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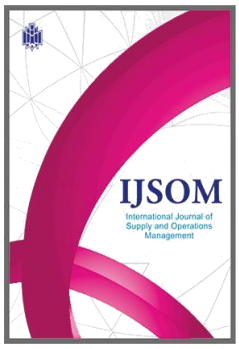

A Review Study on Advancements in Reverse Supply Chain Management for Industrial Waste Management Process

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Abstract

Supply chain management (SCM) is the active management of supply chain activities to optimize customer value and establish a sustainable competitive advantage. It demonstrates that supply chain management firms are actively working to establish and run source chains as profitably and well as they can. The activities that comprise the supply chain include the development of products, procurement, manufacturing, shipping, and the data systems wanted to oversee these processes. This review presents information. SCM was introduced in the opening paragraph of this page, which was followed by information about the participants and the procedures used by different businesses. It employs sustainable supply chain management (SSCM), which offers five-dimensional sustainable approaches, and presents GSCM in this study. The needs in the industrial industry's supply chain are continuously presented. Accordingly, the waste material management process is presented for different manufacturing industries, however, it consists of waste management methods like disposal method, landfill, and incineration. Additionally, this study presents detailed information about reverse Supply Chain Management (RSCM), their concept and process are explained in this review. The review describes the state of the art in survey technology, the methodology of implementation, the definition and motivation of the research topic, current trends and advancements, and the goal of the study. Reviewers came to the conclusion that RSCM controls the waste product well as a result. Utilizing the components and materials of returned goods to cut down on raw material usage and expenses is the focus of supply management in reverse logistics (RL). In future, reverse logistic SCM is introduced in the automobile industry to efficiently manage automobile waste.

Keywords: Supply Chain Management; Manufacturing Industry; Consumer; Distributer; Green Supply Chain; Sustainable Supply Chain; Reverse Supply Chain.

1. Introduction to Source Chain Management

The term source chain management (SCM) denotes to the coordination of all processes that convert raw resources into over merchandises. To gain a modest edge and boost customer value in the marketplace, a firm must actively streamline its supply-side operations. Suppliers use supply chain management (SCM) to design and oversee supply chains that are as efficient and cost-effective as is practicable. Information systems, manufacturing, product development, and other related operations cannot be integrated without supply networks. Manufacturing, shipping, and distribution of the goods are all coordinated or centralized via supply chain management. By streamlining the source chain, trades can cut expenses and bring goods to clients more quickly. More attention is paid to sales, internal manufacturing, distribution, internal inventory, and all vendor inventories owned by the company. SCM is originated

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on the impression that nearly every creation achieves the desired market outcome through the efforts of numerous businesses that combine to form a supply chain. Given how long source chains have been in place, most businesses have only recently realized how important they can be to their operations. The figure for SCM is portrayed in figure 1.

Figure 1. Supply Chain Management

Apart from examining how SCM impacts organizational performance, (Attia, et al., 2018) examined the impact of knowledge management skills on SCM procedures and overall company effectiveness. Source chain management data system usage in multicomponent manufacturing enterprises as well as its future prospects is investigated by (Boiko, et al., 2019). For determining information assistance options and for studying supply chain processes, they demonstrated a qualitative research method. At each stage, all parties involved must keep tracking the product's progress and it may include a huge number of steps, due to this a supply chain can be quite complicated. In direct proportion to the product's complexity, the number of stages may expand. Furthermore, because some items are parts for others, a supply chain can be a collection of interlinked supply networks. The components of a complicated product are produced by offering raw materials to the processing units by suppliers (Srivastava, 2022). As the end product, the elements are integrated into a complex product. Distributors or wholesalers subsequently distribute these finished goods. By importers and exporters handling logistics across country lines, the involved parts could be distributed over several geographic regions. Retailers are in charge of further distribution of the products, bringing them to the end-users. The efficacy with which materials, products, and parts are traversed the supply chain may affect how efficient it is and, consequently, the product's cost.

1.1 Process of Supply Chain in Industry

A source chain is a system that links a company to its vendors in order to produce and ship a particular good to the customer. This network is complete up of various entities, resources, people, activities, and information. The supply chain refers to the steps necessary to transport an item or service from its origin to its intended destination. Supply chains are established by businesses to cut expenses and maintain their competitiveness. A collection of three or more businesses that are directly connected through one or more the series of financial, product, service, and information flows from a basis to a customer is known as a supply chain. This chain facilitates the delivery of goods or facilities to clienteles. It involves various processes, including the transformation of raw resources into ended products, their transportation, and distribution to end-users. As a result, (Ghadimi, et al., 2019) provide a maintainable supplier

assessment and assortment process using the Multi-Agent Systems approach that incorporates a communication channel that is suitable, organized information sharing, and visibility between dealers and builders.

Basic Supply Chain: An immediate customer and an immediate supplier who are all connected by one or more information flows on the company's upstream and downstream products, services, and finances consist of this basic supply chain.

Extended Supply Chain: It includes immediate suppliers and customers, all connected by one or increased information, financial, service, and product flows both up and downstream.

Ultimate Supply Chain: It encompasses all organizations participating in all upstream and downstream product, service, financial, and information flows from the initial supplier to the end customers.

(Ben-Daya et al., 2019) examined the function of IoT and its implications for SCM. The definition of IoT, its main technological enablers, and its numerous applications and SCM processes are outlined as key components of IoT in SCM. Third-party logistics (3PL) providers, third-party finance providers, market research firms, and so on are the various services performed by the firm, the nature of supply chain is included with membership available and is not restricted to a supplier, a manufacturer and a distributor.

1.2 Participants in supply chain in Industries

Participants in the source chain are those who manufacture and deliver the good or facility to the customer as share of the source process. Every supply chain has four different types of participants (Srivastava Ashish Kumar, 2021). They carry out the tasks that keep a supply chain running and give it a reason to exist. There are four types in every supply chain: producers, wholesalers or distributors, retailers, and consumers or customers. It is portrayed in figure 2. In supply chains, there are a variety of companies with various functions. They can discuss businesses that are producers, wholesalers, or retailers, as well as companies that are customers. A variety of services, supplies and even resources are provided by these companies because it is backed up by other companies. A novel method based on a game-theoretic approach is proposed by (Kim and Shin, 2019), from obtaining major reward, increased visibility prohibits a single participant. It seems that a long-term sustainable supply chain visibility can be formed by equitably sharing profit with all supply chain players.

