for practical-sized capacitated

warehouse design and management," *Decision Sciences*, vol. 29, no. 3, pp. 729–745, 1998]
4. V. Jayaraman, "Production planning for closed-loop supply chains with product recovery and reuse: an analytical approach," *International Journal of Production Research*, vol. 44, no. 5, pp. 981–998, 2006].
5. K. Lieckens and N. Vandaele, "Reverse logistics network design with stochastic lead times," *Computers & Operations Research*, vol. 34, no. 2, pp. 395–416, 2007].
6. A. Ramudhin, A. Chaabane, M. Kharoune, and M. Paquet, "Carbon market sensitive green supply chain network design," in *2008 IEEE International Conference on Industrial Engineering and Engineering Management*, pp. 1093–1097, IEEE, Singapore, December 2008].
7. M. Fleischmann, J. M. Bloemhof-Ruwaard, R. Dekker, E. van der Laan, J. A. E. E. van Nunen, and L. N. van Wassenhove, "Quantitative models for reverse logistics: a review," *European Journal of Operational Research*, vol. 103, no. 1, pp. 1–17, 1997].
8. S. K. Srivastava, "Green supply-chain management: a state-of-the-art literature review," *International Journal of Management Reviews*, vol. 9, no. 1, pp. 53–80, 2007]
9. Schultmann, F., Zumkeller, M., Rentz, O.: Modeling reverse logistic tasks within closed-loop supply chains: an example from the automotive industry. Eur. J. Oper. Res. 171(3), 1033- 1050 (2006)
10. Kumar, S., Yamaoka, T.: System dynamics study of the Japanese automotive industry closed loop supply chain. J. Manuf. Technol. Manag. 18(2), 115-138 (2007)
11. Yang, G.F., Wang, Z.P., & Li, X.Q. (2009). The optimization of the closed-loop supply chain network. Transportation Research Part E: Logistics and Transportation Review, 45(1), 16-28. doi. 10.1016/j.tre.2008.02.007
12. Arabsheybani, A.; Paydar, M.M.; Safaei, A.S. An integrated fuzzy MOORA method and FMEA technique for sustainable supplier selection considering quantity discounts and supplier's risk. J. Clean. Prod. 2018, 190, 577–591. [CrossRef]
13. Preston, F., 2012. A Global Redesign?: Shaping the Circular Economy. Chatham House London
14. Pearce, D., & Turner, R. K. (1990). Economics of natural resources and the environment. Baltimore: Johns Hopkins University Press.
15. W.R. Stahel, The circular economy ,Nature, 531 (7595) (2016), pp. 435-43
16. Oliver, r. k. andWebber d., (1992). Supply chain management: logistics catches up with strategy. In christopher,M. G., (ed) Logistics, The Strategic Issue (London: Chapman & Hall).
17. Stock, James R., 1998,"Development and Implementation of Reverse Logistics Programs", Business Briefing: Global Purchasing and Supply Chain Strategies
18. Tonanont, Ake (2009)Performance Evaluation In Reverse Logistics With Data Envelopment Analysis, Thesis, University of Texas,Arlingtom.
19. Daugherty, P. J., C. W. Autry, et al. (2001). "Reverse Logistics: The relationship between ,resource commitment and program performance." Journal of Business

J Euro Eco His.
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Logistics,22(1): 107-123.
20. Han X., Wu H., Yang Q., Shang J. (2017). Collection channel and production decisions in a closed-loop supply chain with remanufacturing cost disruption. *International Journal of Production Research*, 55(4), 1147–1167.
21. Bowersox, D.J. (1997), Integrated supply chain management: a strategic imperative. Presented at the Council of Logistics Management Annual Conference, pp. 5 - 8 October, Chicago, Il.
22. David, L.L. (1995), International sourcing and supply chain stability. Journal of International Business Studies 26 (2), pp. 343 – 360.
23. Global supply chain management and international logistics by Alan E.Branch , published 2009 by Routledge 270 Madison Ave , New York,NY10016 ,page2
24. Bottani, E., Tebaldi, L., Lazzari, I. & Casella, G., 2019, 'A model for assessing economic and environmental sustainability dimensions of a fashion supply chain and a case study', *IFAC Papers Online* 52(13), 361–366.
25. A. Cely Torres, "Importancia de la logística inversa para un desarrollo sostenible en Colombia," 2013. [Online]. Available: https://ciencia.lasalle.edu.co/gs/vol6/iss2/8 , E. T. Salas Valdivia, "La logística inversa en el sector manufacturero y su impacto en el medio ambiente," Economía & Negocios, vol. 2, no. 1, pp. 35–42, Jun. 2020, doi: 10.33326/27086062.2020.1.906.
26. Fallah, H., Eskandari, H., & Pishvaee M.S. (2015). Competitive closed-loop supply chain network design under uncertainty. Journal of Manufacturing Systems, 37 (3), 649–661.
27. Ma, W.; Zhao, Z.; Ke, H. Dual-channel closed-loop supply chain with government consumption-subsidy. Eur. J. Oper. Res. 2013, 226, 221–227. [CrossRef]
28. Syed Abdul Rehman1, Yu Zhang2, Syed Shahid Khan , Reverse Logistics and Challenges: Supply Chain Management of Automobile Industry ,Advances in Applied Sciences, 2017; 2(5): 80-86
29. General Office of the State Council of the People's Republic of China. The State Council General Office Document. Available online: http://www.gov.cn/zwgk/2009-06/03/content_1331210.htm (accessed on 26 July 2019).
30. Organization for Economic Cooperation and Development (2001). Extended Producer Responsibility: A Guidance Manual for Governments. Paris: OECD Publications Service. doi:10.1787/9789264189867-en. ISBN 9789264189867
31. P. Calcott *et al.* Can downstream waste disposal policies encourage upstream "design for environment"? Am. Econ. Rev.(2000).

*https://www.apple.com/supplier esponsibility/pdf/Apple_SR_2021_Progress_Report.pdf
**https://www.hp.com/us-en/hp-information/sustainable-impact/document-reports.html
***https://www.dell.com/en-us/dt/corporate/social-impact/advancing ustainability/accelerating-the-circular-economy.htm#tab0=0