

REVIEW ARTICLE

Analysis on Waste Reduction Strategies for Retailers Among their SCM Distributional Partners

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Abstract

The retail sector in United States of America (USA) is currently facing persistent supply chain waste problems, which encompass inefficiencies, excessive inventory, and logistical obstacles. To tackle these problems, specific tactics are needed to decrease escalating expenditures, minimise ecological consequences, and restore diminished financial viability. This study used a qualitative research methodology, utilising secondary data sources, to investigate strategies for reducing supply chain waste in the US retail business. The paper classifies various forms of waste within the supply chain, examines the associated difficulties and reasons that contribute to waste production, and presents a streamlined framework tailored specifically for the retail industry in the United States. Current study emphasis on enhancing the operational efficiency and sustainability aspects of organisations by reducing the supply chain waste. Furthermore, the study will highlight the need of taking proactive actions to mitigate the supply chain waste in USA retail industry by encouraging environmental stewardship. This analysis provides a comprehensive analysis, sensible recommendations, and a reverse logistics model to help US retailers expand and compete with each other and with global players as well.

Keywords: Supply Chain Management, Waste reduction, Environmental impact, Pollution control, Retail industry.

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1. Introduction

In the retail industry, it's more important than ever to make most out of every dollar & minute. Not having good processes, being too rigid, or having poor communication can really cause problems. Also, when there are mistakes in ordering or issues in a company's supply chain, it leads big inefficiencies, which may result in losing a lot of time & money. Hence, applying effective strategies can help reduce waste in the supply chain. Supply chain waste (SCW) includes shortages and surpluses when making & delivering products or services. This can happen due to things like overproduction, having too much inventory, transportation that is not effective, or packaging that's not necessary [1]. In November 2023, President Biden implemented a set of measures to enhance the robustness of US supply networks, leading to significant transformations within the industry. This program demonstrates a dedication to guaranteeing the prompt accessibility of necessary goods and services

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for American citizens, encouraging the utilisation of products made within the country, and nurturing the development of jobs an important point where the country's political, technical, economic, social, environmental, and national security connect [2].

SCW consist of various understocking and overstocking of goods and services that arise during the process of producing and distributing goods or services. Retailers today face many problems with how they handle their supply chains. There's too much stuff being made, and lot of it just sits in warehouses. Transportation isn't always smooth, either, and packaging often goes to waste. Right now, many retail companies in the U.S. are trying to make their supply chains work better by cutting out things that don't add value. The impact of waste in the supply chain on retailers is pretty big. It leads to spending more money, creates environmental issues, and lowers profits. For example, the clothing industry alone estimated that they lost over \$15.3 billion in 2022, mainly because of the inefficiencies including issues having to do with packaging.

Despite such challenges, the retail sector is straining to achieve efficiency, hence they're applying lean techniques to increase supply chain velocity, better inventory control, and convert to sustainable packaging. This paper examines how and specifically where waste can be reduced and controlled in supply chain for better retail operations to be conducted. It builds on a prior study to shed light on what is already understood about the how retailers manage supply chain waste. The purpose here is to provide as realistic overview of various wastes existing in supply chains of the United States. This means elaborating on problems which are: Overproduction, that creates too much inventory, Transports troubles, and methods of packaging that are unneeded – all of which are wasteful and are costly to retailers. The study will also look at the depth the impact of this waste in the retail industry in the United States of America. This paper reviews various cases and facts which show how these wasteful processes increase costs, negatively affect the environment, and decrease profits. It is very crucial to understand these impacts if anyone wants to advance his business and attain financial sustainability.

Furthermore, it will examine the various issues that generate waste in supply chains. This also entails identifying areas of concerns, for instance; weak forecasting tools, inadequate logistics, and bad inventory control. The research will provide knowledge of why waste occurs and assist in providing solution for the same. Lastly this paper will provide rectification measures and a comprehensive plan that will assist retailer reduce food waste in supply chain. It will therefore pay emphasis on the application of the best practices in managing the supply chain together with productivity through new technologies and more the environmental responsibility for achieving the environmental goals. The main purpose is to increase the effectiveness for American retailers to expand gradually and sustain their competition in the markets.

2. Supply chain management

Several significant themes have arisen as a result of this combination. Initially, there has been a shift from a strategy of actively promoting products to clients to one where the supply chain is influenced by customer demand. Customers have gained significant influence in the marketing channel. Furthermore, information systems have a greater impact on attaining enhanced control over the supply chain. Furthermore, there is a deliberate and coordinated endeavour to eliminate unnecessary stock within the supply chain. Furthermore, there is a strong focus on the fundamental skills and abilities that are essential to the organisation, with a heightened dependence on external specialists for jobs that are not directly related to the organization's main activities. Aspelting [8] assert that food logistics in the UK has progressed to a crucial fourth stage, characterised by the development of comprehensive supply chain management systems and the adoption of collaborative partnership initiatives. This stage represents a transition towards a more collaborative approach in supply chain management, departing from the traditionally hostile dynamics between merchants and suppliers. The grocery supply chain in the UK is often recognised as the most efficient on a worldwide scale, making a substantial contribution to the success and profitability of its food stores. Hence, retailers from many industries and geographical areas have endeavoured to imitate this efficient supply chain framework, as demonstrated by Best Buy's initiatives in 2007.

In order to enhance the efficiency of the supply chain, it became clear that supply chain integration (SCI) is required to combine the separate processes into a single system. Companies have to adopt a system which help in minimize the duplication and assure the overall cost reduction to handle their expenses. SCI approaches are increasingly focused on integrating customers into the supply chain structure and can be accomplished

by developing continuing relationships with trading partners along the whole supply chain [9]. The swift progression of grocery retailing in the UK has taken place over a comparatively little timeframe (Sparks, 1998). Prior to 1980, manufacturers were primarily responsible for managing the distribution of products to retail outlets. They would hold goods at their manufacturing facilities or field warehouses and then make multiple deliveries to tiny shops. Nevertheless, as retail chains expanded, significant amounts of money were allocated to establish regional distribution centres (RDCs) in order to improve the effectiveness of delivering products from suppliers to stores. Third-party logistics providers emerged due to the centralising of the purchasing and distribution of fast-moving consumer goods (FMCG) at the end of the 1980s [10]. This transformed the whole context of logistics and deprived manufactures as well as suppliers the major level of control over the supply chain and centralizing power within the retailing sector. Through the centralisation process, shops were able to challenge the long delivery time, minimise on inventory, and increase the variety of products for the consumers.

In 1990s, these advancements were further solidified as inventories often transitioned directly from the shop to the RDC. Retailers began paying much attention to their primary supply systems, the focus of products' transportation from the suppliers to the various RDCs was on JIT and other flow concepts. Therefore, this change created the necessity of more deliveries of smaller quantities, and this proved a problem for many suppliers who struggled to transport big vehicle loads [11]. Consolidation centres were established prior to the RDCs to get the maximum outcome from distributional vehicles and merchants developed programs for picking up products from supplier locations as part of store delivery trips. Among these factors, channel management and the nurturing of supplier and consumer relationships are essential primary activities for these merchants. However, there is still a need to point out imperfections in these supply chains, which are inevitable. It should be noted that some of the UK shops for instance Sainsbury have described significant challenges that they have faced [12]–[13].

Supply chain disruptions are best described as an ugly reality of life that has a ripple effect on the physical supply of goods. The issue of out of stocks has become an important challenge in everyday practice as well as in theoretical research [21]–[26]. Such shifts in food logistics in the UK reflect an overall trend for improvement and integration and set up the sector as a benchmark for the methods of the international retail logistics. This approach to the management of transport and distribution of groceries in the UK has not only improves the operational performance but has set a standard that many industries and sectors aim at. During the early 2000s, there has been a development of the retail networks for instance through the implementation of Efficient Consumer Response projects. Distribution centres of supermarkets have evolved to a surge in the number of non-food products sold inside supermarkets. The current fashion of information access which has established the internet has facilitated the establishment of Collaborative Planning, Forecasting, and Replenishment (CPFR) projects. These programs are meant to help reduce the latency that is characteristic of supply chains. In the UK, supermarket merchants have taken on more authority over the supply chain, expanding their duties to encompass tasks that were formerly handled by manufacturers. The current duties include product development, packaging logistics, branding, advertising, and distribution. The robust market dominance of retail product brands has cultivated customer allegiance and facilitated expansion into supplementary industries, such as banking.