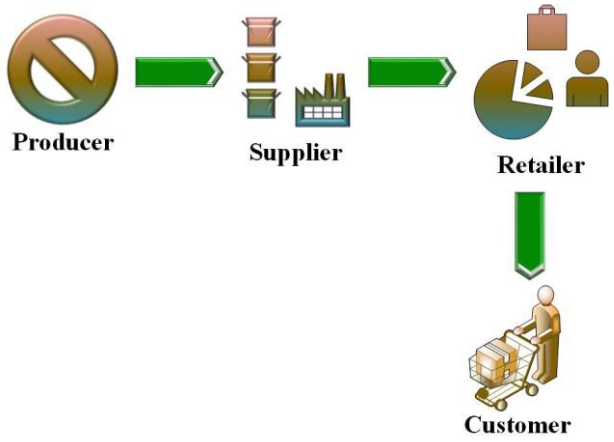

Figure 2. Flow Diagram for Source Chain

The source chain separates the transfer of materials and information, and logistics services support their contents, including material handling and procedures. At this point, the logistics division enters the supply chain. Networks of suppliers in the motorized industry with a high number of players and dispersed parts across several levels and geographical locations. Supply chains typically lack responsiveness and transparency because of their innate complexity and strong emphasis on data security in a market crowded with original equipment manufacturers (Miehle, et al., 2019).

Producers: Producers are organizations that create products or services. Companies that manufacture raw materials as well as companies that produce final goods are included under this category. Mineral miners, oil and gas drillers, and cut timber are examples of raw material producers. Included are businesses that cultivate land, rear animals, and capture fish (Ashoka and Hamid Reza Keihani, 2021). Producing companies of finished goods construct their products from subassemblies and raw components manufactured by other companies. Manufacturers and service providers are both service providers and product producers. As a result, (Malak-Rawlikowska et al., 2019) explore 486 chains in total, proving that a single producer simultaneously takes part in a number of short and long chains. Consequently, some producers also buy or use the goods complete by other producers. Other supply chain members require the goods and the services that are supplied by the producers.

Distributors: Distributors, sometimes referred to as wholesalers, are businesses that buy inventory from manufacturers in large quantities and deliver it to clients in the form of an assortment of connected product lines. Distributors are also referred to as wholesalers (Ashish Kumar Srivastava et al., 2020). They typically sell in more amounts than what a single customer would typically buy, and to other businesses. Distributors shield producers from shifts in consumer demand by keeping inventory that they have bought from producers and handling the mainstream of the sales effort to identify and meet customer demands.

Distributors also handle inventory management, customer assistance, warehouse operations, product mobility, and post-sales service, in addition to sales and product advertising. Distributors can also be businesses that merely serve as middlemen, never assuming ownership of the items, between a builder and a buyer. When customers' demands vary and the assortment of products that are offered changes, distributors monitor those needs and match customers with products that meet those needs.

Retailers: Retailers keep goods and sell them in lesser quantities to the broader public. Customers' preferences and expectations are closely monitored by retailers. To entice them to buy, they promote to their clients and utilise a combination of service, price, product selection, and convenience (Krytyk Prawa et al., 2023). Because of their low prices and large product range, customers are drawn to discount retailers. Excellent service is provided by the upscale stores and it has a distinct product selection. To fulfil the needs of single customers who purchase in modest amounts, retailers provide items and services.

Customers: Customers are groups or individuals who purchase and make use of properties or services (or consumers). A client may be a business that acquisitions a good to integrate it into additional good that they subsequently offer to their clients, or final consumers. Customers depend on manufacturers, distributors, and shops to meet their needs for goods and services.

2. Needs of Source Chain in the Industrial Industry

The supply chain elements comprise every task that starts with receiving an order and concludes with fulfilling the customer's request. Marketing, distribution networks, product creation, financing, operations, and customer service are among these functions. (Golov et al., 2021) present a system for SCM in manufacturing. A system of indices for measuring supply chain compliance with sustainable development standards is proposed. This method allows for more sustainable manufacturing and allied sectors, such as the power industry and metallurgy. When manufacturing items, the supply chain facilitates the movement and conversion of raw ingredients into completed products. The goods are delivered and distributed to a retailer or directly to a consumer by the manufacturer. Producing a high-quality product at a reasonable cost and within the specified time frame, customer satisfaction is based on this product production. The roles performed by Industry 4.0's primary enabling components as well as product lifecycle organization in the industrial system and advancements in supply chain security and numerous trends are discussed by (Chhetri et al., 2018).

In order to make knowledgeable decisions about costs, price, quality, and speed at various production process, from materials and labour through delivery and storage, all successful supply chains build and revisit their criteria. It all begins with the value of raw materials (Konstantinos Vasilakakis and Ioannis Giannikos, 2023). However, quality and sourcing are equally important. Materials must arrive at the manufacturing site on period and in the amount required. The entire source chain can come to an abrupt stop due to a single point of failure. As a result, controlling One of the biggest issues facing modern production networks is supply chain unpredictability. There are several reasons why supply chains can become volatile, making it a difficult task to manage because doing so would need an excessive amount of time and money. (Nitsche and Straube, 2020) provide a outline for managing supply chain volatility in the

manufacturing sector that outlined the main management groups and prerequisites for actual supply chain volatility control. All other supply chain procedures related to product manufacture require a significant degree of coordination, communication, and decision-making. As it transforms raw materials into completed commodities ready for use, a strong organization is continually motivating itself to increase speed, quality, and cost.

