

## **“ACHIEVING SUSTAINABILITY IN LOGISTICS AND SUPPLY CHAIN THROUGH DIGITALIZATION”**

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**Abstract-** In the modern age of technology, it is essential for the businesses to adapt digitalized tools and techniques in their logistic and supply chain system in order to achieve the sustainability and overall profitability. The goal is to reduce carbon footprints and reducing environmental damage by adopting certain technological tools in the process of procurement and delivery of raw materials, semi-finished goods and finished goods. This paper presents a systematical evaluation of how we can achieve the sustainability in logistics and supply chain by adopting the latest technology that are available in the current market.

**Key words-** Sustainability, logistics system, supply chain, digitalization

### **Introduction**

"Sustainable Logistics and Supply Chain" represents a dynamic paradigm shift in the realm of logistics, encompassing a comprehensive transformation of strategies, structures, processes, and systems. This evolution aims to optimize the utilization of resources throughout the entire supply chain, from the sourcing of raw materials to the various stages of production, storage, packaging, distribution, and ultimately, the management of products at the end of their lifecycle. This approach strives for a more thoughtful and efficient integration of sustainable practices into every facet of supply-chain activities. <sup>1</sup>

At its core, sustainable logistics seeks to enhance the eco-friendliness of logistics, freight, and transportation. This involves reducing the environmental footprint associated with the practices employed in these processes, fostering a commitment to minimizing their impact on the planet through modern technology in logistics. <sup>1</sup>

Numerous companies are transitioning their conventional logistics into more sustainable practices. This transformation encompasses initiatives across all organizational levels, contributing not only to the well-being of the planet but also yielding eventual business advantages. <sup>3</sup>

### **Need for the study**

It is a well-known factor now days that how much environmental pollution has been occurring due to the motor vehicles used for the transportation of raw materials, finished goods etc., in order to reduce the pollution level of the environment the companies need to think of redesigning their logistics and supply chain system and adopting modern technologies to achieve the SDG.

### **Literature review**

#### **Sustainable logistics**

Sustainable logistics revolves around prioritizing environmental sustainability and minimizing the ecological impact in the realms of freight, logistics, and supply chain operations. The path to achieving sustainable logistics operations may vary, but several best practices can serve as a guiding roadmap in this endeavor. <sup>2</sup>

#### **Green logistics**

Green logistics entails efforts to reduce the environmental impact of logistics activities. Also referred to as sustainable logistics or eco-logistics, the focus of green logistics is on promoting sustainability and ecological efficiency in the transportation and supply chain processes. <sup>2</sup>

#### **Sustainable supply chain management**

A sustainable supply chain is characterized by the seamless integration of ethical and environmentally responsible practices into a competitive and successful model. Complete transparency throughout the entire supply chain, from sourcing raw materials to last-mile logistics, as well as encompassing product returns and recycling processes, is imperative for the success of sustainability initiatives. <sup>4</sup>

### Technological trends in logistics

Over the years, technology has undergone a significant transformation within the logistics industry, fundamentally altering the transportation, storage, and management of goods. Automation has played a key role in streamlining various processes, encompassing sorting, packaging, as well as loading and unloading activities.

Furthermore, the integration of GPS technology has revolutionized navigation and route planning, leveraging route optimization software to identify the most efficient paths for delivery. The advent of logistics apps, facilitated by technology, has fostered seamless operational management by connecting consumers, retailers, and logistics providers.

These advancements represent only a fraction of the transformative impact technology has had on the logistics sector, reshaping its operational landscape through technological innovations and integrations. This evolution is not a culmination but rather a prelude to continued advancements and enhancements in the industry. <sup>7</sup>

### Research methodology

The qualitative research approach was opted in order to collect the information from different online sources and related research papers were referred. This article's analysis is supported by research-oriented data and real-life industrial examples which provide the understanding of sustainability in logistics and supply chain management.

### Three Pillars of Sustainability

Sustainability comprises three essential pillars: the economy, society, and the environment, often informally known as "the 3 Ps" - Profit, People, and Planet. Striking a harmonious balance among these principles allows logistics to deliver optimal services while simultaneously promoting conscientious resource. <sup>1</sup>