Tesco is renowned for its very efficient supermarket supply networks, both in the UK and potentially on a worldwide scale. Since the early 1980s, the corporation has experienced a significant shift, largely influenced by the development of its supply chain management role [13]. An illustrative depiction of the primary phases of development demonstrates notable changes in strategy and authority, signifying a substantial rise in the influence of retailers. This regulation has resulted in the creation of a supply chain organised by retailers, with the goal of optimising the efficacy and efficiency of delivering items to consumers.

Tesco has undergone restructuring of its local, national, and global supply chains in response to its international expansion of sourcing and store operations. Nevertheless, this shift has encountered obstacles, giving rise to multiple apprehensions [14]. The transformation in the retail industry has required a restructuring of the supply chain to meet the ever-changing and unpredictable needs of modern consumers, revealing the insufficient flexibility of current systems. This change highlights the necessity for ongoing innovation and adaptability in supply chain management to maintain effectiveness and fulfil consumer expectations in a swiftly evolving market environment.

Kim et al. [30] proposed that an SSC is a supply chain that integrates sustainable development principles

and operates within the three pillars of sustainability. More than ten years ago, academics combined the management of supply chains to create Supply Chain Sustainability Management (SCSM) [15]. The purpose was to achieve sustainable development goals and overcome problems by merging effective methodologies and strategies. The initial techniques primarily emphasized environmental concerns and associated subjects, such as sustainable design, eco-friendly products, and environmentally conscious supply chains. Further extensive literature surveys uncovered multiple interpretations of SCSM [16], highlighting the importance of the three sustainable dimensions such as coordination, cooperation, and collaboration along the entire supply chain [17].

SCM, as often defined, refers to the operations that comprise the movement and transformation of goods and services within a supply chain, together with the associated information flows, from the initial sources of materials to the ultimate consumers. Supply Chain Management (SCM) is of utmost importance in the current global economy and necessitates a thorough assessment that highlights the interdependence of its members [18]. Firms aimed to minimize waste mainly for commercial purposes, give less importance to social or environmental factors [19] and the main focus of the company's strategy was to utilise its purchasing power effectively [20].

Read et al. [31] focusing on the coordination, efficiency, and effectiveness aspects of SCSM and defined SCSM as the purposeful incorporation of economic, environmental, and social elements into crucial inter-organizational business processes. The authors [14] undertook a comprehensive investigation into non-economic aspects and the incorporation of sustainability into SCM. As a result, they put out a conceptual framework that specifically addresses this issue. SCSM emphasises the necessity of a deliberate and transparent strategy for incorporating sustainability into supply chain processes. Halldorsson et al. [33] define SCSM as the strategic management of the movement of materials, information, and capital between companies in a supply chain. Its purpose is to meet the needs of stakeholders and improve the organization's profitability, competitiveness, and ability to withstand challenges in both the immediate and distant future.

Sustainability and improved supply chain performance have prompted the creation of sustainable supply chains (SSCs), which consider economic, social, and environmental factors from a three-dimensional standpoint. The concepts jointly emphasize the crucial role of the supply chain in attaining sustainable development by meeting environmental, social, and economic standards [18]. Research on SCSM has confirmed its importance as a management strategy for improving organisational sustainability [19]. However, businesses have not completely adopted the incorporation of sustainability into their supply chain operations, despite the advances made [20]. SCSM aims to achieve a state of equilibrium where social responsibility, environmental stewardship, and economic viability are all upheld in every step of the supply chain. The integration of several logistical services, including storage, transport, and inventory management, into the supply chain enabled this change. It transformed these activities from separate entities into interconnected components. The integration was facilitated by technological breakthroughs and the evolution of information communication networks.

3. Retail industries

The previous examples have primarily concentrated on the fashion and food industries, showcasing prominent retailers in these areas that demonstrate exceptional performance on a worldwide level. Some retailers clearly stand out in the market, demonstrating extraordinary success. In order to remain competitive in retail SCM, smaller or less organized retailers, as well as those operating in locations with diverse infrastructure or channel power dynamics, must make an effort to implement the tactics described in this study. While it is true that not all organisations will attain equal levels of success, the endeavour to improve supply chain efficiency remains a shared goal throughout the sector.

Retail Supply Chain Management (RSCM) involves a management of the flow of goods from the suppliers to consumers. It includes such processes as purchasing, storage, and distribution, as well as the storage of products. There is always the need for an effective and well implemented Reverse Supply Chain Management system to enhance customer satisfaction, scale down operational costs and sustain a competitive edge [24]. Technology and big data can be used in a store context to help maintain the right stock levels, to meet customer needs without producing excess stock. Suppliers are apt in supply chain management since it important hence necessitation of proper relationship to shape communication networks and partnership. Moreover, the ever-growing speed of technology advances also puts pressure on merchants to adapt its supply chain through the use of automation, artificial intelligence and real-time data processing. The above technological enhancements have the potential

of increasing the effectiveness go supply chain by optimizing frequency and efficiency [25]. Even though the challenges that the retailers in the various sectors would face differ, the overall goal of improving on supply chain management is always the same. Consequently, retailers may service better and improve consumers' loyalty by incorporating best practices together with the application of technologies that provide navigation through the complexities of the supply chain.

4. Research approach

The study is based on observation and systematic literature review, the qualitative approach gives a first understanding of topics to make subtle investigations into concepts, thoughts, and experience. It also helps simplify complicated subjects and easily develops exploratory ideas and theories labelled in descriptive words. This research adopted an inductive approach for analysis where the focus is on seeking overall patterns from specific data. This methodology allows patterns and relationships in the data to be seen and as the research progresses, the generation of new models or ideas [14]. The inductive process enhances the depth of understanding the subject matter and to explore the new evidence and enter the conceptualization stage. The distinction of the inductive and deductive research methods remains very vital. The reliance on theory development makes inductive research descriptive and less specific in terms of the designs; thus, it is helpful in the qualitative research aimed at identifying new ideas [30]. The inductive procedures can be used when studying new phenomena and developing hypotheses, and concepts, while deductive procedures are suitable for the validation of hypotheses and developed concepts [38]. Through the use of mixed-methods, the researchers can gain deeper and wider results compared to the single methodology used. The benefit of this approach is that it offers a broad view of the research issue.

4.1. Collection of data

This paper defines data collecting as an intensive process in any research activity whereby sources or places to be studied in the research are determined. This study exclusively adopted secondary data collection and analysis and assessment techniques. The sources include but not limited to books, research papers, journals, peer-reviewed articles periodicals, and any other related resources. This approach makes it possible to exercise critical thinking through the use of previous material as well as theories. Researchers have to perform a comprehensive check of adaptability and limitations of secondary data to avoid compromising the credibility and effectiveness of the research outcomes. To achieve this objective, only secondary research information in books, journal and articles, which have undergone quality scrutiny by various scholars, has been adopted in this study. The study plan seeks to enhance the research results relying on secondary data since they provide more convenient costs and time.

5. Literature review

Encouraging integration at all tiers of supply chain management is another element. The proper relationships with the principal suppliers, distributors and logistic providers enable the company to provide optimal organizational processes and improve the transparency of supply chain system. Thus, the described cooperative method promotes better interlocking efforts in matters of inventory and waste minimization. Furthermore, environmentally friendly strategies in logistics, including the selection of efficient transport networks and environmentally friendly packaging also aligns the company towards its sustainability goal. The gap identified for the retail industry in the United States is that supply chain waste reduction requires urgent and effective strategies. For these problems to be solved it is possible to employ some fundamental methods. First of all, technology represented by instant analysis of the data is crucial to improving the performance of the supply chain. This includes the combination of systems that provide accurate demand estimation that would enhance the comparison of stock with real customer needs among retailers.