2.1 Sustainable Supply Chain Management

SSCM is the procedure of incorporating economically and environmentally sound practices into the whole lifecycle in supply chain, from product conception and design to material selection (which may include agricultural production or the acquisition of raw materials), shipping, receiving, distributing, using, packing, discarding, producing, and storing. As a result, researchers and practitioners are becoming increasingly interested in maintainable source chains (Chandan et al., 2019). Focusing on environmental and social dimensions has resulted in a more generalizable and comprehensive view in supply chain, but they are not only for supply chain business factors vital for long-term sustainability. While avoiding social impacts and negative environmental source chain, the business's long-term economic success is maximised, that maintainable supply chain design is a layout of a corporation's source chain. Subsequently, under the influence of government and other stakeholders outside the supply chain, long-term supply chain partnerships are developed among a focused company, suppliers, and customers. (Kusi-Sarpong et al., 2019) proposed a sustainable innovation criterion framework for manufacturing enterprises to examine the maintainable source chain. A to, Using the BW-MCDM model, evaluate and priorities the maintainable invention organization criteria, and a example of five Indian industrial enterprises is utilized to show how effective and applicable the suggested structure is. The study's conclusions will assist industrial managers, practitioners, and decision-makers in deciding which criteria to prioritize during the implementation stage in order to enhance the manufacturing supply chain's sustainability and promote corporate and source chain sustainability (Ilkay Saracoglu, 2024).

The forces that drive SSCM methods are investigated by (Dai et al., 2021). This study uses experiments to look into how institutional pressures and their interplay affect SSCM practices. drawing on institutional theory and the resource-based view. It also looks at the internal sustainability capabilities and their interactions. For the development and implementation of new practices, these factors set the stage. Corporate social responsibility, sustainable supplier management, and sustainable operations and risk management are approximately of the important management strategies associated with SSCM. Achieving financial, ecological, and social performance simultaneously is one of the supply chain's main goals. (Khokhar et al., 2020) sought to implement the supply chain management (SSCM) approach and to compile the literature on the obligations of manufacturers, suppliers, and customers by examining the relationship between survey variables and structure. strategies used in Pakistani industry aim to find every potential facet of sustainable social development. The study's conclusions showed that the most important aspect of supplier social sustainability was organizational learning, which had a value of 40.5%. This was followed by supply chain effectiveness and supplier performance, which had values of 37.7 and 9.6%, respectively.

2.1.1 Five-Dimensional Sustainability Approaches

The social, ecological, and financial components are all enclosed by the traditional sustainability approach. All organizational systems are not addressed by this paradigm, despite its resemblance to a triangle model. A company's ability to sustainably manage supply chain risk is one of its most enduring competitive advantages. To mitigate the risks associated with supply chain sustainability, (Valinejad et al., 2022) present innovative three-phase methodology. With this methodology, risks are identified, evaluated, and classified using the failure mode and effects analysis phase; critical risks are ranked using the fuzzy VIKOR phase; and manageable risks are addressed. Using a novel five-dimensional framework for sustainable development, hazards were categorized. including the many supply chain sectors' organizational, technological, social, financial, and ecological elements. The following is an explanation of the five-dimensional sustainability approaches:

Social Sustainability: The social benefits of SC activities are indicated by this component. Evaluating the system's social acceptability in a community can be beneficial.

Environmental Sustainability: The environmental sustainability method focuses on how an organization's operations negatively affect the environment.

Economic Sustainability: With the aim of motivate the company to make investments in attaining sustainability, this factor guarantees the systems' economic viability.

Technical Sustainability: By taking technological difficulties into account, this dimension aids in evaluating the system's technical sustainability. It focuses on input and output as well as an organization's technical framework.

Institutional Sustainability: The management facility and its effects on sustainability are the main topics of this dimension. Systems of management, instruction, plans, strategies, etc. are all included.

2.2 Green Source Chain Management

"GSCM is the process of incorporating environmental concerns into SCM including product design, material sourcing and selection, manufacturing, delivery of final products, and the management of product's end-of-life" (EOL). According to Beamon, the term "extended traditional supply chain," or GSCM, refers to the expansion of traditional supply chains to incorporate practices like resource conservation, green design, reducing the use of hazardous materials, and product recycling or reuse that are intended to minimize the environmental effects of a product over the course of its whole life cycle. Dematerialization is the procedure of producing and delivering goods and services that consumers need in less time or with fewer materials. The process of lowering industrial waste and pollutants transported on by the usage of hazardous compounds in industrial products is known as detoxification. Decarbonization, often referred to as de-energization, is the procedure of lowering the amount of carbon emissions produced during the production of hydrogen. These problems are connected to the four R's of business practice: reduction, redesign, reuse, and remanufacturing. As a result, businesses that typically focus on product design, the manufacture procedure, and the organization itself have taken a different tack when it originates to implementing sustainable practices.

(Al-Sheyadi et al., 2019) examined the effects of interior and exterior GSCM procedures on two aspects of ecological presentation ecological cost decreases and environmental impact. Environmental management systems, eco-design, source reduction, and exterior ecological activities are the four separate but connected sets of practices that make up the proposed collective competency known as GSCM. Green supply chain techniques also save non-renewable resources and cut depressed on waste. Businesses may lessen their dependency on petroleum-based goods and use recycled paper items rather than plastic to keep trash away from delicate ecosystems and landfills. They use less gasoline when they enforce stricter speed and idling laws and load trucks more effectively. Additionally, they protect resources for next generations when they follow the sustainable forestry and agriculture concepts. In summary, adopting GSCM principles is crucial for more reasons than merely the environment's health. It is essential to the long-term viability of communities and industries. The increasing demands of environmental regulations, in particular, are unique of the many new difficulties that the green source chain trends help to address.

Subsequently, (Cherrafi et al., 2018) examined the connection between green supply sequence performance and lean, green, and process innovation methods. This research adopts a fresh viewpoint by investigating lean, innovative processes, green paradigms, and sustainability's three pillars. All of these subjects are regarded as strategically significant for supply chain competitiveness. (Seman et al., 2019) intended to persuade organizations to adopt these practices by presenting empirical data demonstrating how GSCM and green innovation approaches greatly improve environmental performance. The relationship between green innovation strategies and GSCM is also examined in this study, as is the influence of these endeavors on the ecological presentation of 123 manufacturing firms that have obtained ISO 14001 certification. According to the PLS-SEM results, there is a strong and favorable correlation between environmental performance, green innovation, and GSCM. Prominent examples of maintainable supply chain management encompass aggressively pursuing the shift to biofuels, employing recycled materials in manufacturing processes, and reducing energy usage.