An efficient system of stock control measures is vital to prevent overstocking and to reduce product returns [25]. The retail industry is experiencing a development that is cause for concern: conveying the notion of trash as a cost of doing business, has wasted nearly fifteen billion US dollars annually [US Department of Agriculture]. This acceptance negates proper implementation of correct waste minimization processes and underlines the need

to review present practices in the context of the retail supply chain. Though, there are a range of improvements that have been done towards the use of technologies that will reduce waste in the supply chain within the retail business in the United States of America, there is need for retail specific research and solutions to the challenges that are faced by the retailers. Retailers are can advance their sustainable and avoid waste-making actions in the supply chain through the use of modern technologies and doubling up efforts [26]. The ideas of the circular economy promote other opportunities for developing environmental responsibility in the sphere of the retail sector. This way, circular economy may be used by retailers to reduce waste, lengthen the duration that products are used, and reduce the environmental impact of their business. All these approaches enable a more responsible and stable retail business that reduces the risk, among other things, and increases efficiency [27]. Another challenge in the retail area of the USA is the fact that there is an enormous amount of supply chain waste and contributing factors include stock prelude, supply chain inefficiencies, and added logistical issues. These problems cause several financial constraints, and affect merchants' business performance significantly. The use of specialised procedures is critical if the general sustainability is to be enhanced, excessive stock is to be eradicated, and activities are to be optimised. This is because waste in supply chain process is not in simple forms but it in a compound way.

The retail industry relies on finding creative solutions for these questions. These solutions are able to foster improved resource utilisation and can cause a monumental leap in the tenacity and affluence of retail industry in the United States. It is worth to note that several aspects of supply chain waste can be effectively addressed through specialised methodologies which include the aspects of operation and environmental impacts [28]. Sophisticated analysis of demand data is a better way of achieving deeper understanding of demand patterns in order to avoid excessive stock holdings. Similarly, in the area of logistics, environmental load is reduced by means of such methods as optimising the transport network and in the use of reusable and environmentally friendly packaging materials. Besides, applying technologies that can enable real-time tracking accompanied by automation of decision-making can enhance the speed and flexibility of supply chain. This integration enables better supply chain communication and improves compatibility with the market needs, and thus, the escalating appropriation of systems in the supply chain environment. In sum, the above specialized strategies can help a merchant to make a lot of leaps forward in supply chain management [29].

In 2008, the United States had a 10% decrease in the overall quantity of food available for purchase in retail, equivalent to almost 48 billion pounds. This statistic underlines the significant impact that retailers have on the total losses in the supply chain [30]. Current research frequently emphasises food loss while neglecting crucial control mechanisms necessary for waste reduction and efficiency improvement in retail supply chains. Hitt [30] identifies notable deficiencies in the existing body of research on supply chain management, specifically pertaining to the intermediary function of leadership styles. Previous research has indicated that combining Supply Chain Leadership (SCL) with governance mechanisms can have a favourable effect on sustainability practices. However, existing literature hardly analyses these topics together. The purpose of this study was to address the gaps that were identified. Retailers, despite their crucial position in the supply chain, have not been extensively studied in academic study, especially in the United States.

The study aims to surpass the constraints of previous research and enhance our comprehension of efficient waste reduction tactics in retail supply chains. The purpose of this article is to fill a vacuum in the existing body of literature by investigating different approaches that can be taken to reduce waste, particularly within the retail industry in the United States [32]. In some cases, it is important to have a theoretical background to grasp with the principles of supply chain management (SCM). When developing this framework, such perspectives as resource-based views, systems thinking, and various supply chain management theories should be integrated to complement the evaluation of the literature and analyse the relationship between leadership styles, governance mechanisms, and supply chain performance. There has been tremendous advancement when it comes to the management of waste in the supply chain; however, the retail industry's challenges remain unknown [33]. This research endeavour aims to fill this gap by assessing the relationship between leadership, governance prerequisite elements and operation effectiveness as a way of providing understanding on effective waste minimisation strategies in the retail SCs.

5.1. Systems theory

In SCM, Systems theory is embraced, articulating organizational operations as an integrated network where increased efficiency of these integrated work processes reduces waste. Resource allocation is optimised and procedures are made less opaque depending on the chain of supply, it is possible to greatly reduce inefficiency and to strengthen support relationship building as fundamental both with the suppliers and the customers [34]. Relational perspective of SCM acknowledges the role of partners and relationship between them, using reward power for increasing effectiveness of the supply chain. SCM theories including TQM, strategic choice, organisational learning, resource based-view, and time-based competitive theories offer diverse views on how the supply chain can be well managed [35]. Such theories present frameworks of understanding and application of waste reduction solutions in internal and external processes. From the perspective of organisational learning, managerial practice underlines the importance of SCM that involves external and inter-organizational factors. The method encourages continuous improvement and reduction of the time required to accomplish all the functions of the supply chain, rather than focusing on internal activities [36]. This strategy points to the relevance of both internal and external resources and, especially, the resources of partners, with regard to the issue of workforce training. The theories in SCM implementation reveals vital strategies applicable towards achieving the best results in the slightly complex and much global context. Hence, this investigation integrates literature evaluation and theory to provide an all-inclusive and coherent model for understanding and enacting the methods of eliminating supply chain waste on US retail.

5.2. Natural resource-based view(N-RBV)

Hitt [30] focuses on external and relational factors, which popularizes such strategic choices as the ones that incorporate all supply chain gains rather than emphasizing specific organizations alone. This calls for collaboration with supply chain management partners with a view of fine tuning the strength of mutual resources and capabilities. The N-RBV theory posits that integration of sustainability into supply chain leads to efficiency in waste management, reduction in operation costs and overall high effectiveness in the operations of the supply chain [31]. Hence a form of cooperation with other companies within the supply chain can help in unleashing the creative side and productivity due to the available resources and human resource. This standpoint seems especially fitting in the supply chain management area, where applying various environmentally friendly efficient methods including working multi-nationally on environmental problems, cutting waste, and sharing information gives significant competitive edge. According to the N-RBV, integration of the environmental management into supply chain operations not only serves the organisational environmental goals but also the efficiency and competitive advantage. This approach thus emphasizes the appropriateness of the multiple resource perspective that may cover pollution management and clean technology resources [30]. In addition, the Resource-Based View (RBV) analyses propose that organisations must develop unique and, in particular, valuable resources that distinguish them from competitors. These skills should be used to exploit these markets opportunities as a way of addressing environment issues. Thus, the N-RBV and RBV frameworks give useful insights as to how these competitive advantages might accrue through the employment of sustainable processes and proper management of resources [30], [31].

5.3. Types of supply chain waste

SCW waste in lean manufacturing is any action that uses resources or expenses without creating value. In an economic downturn, companies reduce supply chain waste, and this issue persists in many retail companies. Hence, this section classifies and analyses US retail supply chain waste [40, 41].

5.4. Challenges of overstocking in retail industry

Young [7] argued that big merchants operating in the United States experience great challenges on issues to do with stockouts majorly due to the fact that there are times when products are easily available in the stores while the actual customers' demand is low. According to the United States Census Bureau, the inventory-to-sales ratio was 1.18 in April 2022, lowering from the 1.48 in the April 2019. The Zero inventory to sales ratio is used to establish the stock holding efficiency. While a smaller ratio often points to greater productivity, very low values may lead to stockout and lost sales like during the early stages of COVID-19 pandemic [4]. Extensive supply chain disruptions were observed as the pandemic caused changes in consumers' demand fluctuations,

highlighting the balance between holding and overstocking [7]. In April 2022, the United States Census Bureau reported an inventory-to-sales ratio of 1.18, which indicates a decline from the ratio of 1.48 recorded in April 2019.

The inventory-to-sales ratio is a crucial measure used to evaluate inventory efficiency. Although a lower ratio usually indicates higher efficiency, extremely low ratios can result in stockouts and missed sales opportunities, as was seen in the initial phases of the COVID-19 epidemic [4]. The pandemic's unexpected changes in consumer demand led to extensive disruptions in supply chains, emphasising the delicate equilibrium between keeping sufficient inventory and avoiding surplus [7]. This problem takes place when shops make large quantities of stocks in their inventory, a term that is widely referred to as surplus stocks as they increase expenses and conspicuous waste. There are various reasons that lead to this problem of over stocking.

One of the challenges is underestimating of client demand, this is because retailers tend to order many things for fear that their inventories could run out [32]. This assumes a new dimension when demand estimates affirm inadequacy thus resulting in retailers protecting against this risk by ordering excessively. From our case, poor inventory management procedures make the problem even worse through accumulation of un-saleable stock. When trying to address problems with supply chain disconnections or breaks, retailers may face new problems in the form of an oversupply. Promotional marketing that is improper can mean businesses have left over stock if their promotion strategies does not appeal to the target market [34].