3. Waster Material Management in Industries

The full spectrum of tasks involved in handling, processing, getting rid of, or recycling waste materials is called the waste management system. Ensuring that waste products are processed, disposed of, or recycled in a harmless and acceptable manner while removing them from their source or region of generation is the aim of the waste management system. Many developing-nation cities strive for high reprocessing rates of clean, source-separated materials in their contemporary waste management systems. One of the many types of trash that, if not properly managed, can do significant harm to both humans and the environment is hazardous waste. Although hazardous waste is produced to variable degrees by many other industries, in terms of volume, heavy industries create the most. Hazardous waste management (HWM) has been thoroughly researched in a number of industries and nations, but heavy industries in

emerging nations have received less attention. (Gunawardana et al., 2021) identified the factors affecting the HWM practices in heavy industries in Sri Lanka.

The four main components of the waste administration system are as follows: (a) generation, or waste production; (b) collection, or waste material transportation and collection systems; (c) treatment, or converting wastes into useful products; and (d) final disposal, or dumping non-recyclables in landfills or utilizing recyclables for final disposal. Again, there are multiple subparts in each of these processes. Prioritized management techniques are part of advanced waste management systems, which decrease environmental issues and protect resources. Four categories apply to waste organization plans with respect to how the garbage is ultimately disposed of:

- Prevention of waste generation,
- Waste Recycling,
- Thermal treatment with recovery of energy,
- Landfilling.

The primary goal is waste minimization, which is typically the waste producer's responsibility. A company's waste output is a direct reflection of the size and type of its operations. Businesses need to know how much waste is generated on-site, what form of rubbish is that and why does it occur. They must also search for strategies to reduce or eliminate waste production. If it is not likely to avoid, waste streams produced on site should be properly held before being sent to contractors who handle properly regulated trash for treatment off site. Then, (Ali and Gulraiz, 2021) dedicated a thorough examination of waste management techniques used in the global car industry. The enormous influence that the automobile sector has on the GDP growth of any nation is also briefly discussed in this text. Although there are considerable disparities in prices and quality of vehicles produced the world over, however, the demand for automobiles has increased annually and in recent times many new and innovative brands of cars have emerged, globally.

3.1 Waste Management Methods

Conventional characteristics make it difficult to classify and assign various waste items to classes. Researchers have created and proposed a few novel techniques. These days, not all wastes fall into the same traditional category and need to be eliminated using the same process. Setting up and running separate management systems for distinct forms of garbage is exceedingly difficult and impracticable, particularly in businesses where waste types are so variable. Amid this natural trial, (Kulkarni and Anantharama, 2020) examined current Q MSW organization techniques, focusing on MSW disposal and treatment facilities in a few industrialized and developing nations. This article explores many facets of MSW organization and provides a global context of MSW organization throughout the COVID-19 epidemic, despite the paucity of investigation on the subject. To make the shift to a zero-waste circular economy, waste management needs a radical makeover. But in actuality, waste production is increasing in many economies, which presents a important threat to the environment. Due to the numerous parties involved, the need for behavioural adjustments, and the need to completely reevaluate the prevalent linear economic model and waste management systems, the problem is extremely difficult. Although there are still many obstacles to overcome, smart allowing skills can help convert waste management to a round cheap (Zhang et al., 2019). Thus, the essential for a management system that would get rid of all trash has arisen.

Disposal Methods: The management of such vast amounts of a polluted, heterogeneous combination of wastes in an environmentally friendly and energy-efficient manner requires an integrated approach. This would include conducting a thorough analysis of a number of waste life cycle stages, including the procurement of raw materials, manufacture processes, design and fabrication of final goods, potential repurposing of those items, and overall waste management. This kind of combined waste management idea consists of:

- Reduction of Source,
- Reuse,
- Recycling,
- Landfill and Gas-to-Energy,

- Waste to Energy Conversion.

Solid garbage has often been dumped in landfills. The least expensive waste management solution is landfill disposal. The primary issue with outsourcing the last stage of disposal or recovery is the unpredictability of the service's cost (Tomić and Schneider, 2020). This type of technique, which is a useful tool for decision-makers, has not yet been used to the evaluation of the socioeconomic sustainability of the entire waste management system. Figure 3 illustrates the disposal methods diagram.

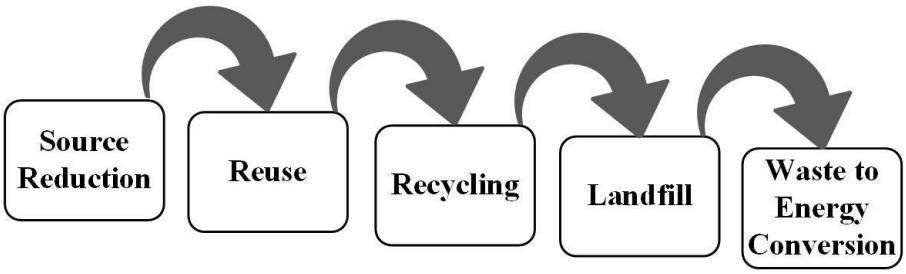

Figure 3. Waste Disposal Methods

Landfill: It is not meant to be a typical ecological setting. Rather, a landfill functions like a sealed storage unit. A landfill's main function is to halt deterioration so that hazardous pollutants cannot harm the ecosystem. In a landfill, even organic wastes like paper and grass clippings break down very gradually when they are cut off from oxygen and water. According to (Verma et al., 2020), landfills are the most common way to manage trash in developing nations and are a major source of emissions of CO2 and methane. Numerous chemicals are included in landfill leachates, some of which pose a risk to human fitness and the ecosystem if released into the wild.

Incineration: It is one method of waste removal that includes burning waste. The term "thermal treatment" describes high-temperature waste treatment techniques like cremation. A typical incinerator accomplishes its main goal of treating waste material while also recovering thermal energy as a by-product of the burning process by treating garbage that has been collected as input material.