Individual retail segments may be facing several challenges that would make it worse to get a hold of overstocking situation. This is because some industry segments most likely to encounter more serious issues because of their operating characteristics. These penalties are perhaps most apparent in general merchandise stores, given the increase in the inventory/sales ratio, up from 1.38 in April 2019 to 1.58 in April 2022. The rise in the number of restocking indicates that the strategies of replenishing stock have not been keenly adapted to reflect the new purchase behaviour consumers are embracing hence, stock piling occurs. This paper examines and assesses the various detrimental impacts of overstocking in retailing efficiency. An excess stock seen in the picture limits the amount of capital that is available to finance other elements within the firm, and in the process leads to poor liquidity [23]. Increase in storage cost is as a result of increased holding cost meaning that other financial resources need to be used to ensure that stock is always in excess. Thirdly, each item of the unsold merchandise may become out of fashion or deteriorative thus causing additional product obsolescence cost. There are also issues of stock replenishment, which entail well-coordinated chain supplies that ensure material is sourced within the right time in association with suppliers. Additionally, it is also important to ensure that promotional strategies that will be used in the marketing process are efficient in such a way that marketing activities are in line with consumers buying patterns hence reducing on instances where inventories pile up [34].

5.5. Understocking

It is important to advance solutions such as the resilient inventory systems in order to maintain the vulnerable equilibrium. It is therefore important for the retailers to ensure that products are available when needed without incurring any extra cost while at the same time ensuring the true risks of under inventorying are averted. When it comes to predicting client demand inventiveness necessary that requires engaging data analytics, and forecasting technologies among others [35]. When implemented on the supply chain, the technologies will help merchants to stock more, reduce the chances of experiencing a stock out and hence improve the supply chain performance. Understocking is defined as an intricate issue that negatively affects the usability of the processes within the supply chain in retail. In conclusion thus is the position. It is only essential for retailers to find strategies that would allow them to incorporate efficient inventory management, given that several evil correlated with poor levels of stock can significantly affect retailers in terms of their operations, as well as their prime customers [36]. The problem of understocking presents various problems in the attempt to control the supply chain and is well experienced within the retail sector. This means that if a store runs out of stock, they are likely to spend a ton of money restocking when they implement the under-stocking strategy. The pressure to deliver goods faster results in faster shipment and higher expenses of handling transportation, expenses that, expense to the retailer, cut deeply to his profit margin. In addition, low inventory could also lead to the worst customer experience or customer perception of the business. Consumers also get a bad impression about the retailer when they find shelves with empty shelves or those that have some items missing from the

shelves [37]. In other cases, the restoration of the gained confidence frequently requires additional marketing and promotional efforts, resulting in more costs. This scenario not only costs loss of resources, but also affects the retailer’s friendly relationship with its customers.

5.6. Spoilage in the supply chain: A costly challenge

In the supply chain, inventory spoiling occurs when things degrade or expire, leaving them unsuitable for use or sale. This issue costs companies, especially merchants, money by forcing them to sell or devalue damaged items. Unsanitary storage, expired dates, and mishandling during shipping can cause spoilage [38], [39]. Food spoilage is an issue that is experienced across the supply chain added to the issue of food wastage in the world. Logistics and transportation management is another strategic area for which retailers must take conscious steps to ensure that food items reach the consumers before their expiry. In addition, every farmer, manufacturer, distributor, or retailer involved in the food supply chain must work together to ensure they identify early any challenges that may lead to spoilage of the food. With the help of ICT and big data, organisations can improve their knowledge of supply chain and hence, the forecast of demand and optimisation of stocks [40]. Spoilage proves to be one of the biggest challenges in food supply chain and which gives rise to significant impacts for the merchants and the economy in general. The approximate large amount of food waste and the correlative losses yield the efficiency of such techniques that would tackle the reasons for spoiling. Implementing complete solutions that are both efficient and environmentally friendly, retailers can work wonders for waste management and the general productivity in the food supply chains. Table 1 indicates the food wastage in USA as of 2023 [3].

Table 1: Food wastage in USA 2023 [3].

Source of wastage	Percentage (%)
Homes	43%
Restaurants, Grocery stores, Food service companies	40%
Farms	16%
Manufacturers	2%

The world wastes more food than it wastes plastic and has reached a staggering 2.5 billion tonnes and the biggest culprit is the United States of America as recognized by RTS (2023). Statistics show that the US alone discard as much as 60 million tonnes, which is equivalent to 120 billion pounds of food per year. The money wasted on food waste amounts to USD 218 billion, or 130 billion meals. This problem is made worse by the retailers because they are responsible for 40% of US food wastage. It is widely estimated that wasting food takes place at every stage of food processing and consumption. It is important to understand that the factors that get into the process of rotting are numerous and almost too close to each other. Slightly more than a third of the garbage comes from residential spaces in the United States while other sorts of retail outlets like restaurants, supermarkets and food services contributing slightly shy of a third [43]. It also shows that farms account for 16 % of the waste while manufactures and distributors who are in charge of production accounting for 2%. The overproduction deepens the problem of food wastage, highlighting the need to address methods used by the food industry in an attempt to cut lower the rate of food spoilage. Consequently, it is imperative to employ a general approach, in an attempt to solve the problem of spoiling [43].

It should plan for the enhancement of product handling across the supply chain, enhanced procedure of inventory management, and enhanced storage conditions. It is crucial to learn the coordinated and complex way that will address many levels of the supply chain since the food waste is a very big issue in the supply chain. This highlights the importance of customer education on issues to do with food safety, portioning, and preservation. It shows that the households contribute about 43 % to the overall food waste. There is a lot of power in informing households about what they require in order to make decisions that they can effectively put into practice that will decrease the amount of food that is wasted. This requires informing the target market on how to manage food, so as to reduce cases of wastage that are unnecessary.

The retail industry that includes restaurant business, supermarket and several food chain organizations has a significant responsibility in the matter. There are many important issues that must receive prior attention in the retailers' context to address the issue of food waste: It includes incorporating strict and comprehensive quality check measures, providing periodic checks for storage conditions and improving the inventory management system [44]. With the help of these techniques, retailers can minimize spoilage and therefore cut down on waste significantly.

Merchants contribute to food waste by procuring approximately 40 percent of all the food that is wasted in the whole supply chain, their role in reaching optimal inventory control and minimizing wastage is paramount for chain efficiency [45]. In the field of agriculture, about 16% of food losses occur at the farm level. Guaranteeing crops and matching supply to demand, and examining efficient, sustainable strategies to combat this problem can be achieved by farms. Through producer-consumer reconciliation of demand, farms are able to reduce instances of excess production and therefore waste. Manufacturers and wholesalers, which are involved 2% of waste, may increase sustainable by employing demand driven manufacturing, accurate demand forecast and appropriate buying and stocking policies [46]. Such a strategy helps to reduce wastage levels of output and also encourages the channel to become more efficient and friendly to the environment.

The consequences of considering food waste being solely an economic issue are as detrimental to the environment. Overproduction exhausts the resources, increases the emissions of Green House gases, and aggravates the condition of the ecosystem. Standardization of production with real need can help avoid overproduction of certain goods and services that may in future become garbage. Therefore, the solution must be multi-sectoral and extend over all subjects involved in the supply chain: consumers, industries, and producers. Consumers can double source information and use new strategies to decrease food waste and reduce the impact on the environment by following some specific ways including education of the consumers, management of stocks and sustainable production methods [47]. Cooperation of households, retailers, farms, manufactures and other stakeholders should form the basis of multi criterion method to overcome food wastage [48]. The key guiding principle is to introduce targeted solutions at each stage of the supply chain, from raising awareness among the population through rational management of product stocks to practicing environmentally friendly production.

5.7. *Excess packaging*

Some of the leading businesses have taken relevant action to address the problem of over packaging. Some organisations like, The Coca-Cola Company, and McDonalds have made efforts with the aim of reducing their reliance on disposable plastics as well as reducing on their impact on the environment. Such efforts fall within a trend in the industry of moving towards the use of more sustainable types of packaging. Through using better and more environmentally friendly packaging material these firms not only aim at reducing on the level of wastes but also enhance the perception of their brand by responsible consumers of the world today [49]. Both the uses and discards of the packaging reduce the scarce resources and increase the volume of greenhouse gases in the atmosphere, exerting more stress to the ecosystems of the earth. For example, the energy and the material used in the production of the plastic packaging take part in ecological exhaustion and pollute the environment.