4. Reverse Supply Chain Management in the Manufacturing Industry

The efficient execution of the set of procedures required to retrieve a creation from any point in the forward supply chain and either recycle it or recover its value is known as reverse supply chain management, or RSCM. A series of actions are needed in the reverse supply chain (RSC) to collect the used product and implement the best product disposal strategy, such as recycling, remanufacturing, or reuse. The RSC begins with a collection of goods from several supply chain phases, involving both businesses and consumers. These source chain memberships are usually dispersed across a large geographic area. (Yadollahinia et al., 2018) devised a tire forward and RSC, as healthy as a mixed-integer wrinkled software project model that takes uncertainty into account is created for multiple objectives, multiple periods, and multiple products. Furthermore, a novel idea for combining the concepts of customer relationship management and source chain management is proposed and included into the mathematical modeling framework. Next, using updated multi-choice goal programming techniques and robust optimization, the suggested scenario-based multi-objective model is solved. The realization rates of the objectives, taking into account their significance to the SC, are displayed in order to talk about the managerial implications of the model and its findings.

Since the product is returned from a client to a vendor, supplier, or retailer, the RSC process is almost exactly the conflicting of a traditional supply chain. RSCM includes pickups, cleaning, repackaging, sorting, mending, and finally reshipping. RL is crucial because it keeps the movement of crops efficient. In addition to completing the creation lifetime cycle, the approach lowers costs and increases value while lowering risk. From a wider angle, a closed-loop source cable is created when the forward and RSCs are merged. RL is included in these RSCs. Numerous products in the forward SC arrive at their destination before they are even seen by the customer. These products need to be transported back to the initiating stages of the forwarding supply chain for product disposition. Some products are:

- Broken down crops which are reusable,
- Products that are no longer in production but still hold some value,
- Unsold goods in retail establishments,
- Products are withdrawn from sale,
  - Products that have multiple uses yet cannot be recycled for their envisioned drive
  - Trash that can be gathered and utilized to provide energy, such as leftover wood, etc.
- Packages which need to be returned to their opinion of source or point of a consolidation.

(Özçelik et al., 2021) examined the influence of the ripple effect on the RSC network's system performance and presents a solid optimization model for building resilient RSC networks that can handle the uncertainties transported on by the ripple outcome. To the best of the authors' knowledge, this leads to the development of the first-ever robust optimisation model within the context of green principles for RSC design in contradiction of the ripple effect. (Heydari et al., 2018) study a two-stage RSC in which the manufacturer remanufactures eligible returned items after the retailer provides customers a reward for returning outmoded products. The capacity for remanufacturing is taken to be stochastic. It is conceivable that certain reviewed and qualified items could not be treated due to the uncertainty surrounding remanufacturing capacity. If an item purchased is unprocessable, it ought to be salvaged at a discount and counted as a lost profit. When there's a good accidental that there will be sufficient volume for the re-manufacturing process, then it makes sense to increase the quantity of returned old products.

4.1 Reverse Supply Chain Management Concept

Consumer pressure, cost containment, and environmental concerns have grown to be significant issues in RSCM over the past few decades. Concerns about reserve depletion, full landfills in many nations, and government legislation requiring the return of end-of-life products have made issues like RL, creation recovery, remanufacturing, and reuse appear to be important areas for future development. Competitive RSC implementation would reduce waste disposal, transportation, and inventory costs. It would also encourage future sales and the development of stronger consumer loyalty. Specifically, it highlights the need of comprehending the BDA idea in Indian sectors and suggests a framework to assess how industries have evolved in implementing BDA extensions in RSCM. As a result, figure 4 below depicts the figure for RL and its procedure.

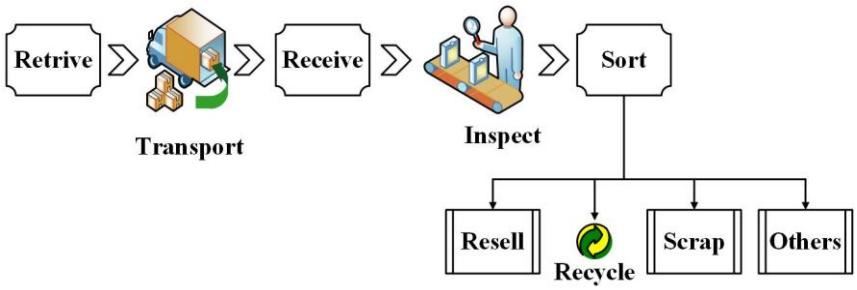

Figure 4. Reverse Logistics and its Process

A sustainable SC management is the RSC. By obtaining the most value possible from the end-of-life/use products, it contributes to the decrease in the amount of garbage dumped in landfills. Subsequently, RSCs deserve as much attention at the corporate level as forwarding supply chains and should be managed as business processes that can create value for the company. Many manufacturing companies see RSC as a huge nightmare for their organizational structure and have not yet adopted it. Similar to numerous other systems, the RSC possesses essential elements for success. The goal of (Sunil et al., 2020) was to pinpoint the systemic obstacles that RSCM always faces. The quantity

of e-waste is steadily increasing due to the rapid advancement of technology; this is essentially the case with returns of electronics. The social activities of international non-governmental organizations are just one of the factors influencing RSCM; other factors are also present. collecting trash for proper disposal, recycling, and repurposing.

4.2 Reverse Supply Chain Process

Businesses are compelled to invest in ecologically friendly production, which uses RSCM, as a government legislation pertaining to the environment becoming more stringent and consumers being more mindful of sustainability and the environment. RSC must handle returned goods with care in order to obey with the round economy, which seeks to reduce waste from the disposal of EOL products. (Hosseini-Motlagh et al., 2019) explored a RSC system managing interruptions in demand through its internet channel. Due to the loss of some online channel demand, the disruptions have a negative influence on the company's revenue. Through a collector whose efforts boost the collection volume, the company gathers used products through the reverse channel. The reverse channel's profitability is heavily reliant on the capacity of products collected, so devising a winning tactic to persuade the collector to gather a sufficient quantity of pre-owned items is vital for the business. RSCs despite being different in every unique case generally have the following five key processes:

- Product acquisition,
- Reverse logistics
- Inspection
- Product disposition
- Sale and distribution

Product Acquisition: The product is retrieved from the consumer during the acquisition phase. Product acquisition comes from three main sources: existing RSCs known as market-driven systems; forwarding supply chains that handle the collection of damaged or faulty products; or the waste stream, where the product has been abandoned by the customer. Because market-driven systems adhere to a minimum standard of quality, they are less variable. Although the reverse supply chain (RSC) may have the similar interaction partners as the onward SC, the opposite flows are typically supported entirely or in part by alternative channel partners.

Reverse Logistics: Research and practitioners worldwide are paying more and more attention to RL because of growing concerns about going green, sustainable development, intense global competitiveness, upcoming regulations, more product returns, customers' environmental consciousness, and so on. It is “the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin to recapture or create value or proper disposal”. Raw material backflows, inventory held during processing, packed commodities, and completed properties from a industrial, distribution, or end-user point to a location of recovery or appropriate disposal are planned, carried out, and controlled by RL. The implementation of RL can be confidential as an element of a company's environmental management policies, namely environmental recycling procedures, since it promotes material reuse and recycling. The complexity of the produce disposal process necessitates the knowledge of trained labor, which raises the inspection and disposal costs.

Inspection: The main objective of the inspection is to determine the quality level of the repaid material and to choose the best product disposal plan for it.

Product Disposition: A product is allocated to a overhauling operation, such as refurbishing, repairing, or remanufacturing, if it is determined that a product upgrade is the best disposition plan for it. The process of disassembly is difficult. The procedure is primarily manual due to the challenge of separating and sorting the components as well as the variety and complexity of materials. There are four categories of creation disposition strategies, and within each type there are more subtypes:

Direct Reuse: It involves reusing or reselling the product immediately.

Product Upgrade: It means reassembling, repackaging, remanufacturing, or renovating the item. The process of "repairing" entails putting the used goods back in "functioning condition." "Refurbishing" entails raising the calibre

of worn goods to a predetermined point. "Remanufacturing" refers to the process of transporting used goods up to new product-like quality requirements.

Materials Recovery: Recycling and cannibalization are two of its components. Cannibalization is the procedure of extracting a small amount of recoverable parts from discarded goods or parts. For instance, integrated circuits are cannibalized by the US company Aurora. The company takes the necessary bits out of a computer, tests, straightens, polishes, and then sells the chips.

Waste management: It is entails burning and disposing of products in landfills for safe disposal.

5. Implementation of Source Chain Management

In order to effectively integrate dealers, builders, juggernauts, warehouses, retailers, and customers and ensure that the appropriate product or service is distributed in the appropriate quantities, to the appropriate locations, and at the appropriate times, the SCM system gathers coordinated decisions and actions. Consequently, some of the best examples of SCM software are E2open, SAP Epicor, Dassault Systems SCM, Descartes SCM, High leap SCM, IFS, Watson Source Chain, and BluJay SCM. Using SmartPLS software, PLS-SEM was carried out in 2019 (Ni and Sun, 2019). This analysis strategy is preferred due to the following methodological advantages. In order to obtain sufficient statistical power and resilience, it first sets minimum requirements for sample size and residual distribution.

SCM effectiveness has the potential to be a key success factor for Indian SMEs in a global economy that is changing rapidly. (Singh and Kumar, 2020) surveyed Indian SMEs across various industries. In this circumstance, the survey results are statistically analyzed using SPSS software. In order to ascertain the direct and indirect effects of sustainable supply chain strategies on competitive priorities at pharmaceutical companies in Jordan, (Alzoubi et al., 2020) employed a statistical SmartPLS software package to analyze the data. The questionnaire, which was built on a five point Likert scale, was thought of as the education instrument to amount the study variables. However, a 12-item assessment was used to evaluate sustainable supply chain methods, which were divided into three dimensions: maximizing economic gains, reducing adverse environmental consequences, and maximizing benefits to society. The constancy of each constituent of the measure was also assessed using Cronbach's alpha. In order to control which questions were best suited for measuring the study's dimensions and variables, the exploratory factor analysis varimax rotation method was applied. If necessary, a cross-loaded item was eliminated from the scale. The Cronbach's alpha constant was used to evaluate the internal consistency.

5.1 Analysis of Data Collection from Various Research

(A conceptual model developed by Yu et al. (2021) illustrates the relationship between SC relationship capital, financial performance, and initiative green managing. The theories were then empirically tested using data collected from 308 Chinese manufacturing companies, structural equation modeling, and SPSS PROCESS. The study's conclusions show that supply chain relationship capital has a positive impact on corporate green management, which improves financial performance for businesses undergoing Industry 4.0-related digital transformation. (Al-Ghwayeen and Abdallah, 2018) report is founded on survey data gathered from 221 Jordanian manufacturing enterprises. The businesses were selected from a range of industrial sectors to ensure diversity. To analyze the study hypotheses, structural equation modeling was utilized, and Amos and SPSS were used for validity and reliability analyses. Introducing risk management into the expansion of new car models can improve project success and management performance. (Fernando et al., 2018) provided evidence of the possible positive correlations between generalized SCM (GSCM) and project risk management (PRM) and project management success. Organizational equation modeling was used to inspect data gathered from 145 project managers in the Malaysian automotive manufacturing sector. The findings showed that the PRM and GSCM, as well as project success, were positively correlated with project management effectiveness.

(Guarnieri et al., 2020) collected the data by conducting documental examination and interviews with government representatives, managers in the corporate sector, and waste pickers associations all of whom are major signatories to the agreement under study. The findings were triangulated to demonstrate the many viewpoints that the research bases and methodologies revealed. The primary findings indicate that the notion of circular economy, however not explicitly articulated in Brazilian legislation and sectoral agreements, directs the measures devised by the parties involved in the agreement. (Lee et al., 2022) included 3019 manufacturing firms in Malaysia; a minimum of 43 manufacturing firms is required for the sample to be considered valid. After 1160 complete survey sets were sent out by email, 63 responses,

or 5% of the total, were received. Every hypothesis in the study is evaluated using PLS-SEM. The consequences of this paper support six out of the seven hypotheses tested. In conclusion, rather than focusing solely on the problems with IoT, Malaysia's industrial sector has to be more exposed to its advantages.

5.2 Questionnaire Development

A survey questionnaire was created in order to meet the research's goals. The survey's questions were modified based on previously published works. Five professors of operations and SCM examined the questionnaire to make sure the measuring device was measuring the right things. Such a review also guaranteed the accuracy of the translation and the appropriateness and clarity of the survey items. As necessary, changes were made, and certain items were updated, filtered, relocated, or eliminated. Additionally, the survey was pre-tested by five managers from manufacturing firms, and changes were made in response to their input. The following is the review that was created using the questionnaire.