Due to general demand for environmentally friendly practices, this is putting pressure on retailers who are now reviewing and designing better methods of packaging [50]. Over packaging in the retail sector is one of the major environmental challenges and it a big hit pocket to the merchants. There are several ways through which the overuse of packing materials become apparent they could be the use of embarrassingly large boxes, double layer using of wrapping paper or using of non-recyclable materials. These tactics do not only swell expenses for merchants but also contribute to a continuously rising environmental impact and waste [51].

National Geographic has pointed out that as much as 91% of all the plastic that has been created has been thrown away, showing why there is a desperate need for changes in packaging [42]. Thus, to fight the problem of excessive packing it is necessary to use the complex approach. Perhaps, current retail shops should consider adopting the latest progressive package solutions, which enable the reduction of the amount of used material while enhancing product protection and, consequently, the exclusion of counterfeit products in circulation. The environment can be helped even more by employing biodegradable or recyclable materials when constructing the solar panels.

Furthermore, working on the cast ore-spend technique to reduce the need for packaging and offering informational campaigns on the importance of sustainable packaging develop a sustainable culture with the

clients [43]. Consumers can encourage more sustainable movement by making conscious decisions on packaging, and purchasing products from companies that practice sustainable solutions. Last of all, the problem of wastage from over packaging in the retail sector is worthy of attention in order to reduce waste and ease the effects on the environment. Retailers could increase operational performance by using packing-friendly approaches and being innovative in the use of packer products and minimizing the use of disposable materials. The Coca-Cola company and McDonalds who are excellent examples of how the retail industry can blaze the trail in sustainability and reducing packaging waste [47].

According to Mohammad [48], there are many companies that should adopt sustainable practices in order to protect the environment in future. The antecedent study posited that the application of reverse supply chain within green projects has the potential to provide value for both the particular firm and the society. Through reverse supply chains, companies can decrease the prospect of mining fresh raw materials and discharging waste to harm the environment [49]. The strategy a retailer should employ is ecofriendly packing of products and avoiding use of excessive packing materials and use of materials that are eco-friendly for packing. The elimination of this waste contributes to a firm's desirable reputation as well as presents a revenue generating prospect for firms [50].

5.8. Transportation inefficiencies

Puslecki [50] emphasises an important factor that businesses strive to be strategically positioned in close proximity to their consumer base in order to minimize transportation costs, while consumers favour enterprises that are conveniently located. The interaction between several factors provides several points of equilibrium when choices about placement might significantly impact transportation waste. For example, the selection of a warehouse site by a retailer can have an impact on the efficiency of deliveries and the overall effectiveness of the supply chain. In order to reduce transportation waste, organisations should prioritise the optimization of their logistics processes. This involves incorporating sophisticated route planning tools to guarantee optimal delivery routes and leveraging technology for instantaneous tracking and coordination.

Transportation management challenges are one of the critical barriers to efficient supply chain management of merchants across the United States, thus resulting in significant losses and interruption of business operations. These inefficiencies manifest as costs in delays, wrong routing, unused transportation vehicles, and lack of collaboration among suppliers, manufacturers, and distributors [52]. Incorporating such measures as streamlining of operations, application of technology in the coordination of supply chain and route optimization, business organizations can significantly minimize transport waste and increase their supply chain effectiveness [53].

5.9. Drivers of supply chain waste

In addition to this, forecasting errors actually aggravate these issues by inflating demand expectations and subsequently inventory stocks and hence increased carrying costs. It is often complicated by the improper or out-of-date information to make accurate forecasts regarding the production and as a result supply chain issue. Other potential antecedent causes which we can quickly identify are that in many cases, there is ordering beyond the consumption levels necessary for stock, creating an overwhelming stock with retail stores. This excess hinders important capacities including capacity for storage and financial capacity which leads to high costs of storing inventory and raises the probability of the commodities becoming obsolete or spoiled before finding buyers [54]. These challenges have been made worse by the disruptions experienced during the COVID-19 epidemic, and it has become clear that better inventory management practices are needed to minimize inventory loss [47].

Challenges such as variability of demand, failures in demand forecasting, over purchasing, and a weak managing of the existing supply chain network hamper the supply chain greatly. Some of these issues can result in a lot of wastage and discontented operational flow. Fluctuations of demand create confusion, which in a way disturb the flow of supply train. Such occurrences make it quite challenging for businesses to adequately forecast and plan for production numbers because of these unanticipated fluctuations in demand from clients, thereby can overcome the problem of depletion of stock or inventory, which results in the accumulations of unwanted inventory, delays, and additional expenses [55]. Surplus inventories and total inventory deficits are never good since they capture valuable resources and limit their mobility, increase costs of inventory maintenance, and most importantly they cause opportunities to be missed all together.

Moreover, deficiencies in the transportation, warehousing, and dissemination of merchandise add to delays, escalated expenses, and heightened wastage. For instance, Gunder's examination of food loss in the retail supply chain highlights two primary elements: the reasons that contribute to food waste and potential remedies. The factors encompass impulsive promotions, rejected shipments, and faulty packaging. The effectiveness of resolving these problems relies on surmounting constraints such as insufficient integration, absence of quantitative research, and the inclusion of consumer behaviour and communication techniques [56]. It is possible to effectively enhance the efficiency of the supply chain and minimize wastage by implementing the suggested strategies. Increasing the effectiveness of supply chain processes, reducing the number of inefficiencies, and establishing a system that is more durable and adaptive can be accomplished through the use of strategic initiatives and cutting-edge technologies.

5.10. *Strategies for eliminating waste*

The recommendations provided throughout this paper elaborate on various ways of eradicating all forms of supply chain waste within the retail business of the United States of America. The main focus is on the executive of lean principles and inventory management optimization [38]. Inventory control and accurately as the process of holding the right amount of stock to meet consumers' demand with regard to other logistical expenses or issues such as lack of stock or excessive stock. JIT inventory system is one of the most efficient systems that can be used in managing stocks. The Just-in-Time (JIT) inventory system ensures goods are delivered to the clients at the right time they are needed thus increasing efficiency in controlling the inventory level. The JIT approach in particular may prove effective for the retailers by managing excess inventory and the expenses related with the same [38]. This method also guarantees that resources and products are easily accessibly whenever they are required. The inventory management policies may be improved by attentive demand forecasting, and proactively maintaining strong supply relationships. The merchants work on the right strategic direction, reduce wastage, and manage the needs of consumers to improve the business outcomes and sustainability [84].

Lean principles assist merchant to gain more results utilizing less, hence remains in synchrony with the basic tenets of customer satisfaction and enterprise profitability. Environmental conservation is another part of lean concepts; in this case it is waste minimization. The central principle of lean concepts are built around the concept of reducing several important types of wastes such as manufacturing of over burdensome products, possession of excessive inventories, multiple transits of the manufactured products and waiting time [57]. Lean principals is a way to enhance the effectiveness of operative processes, increase the efficiency of resources utilisation and avoid waste accumulation. For instance, Kanban which is a system used in inventory and production highlights instances that require the replenishment of resources or the movement from one process to another. This technology enhances interactions between departments, and thus shortens processing lead times and overall cycle time.

Lean SCM effects the working procedure improvement, product quality, personnel distribution, area management, staff satisfaction; retailers diagnose and rectify supply network problems [58]. This paper examines how lean principles can be applied to the context of US retailers to solve similar problems and increase the sustainability and customer orientation of supply chain management. The present research also reveals the following implications that the American retail industry needs to embrace in order to drive changes towards waste reduction in the supply chain. The subsequent implications revealed in the present research directs the American retail industry to embrace use of lean concepts that are vital for optimization of the supply chain inventory management. Lean ideas ensure that organizations have a smooth operation and do away with wastage while inventory ideas like the JIT system ensures that inventories are put at the right levels required and no excess [60]. Altogether, these methods will significantly enhance the supply chain performance, reduce cost, and enhance customer convenience and sustainability of the retail environment. For demand forecasting, retailers have to use sales history and prevailing trends in the market along with other indicators.

In demand forecasting, the retailers can ensure they keep the appropriate stock levels that will meet the customer needs, but without buying too much [60]. They say that this method enables companies to fulfil consumers' demand since they reduce wastage and enhance the control of stock. Demand forecasting allows efficient use of resources as well as customer satisfaction due to minimisation of overstocking and understocking. Introducing information technology in supply chain management is the best way to eliminate wastage. They

help in improving the interaction between the members of the supply chain partnership, provide improved order management, facilitate better control of manufacturing processes, reduce CO2 emissions, and conform to environmental standards. The IOT is a network of things and sensors applied across the supply chain to furnish the real-time information [61].

Environmental conditions of travel maintain products at set temperature to avoid spoiling. The RFID chips on products minimize inventories and subspecies that involve scarcities in real time tracking. Strengthening of countermeasures of the supply chain to improve the recovery from or the prevention of various risks. Risk management and supply chain responsiveness have emerged as recurrent and critical topics within the supply chain management field because of the COVID-19 pandemic, geopolitical uncertainty, and disruptive technology [62].

A good supply chain management system has the capacity to quickly respond and recover from some supply disruptions; favourable disasters of nature, a failure in supply by a supplier or some worst-case scenarios of geopolitics. There is no doubt that forward shockproof supply chains require not only flexibility and diversification but also nimbleness. For their part, retailers may add more sources of supply, develop a close working relationship with key suppliers, and get ready for contingencies [63]. Risk management is boosted by real time data analysis, and constant monitoring of the supply chain to respond promptly to disturbances. Protecting and managing risks for the retailers can keep and run the businesses for costumers when things go wrong. This is a special approach in stock management that factor in risks in supply and demand. This approach is characterized by holding of stocks of products that are easily saleable and retaining buffer stocks to counter a likelihood of stock out situation and to upstream, downstream irritations. While it is possible to use a safety stock to substantially reduce the impact of stockouts and ensure customer satisfaction, it has to be optimised [65].

The safety stock that has been established might be very high to the extent that a lot of capital is tied down and holding costs are likely to rise. Since cutthroat competition and globalisation apply pressure on retailers to reduce costs wherever possible, it is crucial that retailers should be able to accurately assess the requisite safety stock so that total inventory cost is not taken too high. Returns management and reverse logistics are recognized strategic issues of modern supply chain management. They include the control of goods traffic from the users end up to producer's end. In the process of reverse logistic, return management means the systematic handling process of returned products [5]. These extend to issues such as rechecking, refurbishing, resealing, and remarketing, of the products. These activities are strategic in the minimisation of waste and rational use of resources in the supply chain. The application of reverse logistics in e-waste management.

Singh et al. [73] extend the notion of e-waste elimination processes to include reverse logistics to enable proper management of electronic equipment which has outlived its usefulness. The following reverse logistics process described in this paper may be illustrated by Figure 1 and involves the recovery of electronic waste and its recycling into useful products or material. Defective electronic products are usually repaired and recycled; remaining scraps are marketed to secondary firms as scraps [48]. This approach improves environmental quality, conserves resources, optimizes costs and makes the chain of distribution more sustainable. Reverse logistics and returns plays a vital role in retailing business. They facilitate efficient flow of products through the return to repair, recycling or resale channel. For these returned items to advance their life cycle, they have to be closely inspected and then categorized then disposed. Increasing focus on detail drives effectiveness of the supply chain as well as the proper management of returns.

This paper found that an effective reverse logistics system may lead to waste minimization, sustainability, and better operations among the merchants [49]. However, for efficient elimination of supply chain waste in the US retail business, a strategic approach is required. Global strategy should therefore entail forecasting of the demand, how safety stock should be controlled, implementation of new technology and automation and strategies to minimize risk in the supply chain. Through adequate anticipation of demand, stock control, advanced technology application, and a vigorous delivery structure, retailers may dramatically cut their waste, greatly enhance operational effectiveness, and noticeably increase their organisational performance. It above measures contribute not only to the improvement of sustainability and the customer-orientation of the retail environment but it also prepares the retailers for coming challenges and disruptions [64], [48].

5.11. The reverse logistics process

The reverse logistics process begins by accumulating the merchandise that a customer returns to the business. After that, they are taken to a returns facility where they are again inspected and sorted according to the type of commodity. The returned objects will be mended, recycled or repackaged for resale, based on its condition during the return. Unused or unsellable items are also disposed of in recycling companies with a view of pulling out and reusing some of the materials found in the products. All leftover waste is handled appropriately to in order to reduce its effects on the community [66]. From here, it not only helps in proper management of trash, but also repurposes or revalue returned products, thereby increasing the sustainability of supply chains. Reverse logistics and returns management play a crucial role in minimizing waste and enhancing sustainability within the retail supply chain. Through the integration of these processes, merchants can effectively oversee the handling of returned products, retrieve valuable resources, and reduce their impact on the environment [67]. Implementing a well-organized reverse logistics system not only improves operational efficiency but also contributes to the overall objectives of sustainability and resource preservation in the retail sector.

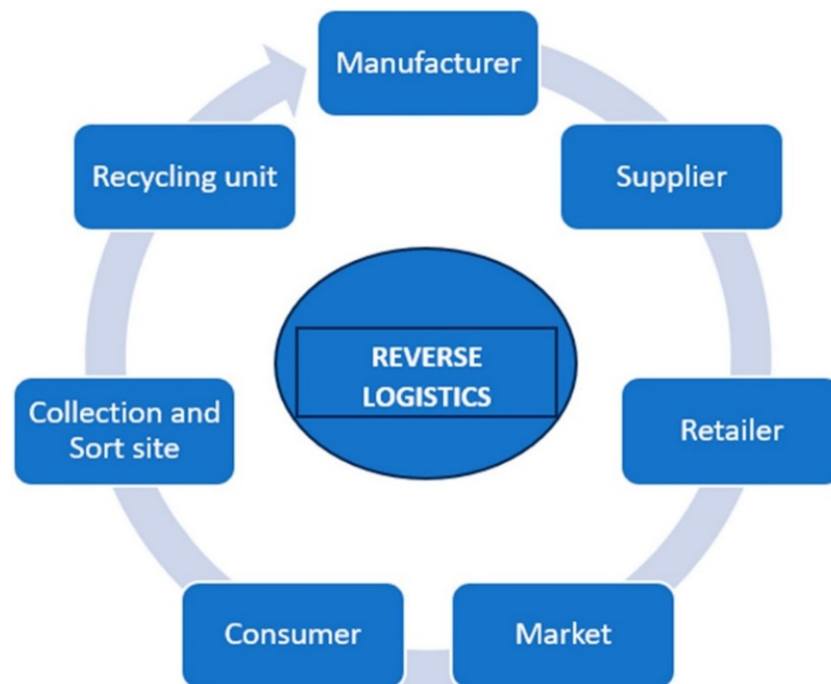


Figure 1: Conceptualized flow chart of reverse logistics.

Figure 1 analyses the supply chain of Halfords, a UK retailer that specializes in automotive and bicycle products, in order to demonstrate the interconnections within retail supply chains. Although these products are neither perishable or tied to fashion, they demonstrate considerable unpredictability and can be influenced by factors such as cost and availability, similar to many other markets. The diagram highlights the shared difficulties encountered in this supply chain, underscoring the fact that despite variations among the fashion, grocery, and automobile retail industries, there are consistent patterns and obstacles that endure [68].

Effects on sustainability and cost effectiveness: Integrating reverse logistics and efficient returns handling can have a substantial influence on sustainability and cost effectiveness in the retail sector. Retailers can decrease their reliance on raw materials and decrease production costs by recuperating and reutilizing materials from returned products, leading to the conservation of natural resources [69]. In addition, effective returns administration can improve customer satisfaction by guaranteeing a seamless and trouble-free returns procedure. This can result in heightened consumer loyalty and recurrent transactions, so bolstering the retailer's profitability. **Supplier collaboration and vendor management:** Efficiently collaborating with suppliers and effectively managing vendors are crucial for optimising order management procedures. This ensures on-time delivery, streamlines order processing, and ensures product availability. Customer satisfaction and repeat business rise when these factors align. Collaboration is needed for inventory optimization, expense reduction, and savings [70]. Collaborations

promote the sharing of best practices and new ideas, eliminating waste and enhancing procedures. Retailers can improve operational efficiency and supply chain sustainability by using suppliers and vendors' expertise.