(Hanaysha et al., 2022) looked into how the digital source chain in Malaysia's industrial sector affected the organization's and the supply chain's performance. The quantitative research design is used to accomplish the goals. Using a stratified sample technique, the researchers sent the online survey to 1160 industrial companies listed in the Confederation of Malaysian Constructers FMM manual. We received 63 replies in total. The seven incomplete responses that were eliminated are replaced by 56 valid responses, or 5.43% of the response rate used for data examination. PLS-SEM was used to evaluate the data. Seven hypotheses, including all of the moderating impact hypotheses, are supported whereas three are not. Malaysian manufacturing organizations may want to think about implementing the DSC into their business processes in order to maintain their dependability in the cutthroat market by offering the best overall organizational performance and strong supply chain performance. The study's implications are directed towards scholars and professionals, particularly those in the manufacturing sector. The limitations have been emphasized, along with a suggestion for additional research.

(Panfilova et al., 2020) Examine how decision-making is influenced by the amount of logistics costs. In order to accomplish the goal, the study employed mathematical modeling, analysis techniques, and questionnaires. The primary problems with supply chain cost management were emphasized. During the research process, they came to the conclusion that while there isn't a single, universal solution to recover cost competence for all kinds of businesses, one may be devised for a specific subset of them. The questionnaire's results indicate that managers' choices about how to increase efficiency are influenced more by their personal preferences than by economic efficiency. Because of the hazards involved, 67% of the respondents are willing to pass up a lucrative enterprise. The survey also revealed that just 4% of managers are prepared to end an ongoing project if it isn't working. The study's mathematical model will be helpful in forecasting and planning the amount of expenses related to logistics. It may also inspire independent businesses to develop sophisticated mathematical models.

(Queiroz and Telles, 2019) surveyed SCM levels of a thousand businesses through surveys. 155 of the 272 surveys that were received or 15.5% of the total were deemed legitimate. (Alnoor et al., 2018) examined the impact of reinforcement learning on environmentally, socially, and environmentally sustainable manufacturing. Employees of LUKOIL, a multinational oil corporation based in Basra that operates in southern Iraq, were given the questionnaire when it was created. The 208 employees that brand up the study's sample were chosen at random. The data was analysed using AMOS 22. The outcomes showed that RL has a direct and beneficial impact on sustainable manufacturing. Numerous assumptions have been drawn, along with their ramifications and recommendations for further study. Having a sustainable plan allows the business to innovate and relocate in order to fulfil the needs of future generations. The corporate social accountability is collaboration in the utilize of RL to sustain the company's positive reputation and image among its clientele.

6. Research Problem Definition and Motivation

SCM applications are growing quickly these days. This idea came about as a consequence of the realization that the procedure of turning raw resources into ended goods and getting individuals goods to final consumers is getting more and more complicated. In light of this, it is becoming more and more clear that analysis and the ensuing enhancement of each particular supply chain do not inevitably consequence in the development of the source chain as a entire. As a consequence, the idea of the SCM evolved to cover every aspect of manufacturing, from acquiring raw materials to bringing the ended creation to the customer. Due to worldwide struggle, there is severe pressure on cost and margin. Utmost efficiency is therefore required in securing economic growth, both at the micro and macro level in any region of the country. It is seen that holdings are small; business houses often lack economies of scale and logistics

integration. The result is high production cost, poor delivery system, inadequate services and all-around efficiency. It is envisioned that integrating business activities in different kinds of units through SSCM will achieve various benefits.

For effective implementation of SCM, all gatherings intricate must be occupied into explanation, such as the dealer's providers, wholesalers, distributors, vendors and every gathering whose influence can aid in the elevation of the government's marketplace segment. SCM has been used for interior and outside logistical activities, processes with other organizations, preparation and switch of information and physical flows, and the development and administration of relationships and shared processes with dealers and clienteles. SCM is now seen as a serious constituent for increasing an organization's effectiveness and competitiveness. Therefore, an appropriate (SCM) strategy makes it possible to achieve operational outcomes such as increased process efficiency, decreased inventory levels, increased customer satisfaction, improved quality, cheaper costs, and better delivery. The term "lean supply chain management" (LSCM) was born out of this. LSCM is complete active of businesses that are directly connected through up and down stream flows of data, reserves, goods, and services. These businesses collaborate to pull what is needed to satisfy each customer's needs in a well-organized and active manner, which lowers costs and waste.

7. Current Trend and Developments

Global technologies, particularly digital ones, are becoming a vital tool for organizations looking to preserve viable alliances and establish high-value connections with other enterprises. Every day, new digital technologies are developing and will soon affect practically every aspect of business operations and procedures. (Hanaysha et al., 2022) investigated how the presentation in source cable and the organization were affected by the numerical source sequence in Malaysia's industrial sector. In the association among the numerical source cable and structural presentation in the Malaysian manufacturing sector, this study evaluates the arbitrating role of source chain performance. Malaysian manufacturing organizations may want to think about implementing the DSC into their business processes in order to maintain their dependability in the cutthroat market by offering the best overall organizational performance and strong supply chain performance. The study's implications are directed towards scholars and professionals, particularly those in the industrial sector. (Quintana-García et al., 2021) gain more information concerning the influence of approaches concerned with GSCM on a company's business standing. They use board data from European industrial businesses for ten years to evaluate a set of hypotheses. Their results offer compelling evidence in favor of the hypothesis that business reputation is positively impacted by dealer assortment, oversight, and business termination based on ecological factors. Furthermore, data indicates that a company's reputation is enhanced by the full implementation of those initiatives and the advancement of GSCM acceptance. This study has insinuations for theory and repetition.

(Dey et al., 2021) examined and measures these advantages of a similar reduction in principal period for frequently used lot size number, manufacturing degree, security influence, rearrange opinion, price of advertisement, and seller arrangement cost. Unlike predicted total cost equations, this study provides an actual total cost equation based on the intrinsic link between on-hand inventory and backorder. More accurate findings are obtained using the lead time and variance marginal value analysis. When an RSC is integrated with simple forward logistics to retrieve the product from the starting location, a locked hoop stream chain is created. (Shetty et al., 2022) established an RSC system to recover various types of plastic and create a circular economy-compliant model. A RSC is designed focuses on used plastic collection from consumers at the group center and after categorization, these plastics are providing to their individual suppliers for further application. The suggested network sheds insight on the methodical approach to recycling and reusing plastic goods. According to the concept, providers can boost profitability by reclaiming created plastic, hence reducing emissions from plastic reprocessing and the essential for new raw materials. A network is created to methodically steer various forms of recovered malleable for its extra activities based on the identification of constructs between the suggestion of the literature study conducted and legislation.

8. State of the Art of Training

The review is founded on the education of RSCM, which focuses on remanufacturing, recycling, refurbishing, etc. Subsequently, the national of the sculpture of the review is depicted in table 1.

Table 1. State of Art of Review

S. No	Author	Objective	Findings
1	(Behera et al., 2022) (52)	The key objective of this purpose is to inspect the current position of BDA on different industrial processes and RSCL in Indian industry. It gives an analysis of how industries have progressed in applying BDA extensions in RSCM and specifically examines how the BDA concept is recognized in Indian sectors.	The information on Indian industries concerning BDA, the steeplechases with limitations to BDA-venture greeting, and the joining with RSCL and BDA data were recognized.
2	(Roudbari et al., 2021) (53)	This work presents a two-stage stochastic mixed-integer software design model that takes into explanation various methods for recovering recyclable materials, including recycling, remanufacturing, reuse, and vending spare parts. Considering indecision about the quantity and caliber of repaid goods, product diversity, and mandible of materials are other model components.	The procedure is applied to a real-world problematic to design a RL system for a small-size laboratory equipment manufacturer.
3	(Hosseini-Motlagh et al., 2022) (54)	An organization model is designed for an RSC that receipts into explanation the management of creation gaining and the rivalry from third-party gatherers. Driven by a case study on malleable reprocessing, gatherers oversee the quality of returned goods that are delivered to the remanufacturer in addition to competing on return incentives given to customers.	The outcomes show that the coordinating approach creates a win-win scenario for members while also considerably improving the amount and quality of items acquired by the remanufacturer.
4	(Tavana et al., 2021) (55)	Several models and supplier selection techniques have been developed as a consequence of opposite source manacles. This paper proposes a fuzzy-based supplier selection strategy for reverse SCs inside a LARG strategic framework. It combines the fuzzy collection best-worst technique with the fuzzy joint cooperation solution method.	The main objective of the framework under consideration is to give manufacturers who are involved in reprocessing and worried with sustainability subjects a simple, dependable way to rank and choose suppliers.
5	(Toktaş-Palut et al., 2021) (56)	This study examines the combined three-stage onward and opposite supply chain that serves the environmentally conscious market by providing new and remanufactured environmentally friendly products. Environmentally friendly production methods require an investment from both the creator and the recycler.	The conclusions show that as consumers grow more aware of how green new and remanufactured items should be, manufacturers and remanufacturers set higher standards; demand for both kinds of green products rises; and source manacles as a whole make more money.
6	(Rayra et al., 2021) (57)	To develop a conceptual opposite supply chain (RSC) model for building and destruction waste (CDW) by systematically analyzing existing literature, aiming to clarify the recovery process and encourage further research.	The study produced a detailed process diagram of the RSC model, identifying key actors and their interactions, providing practical and theoretical insights to enhance reverse logistics and guide policy development for CDW management.

Table 1. State of Art of Survey (*Continued*)

7	(Erol et al., 2021) (58)	This study looks at RSCM programs are doing right now across a number of Turkish sectors, focusing on automotive, white goods, electronics, and furniture sectors.	The study finds that RSCM initiatives are in their early stages, driven mainly by legislative liabilities, with system inadequacies being a major obstacle to efficient implementation.
8	(Mohajeri, et al., 2021) (59)	Using Industry 4.0 technology, the research creates a fuzzy multi-stage classical for optimizing the nutriment contrary source chain, incorporating household waste recycling machines and electric vehicles for collection and delivery.	The model maximizes recycling benefits and customer response while minimizing environmental impact and transportation costs, validated by the whale optimization algorithm.

9. Purposes of the Research Methodology

The procurement process is one aspect in supply chain, along with product lifecycle management, order management, logistics (including fleet and transportation organization), source cable preparation, and procurement. In addition, supply chain organization can be recycled to handle cross-border manufacturing operations and worldwide supplier management. These days, RSCM is highly discussed due to its vital function in both economic growth and environmental preservation. In the RSC, disassembly is crucial. The objective is to disassemble important components from end-of-life items, which are subsequently re-manufactured into new-similar ones through reassembly and reusing procedures. The foremost explanations for which RL is undertaken may be new line economic, legislative, corporate citizenship and ecological issues. Across sectors, RL has been accepted to satisfy either one or extra of these reasons. Retail RL is gaining importance among academicians and practitioners. Various reasons have led to this phenomenon ranging from lowering product quality, as a new line significance of obtaining from developing countries, generous returns policies, buyers, the rise of the internet and home shopping and last but not the least high rate related to margarine formation life cycle. As a consequence, the source chain must understand the ideas of product recycling and remanufacturing. Therefore, RSCM professionally establish and achieve the re-manufacturing procedure from the viewpoint of maintainable growth, respectively.

10. Conclusion and Future Scope

Source chains are attractive increasingly complicated and diverse as a consequence of the increasing need for inter- and intra-organizational connectivity, which is enabled by developments in modern technology and closely related business procedures. The SCM research serves as the base for the review's initial representation in supply chain's specifications and practices. The needs of SCM presented the SSCM and GSCM. The waste material management in industries and their management methods are presented. Accordingly, RSCM and its process are demonstrated in this work. The implementation of SCM is revealed. The research problem definition, present tendencies and development, state of art of review, and the impartial of the study are also depicted in this study. The appraisal work reveals that the source cable preparation of EOL crops in RL has dissimilar characters of ecologically aware industrial that include reuse, re-manufacturing, disassembles and reprocessing. Accurately, this is all around consuming switch over the manufacturing, distribution and user/customer return of products. Distribution returns include functional returns, profitable returns, standard changes, and creation recalls, while industrial revenues comprise quality switch revenues, surplus raw materials, and manufacture scraps. In future work, RSCM is applied in the vehicle manufacturing to reuse or remanufacture the waste product materials.

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