An essential element of collaborating with suppliers is the incorporation of cutting-edge technology that enable instantaneous connection and exchange of data. These technologies offer significant insights into inventory levels, demand projections, and production plans, allowing retailers and suppliers to make well-informed decisions. Electronic data interchange (EDI) systems facilitate the efficient transmission of documents, such as purchase orders and invoices, resulting in decreased processing times and reduced errors. In addition, implementing a collaborative planning, forecasting, and restocking (CPFR) strategy enables retailers and suppliers to work together in creating predictions and inventory plans, coordinating their efforts to more effectively satisfy consumer demand [71]. Environmental impact assessments (EIAs) are an essential element of sustainability initiatives. These assessments appraise the ecological ramifications of corporate actions or products, offering a thorough comprehension of their environmental impact. Retailers can use EIAs to pinpoint specific areas where they can decrease their ecological footprint. This includes strategies like minimizing emissions, decreasing energy usage, and advocating for sustainable sourcing practices [72]. Implementing these strategies not only improves the retailer's environmental performance but also promotes its reputation among a growing number of environmentally aware shoppers.

Sustainability reporting enhances transparency and accountability in the retail sector. Retailers exhibit their dedication to sustainability and furnish stakeholders with vital information about their endeavours by openly revealing their environmental performance. Transparency can result in heightened trust and loyalty from customers, investors, and other stakeholders. Moreover, it can stimulate innovation by motivating shops to embrace novel technology and practices that further diminish their environmental footprint [73]. Effective vendor management is essential for optimizing the supply chain. Cultivating robust partnerships with suppliers guarantees that shops acquire superior merchandise promptly. Regular performance reviews, feedback mechanisms, and the use of vendor management systems that monitor key performance indicators (KPIs) including delivery accuracy, lead times, and product quality can help accomplish this. Retailers may effectively collaborate with vendors by establishing transparent communication channels and cultivating a culture of ongoing enhancement [74]. This enables them to promptly resolve any emerging difficulties and execute necessary corrective measures.

Sustainability reporting pertains to the practice of disclosing an organization's environmental impact. Although sustainability reporting is of significant relevance, a considerable number of retailers have not yet implemented this practice. Suhi states that a considerable proportion of merchants do not participate in sustainability reporting, which entails quantifying and revealing their environmental performance, such as waste production and resource consumption. Nevertheless, sustainability reporting can provide a multitude of advantages. It helps to decrease waste throughout the supply chain and makes it easier to identify areas that need to be improved [75]. Retailers may enhance their sustainability by implementing waste management strategies and recycling initiatives, which enable them to detect and address potential issues. Efficient engagement with suppliers and effective vendor management are essential for optimizing order management processes and improving operational effectiveness in the retail supply chain [76]. Retailers may enhance product availability, decrease expenses, and minimize waste by embracing cutting-edge technologies and cultivating robust connections with suppliers and vendors. Moreover, sustainability reporting and environmental impact assessments are crucial for fostering openness, responsibility, and ongoing enhancement in environmental performance [77]. Merchants may actively contribute to a more sustainable and robust supply chain, ultimately yielding advantages for both their business and the environment by adopting these practices.

6. Future trends and innovations

Global economies depend on micro, small, medium, and big firms. Entrepreneurs create jobs, innovate, and raise living standards. Nevertheless, these businesses have a multitude of obstacles, such as rising prices and disruptions in their supply chains, that might hinder their ability to function and expand. Many organisations in the United States have adopted analytics to gain a deeper understanding of and effectively manage their supply chains in the face of persistent challenges.

6.1. Supply chain management strategy

Tackling sustainability in supply chain management entails addressing various concerns, such as minimizing waste and maximizing resource efficiency. Waste reduction has dual benefits: it is environmentally advantageous and economically profitable. It lowers expenses and increases profitability. The retail business has taken proactive measures to enhance supply chains to reduce waste, acknowledging the substantial influence it has on expenses and the environment. CoDaReCSS provides a full framework for retail supply chain waste reduction and management. Collaboration promotes coordination throughout the supply chain to achieve efficient operations [78]. Data-Driven Decision Making utilizes analytics to develop well-informed strategies. Reverse logistics and product life cycle management promote sustainability by facilitating efficient returns and recycling processes. Consumer Education and Engagement provide consumers with information and understanding about sustainable behaviours. The primary objective of Sustainable Sourcing and Packaging is to prioritise the use of environmentally-friendly materials and employ techniques that are in line with ecological principles [79]. Supply Chain Resilience and Risk Mitigation help firms plan for interruptions, ensuring that they can continue operating and adapt to changing circumstances. This model offers a comprehensive strategy for addressing supply chain inefficiencies and advancing sustainability.

6.2. The effect of predictive analytics on supply chain management

UPS is a clear illustration of how predictive analytic is central to supply chain management. The daily delivery volume is roughly about 21 million items hence the need to manage the logistics efficiently throughout the year but especially at the end of December. Many big businesses use the HEAT system, and UPS uses it as a tool to collect and analyse various types of data, such as customer, performance, or planning data. This solution also allows UPS to monitor the status of each shipment immediately; therefore, enhancing their ability to accurately monitor their shipping system. Applying predictive analytics makes local deliveries on time and contributes to higher organizational performance. Furthermore, the use of digital transformation's has also been useful in enhancing the supply chain management for Pfizer's merchants. Pfizer and its retail partners have optimized cycle times in many processes and guarantee the continuous availability of necessities, such as medication for patients in need, because of the approach. Incorporating complex data analysis into the firm's operations like UPS and Pfizer help demonstrate how a firm can harness the power of technology to strengthen the robustness and resilience of their supply chains.

6.3. Reverse logistics and product life cycle management

Reverse logistics is a system able to handle the flow of the product from the consumer back to the manufacturer. This covers product returns; repairing; and product recycling. On the other hand, Product life cycle management refers to the formalised management of a product starting from the development stage up to disposal. Product life cycle management and reverse logistics are the key factors in the supply chain management system [80]. Reverse logistics and product lifecycle management as the concepts determine strategies for more efficient workflows for the handling of backflows and disposal of end products. Returns are a critical part of the process since retailers have to efficiently direct returned products for repair, recycling, or redistribution into the supply chain in an efficient manner means. Appropriate reverse logistics management integrated here minimises waste and enhance value recovery from returned products for a circular economy [59], [80]. Appropriate assessment, categorization, and appropriate management of reverse logistic streams are crucial factors in optimal supply chain management and for the environment. Therefore, such methods might help the companies lessen the negative effects, related to their activity on the environment and enhance the effectiveness of the supply chain [45], [65], [81].

The use of solutions that facilitate dealing with returned, repaired, recyclable or disposed of products increases product durability as well as reduces wastage. Sound reverses logistic procedures ensure timely inspection of returned assets for repair and resale or recycling. Besides, this approach minimizes the impact on the environment while also finding value from returned products, shouldering the idea of a circular economy [82]. Applying sustainable principles in product design and using recycled materials will go a long way in enhancing product LCM. Sustainable purchasing and packaging are the assessment of sustainable procurement and control of packaging waste is very significant indeed in lowering the organizations' impact on the environment. Reducing

packaging complexity and de-kitting layers that are not very necessary serves to reduce waste conducting market pulls of the eco-concerned consumers hence enhancing brand image and encouraging a loyal customer base [83].

The merchants have to focus on sustainable purchasing while choosing the suppliers who use their environmentally friendly policies while supporting products more ethical for the environment. Sustainable sourcing ensures that goods are produced with the least negative impact on the environment and supply chains are sustainable [66]. The application of this approach to product packaging by the use of recyclable or biodegradable materials also minimises wastage. Sustainable sourcing and packaging may be used as key differentiators that retailers use to build up their environmental image and appeal to environmentally conscious consumers. Improving resilience of the supply chain and mitigating the risks and their consequences whenever possible. They pointed out the need to build supply chain networks that are able to withstand any disruption of operations in order to deal with the possibility of inefficiencies. FBSM-solutions, that include real, time data analysis and supply chain monitoring provide timely signs of issues, to enable victual, effective remedies to disruption [48]. Measures that would increase the supply chain's ability to bounce back includes flexibility and reserve, multiple supplier portfolios, and spare plans. The application of the CoDaReCSS methodology minimizes waste, whereas the management of the entire control processes in the context of the retail supply chain is enhanced. Collaboration, useful information, reverse logistics, change in customer awareness, green purchasing, and supply chain quickness will assist the retailers in minimizing waste alongside the impact of the physical environment [78]. They are about sustainability, operations, clients, and the prosperity of organisations in the long-run.

6.4. *Consumer education and engagement*

Hence, there is need to create awareness and encourage the customers to participate in minimal waste projects. Educating people about proper ways of recycling, promoting the use of bags and other containers, making an emphasis on the benefits of using 'green' products fosters responsible consumption. Through such mechanisms as the introduction of rewards for bringing recyclable products, the use of attractive bonus programs for customers for repeated purchases, and disclosure of information concerning the management and reduction of waste, every client is motivated to contribute personally to an improved recycling level [75]- [78]. Commerce businesses are in the best position to drive down trash levels by informing consumers adequately on sustainable consumption practices. Cueing consumers about the environmental impacts of the decision to purchase goods and educating consumers on 'the right' sustainable behaviour might help foster helpful change. To a greater extent consumer knowledge and engagement cannot only prompt the customers to act in a more sustainable manner such as avoiding products with excessive packaging, separating recyclable products and supporting brands that are environmentally conscious [83]. Thus, by creating awareness and convincing many people to embrace sustainability, retailers may play a central role in the reduction of the rate of wastage and provision of environmental responsibility.

Retailers should enhance supply chain resilience to disruptions and recovery, as well as decrease likelihood of adverse events for maintaining business continuity and preventing waste. Disaster, supplier downfall and geo political instabilities can be overcome by a supply chain [26]. The concepts of flexibility, redundancy and agility are valuable for planning the merchant's supply chain in order to adapt to crises. The evaluation of suppliers and products, diversification, and development of an effective relations system are critical to supply chain security. In other circumstances, other opportunities for sourcing may also be exploited, development of back up strategies and policy on risk management can also be employed in order to address the customer needs [32], [38]. While evaluating risks and applying strategies to address some of them as threats, productivity, and clients' satisfaction increase. The main benefits of adequately structured supply chain include guaranteed product accessibility, reduced interruptions, as well as efficient consumer alerts. This assures in the decrease of risks affecting the business to be able to have sustainable supply chain management. Selecting multiple suppliers, maintaining sound supplier relations, achieving supply chain awareness, maintaining safety inventory, creating backup strategies, and analysing the hazards and conducting adverse effects lowers retail risks [46], [53]. It is also important for merchants to scrutinize and modify risk management strategies with the aim of coping with threats that compromise a favourable supply chain.

6.5. *Collaboration and data-driven decision making*

US retailers, suppliers, manufacturers, and logistics providers must improve communication, accountability, and openness in waste reduction efforts. A coherent sustainability plan requires efficient coordination. These

parties can align their goals, share best practices, and create innovative waste reduction solutions by working together. Additionally, the government and business should actively assist small and mid-size firms in improving their technology infrastructure [23], [65]. These companies are vital to American supply chains but struggle with efficiency and technology. These issues can be overcome with government and commercial support, improving supply chain resilience. Collaboration is needed to reduce waste, improve sustainability, and streamline the supply chain. Effective collaboration with suppliers and efficient vendor management are essential for optimizing inventory levels and minimizing expenses.

Through the cultivation of robust alliances, merchants can guarantee prompt delivery and improve order precision, resulting in a more durable and streamlined supply chain. Increased use of analytical tools for decision making enables firms to effectively forecast demand, control stocks and reduce on excess stock [25]. By analysing past performance of the sales data, market trends and other such relevant criterion the retailers are then able to match the stock available to stock consumption thereby channelling reduced wastage and much improved efficiencies in stock control.

The paper thus finds it necessary for retailers to incorporate the principle of data analytics decision making into their operations to minimize waste in the supply chain and enhance supply chain robustness. This approach allows the merchants to identify areas where wastage is high, evaluate the degrees of performance, establish realistic goals, and understand consumer behaviour [19]. Using data to make decisions is seen by McDougall et al [39] as crucial for the purpose of determining areas for improvement within the supply chain. Small trader experienced a severe contraction with regards to supply chain function during the COVID-19 pandemic period where the disruption stood at 38.8%. But, to solve this problem, governments and industries need to come up with better technologies used by those small-scale dealers. Such great cooperation is likely to highly help in reducing delays, minimizing wastes, and improving efficiency levels in the supply chain. Sacco also notes that there is a possibility that small enterprises make use of automated spreadsheets, advanced analytics to identify the subsequent sales in supply chain, KPI of profit, and inventory management [32], [33]. It benefits organisations by aligning their resource deployment, cutting costs and managing avoidable waste, and enhancing productivity.

7. Limitations to the study

The investigation on supply chain waste management is mainly focused on the retail sector in the USA with accentuation of the peculiarities of the problems and opportunities of this kind of business. The following findings and outcomes derived in the research are particularly relevant to the retail sector and therefore may not easily generalize to other types of ventures. Despite the general nature of this topic, retailers have their own set of problems, relating to the supply chain waste management, which includes problems in inventory management, demand forecasting, logistics etc. Some of these may be different from challenges typical for an industry such as manufacturing or service industry.

Additionally, one limitation of this study is the reliance of secondary data aimed at by restrictions of time and funds available. This means that the conclusions which are made are based on existing research studies, reports and industry analyses without having interviewed or acquiring data directly from certain participants from various industries. The restriction may potentially affect the richness and immediacy of the data analyzed since the original data collection could provide better perceptions and additional understanding of the supply chain waste management strategies. Therefore, some degree of caution should be employed when generalising the results of this study, particularly with regards to other firm types and/or locales.

8. Further research

It is as such a useful paper for the retailers who are interested in approaches to manage and reduce waste in their supply chain and who are looking for solutions regarding the specificity of the retail sector. However, there are other aspects that remain relatively unexplored and if developed can foster a much better understanding and performance in waste management.

Moreover, new opportunities related to the sustainable implementation of circular economy approaches in the retail supply chain might be identified. The management should dedicate its research on activities that

will help extend the life span of products, remanufacture products or recover resources. These concepts can be said to help researchers assess the effectiveness of implementing them within the retailers and wholesalers so as to implement the closed loop supply chain where the resource is recycled continuously causing minimal wastage of resources [80]- [84]. Another research avenue could compare the impact of new wave technologies, for instance IoTs and AI in the waste reduction and management of the supply chain. All these technologies have the capability of transforming the wholesaler's and retailer's waste management by offering real-time tracking, analytics, and decision making. An analysis of, for instance, the role of IoT devices in maintaining records about the condition of products to enable improved stock control, or the Scale of change that AI may bring to the precise and accurate forecasting of demand would give a better understanding of their impact on waste elimination.

Last of all, establishing simulation models through pretending certain hypothetical scenarios could be very important in the identification of the best course of action to reduce waste. These models have the ability to show the organization how they can deal with a variable number of situations, including changes in demand, supply chain issues, or advancements in technology, in order to determine the best ways toward waste minimization. Such simulations would provide valuable information on the effectiveness of various interventions in specific contexts and therefore could give present and potential advice in the contexts of waste management. The increase of research in these areas could, in general, give a better overall understanding of how to deal with waste in various supply chain environments and augment appropriate behaviours within the retail sector and others.

9. Conclusion

Papers for this research evaluate and identify the types of waste in the supply chain in the United States retail industry, acknowledging that it is a crucial issue that increases costs, impacts the environment, and reduces the efficiency of systems. The major type of waste includes; excess or unsuitable materials, spoilage, excessive packaging, and transport wastage. Such issues are often blamed on fluctuations in demand, errors in the forecast, over-purchase, and poor control over inventory. To address these challenges, the article posited that lean ideas should be adopted for enhancing manufacturing since lean is well known for simplifying processes, optimizing resource use and increasing output. This paper reveals that it is imperative that an organisation embraces a contextual strategy that involves collaboration, innovation, and continuous improvement to optimize the improvement of waste and sustainability in the supply chain. Some of the suggested approaches includes inventory management and control, packaging policy, technology and automation, supply chain risk management, reverse logistics and integrating data. These extensive approaches assure both the commercial gain and environmental protection to the retailers. This article gives an elaborate understanding on Walmart's planning approach to minimizing cost in supply chain and shows various options that offer better result. Therefore, this paper found that Walmart's initiatives and planned plans are quite insightful in terms of innovative work and proposed plans for effective waste thrust and sustainability in the retail supply occurrence. Similarly, the different corporations might enhance their ecological and societal responsibilities, strengthen their corporate position, bring positive change to the global environmental goals and objectives.

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CRediT authorship contribution statement

Guna Sekhar Sajja: Conceptualization, Methodology, Visualization, Writing–Original draft, Review & Editing. **Mohan Kumar Meesala:** Conceptualization, Methodology, Writing–Review & Editing.

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