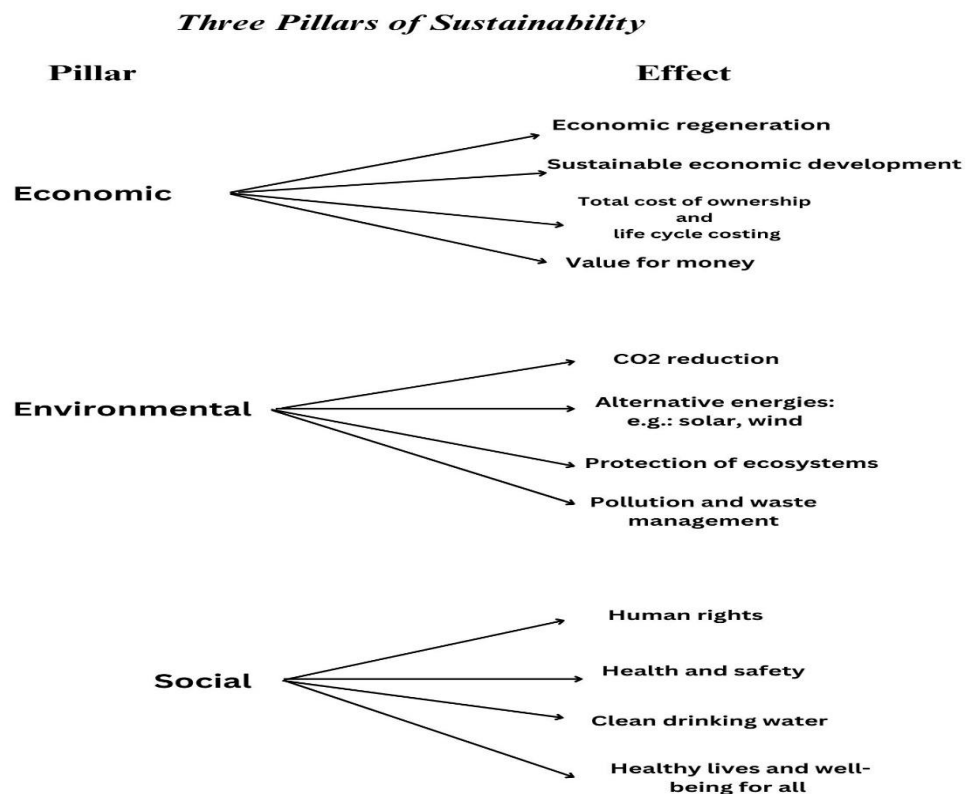


Figure 1 – Three pillars of sustainability and their effects

### **How do we get started with sustainable logistics?**

Embarking on the journey of sustainable logistics may seem challenging and overwhelming, so let's explore the steps to integrate sustainable practices into your business strategy. A crucial initial step involves optimizing the efficiency of your logistics process. Achieving this can be facilitated by employing a diverse range of transport options for product distribution. For instance, incorporating inland transportation services like train freight or inland water transport in conjunction with road freight enhances journey efficiency. These transport modes contribute to reduced air pollution, mitigate congestion, and enable a faster and more efficient cargo transit from point A to B.<sup>5</sup> Processes involved in sustainable logistics Sustainable logistics pursues a dual objective: minimizing the environmental impact of operations while maintaining competitiveness.

Transportation is a pivotal component of sustainable logistics, spanning the supply of raw materials to production centers and the subsequent distribution of orders to end customers. To reduce the carbon footprint in transportation, strategic route planning is essential for optimizing the movement of goods. Effective fleet management not only mitigates pollution but also enhances efficiency by preventing vehicle idling in yards and loading docks.

Improving warehouse management and increasing operational throughput are integral to advancing sustainable logistics. A facility with a lower error rate in order picking and consolidation can significantly reduce product returns, a costly warehousing process.

Additionally, sustainable logistics involves curtailing the unnecessary use of materials in the goods dispatch process. Implementing a logistics program that guides operators in packing, labeling, and wrapping operations not only boosts productivity but also mitigates the risk of errors in the warehouse.<sup>6</sup>

### **How technology can boost sustainable logistics?**

As highlighted in McKinsey's study on "Embracing technology and sustainability in freight transport," new technologies are poised to be pivotal in advancing sustainable logistics. The report emphasizes that achieving rapid decarbonization in the sector necessitates a reevaluation of long-term infrastructure investments, emphasizing the integration of both technology and sustainability.

Innovations like logistics process automation and digitalization through a Warehouse Management System (WMS) play a crucial role in eradicating operational errors in tasks such as material movement, order picking, and lorry loading. The reduction in mistakes translates to fewer product returns in the warehouse, contributing to enhanced sustainability for businesses.

The landscape of sustainable logistics is in a continual state of evolution, exemplified by advancements like electric lorries and route management programs. According to the authors of the McKinsey report, there is a pressing need to scale up innovations such as electric vehicles, fast-charging infrastructure, and hydrogen fuel cells. This scaling is aimed at bolstering the sustainability and resilience of our freight transport system. The overarching objective, as outlined in the report, is to diminish the sector's significant environmental impact and safeguard infrastructure from the repercussions of climate change.<sup>6</sup>

### **Three components of sustainable supply chains**

- **Green supply chain:** Establishing a green supply chain involves seamlessly incorporating environmentally responsible principles and standards into every facet of supply chain management, spanning product design, materials sourcing, manufacturing, logistics, and end-of-life product management. In the era of increased e-commerce, the market is flooded with a myriad of product and shopping options. To remain competitive, businesses must seek robust solutions to environmentally optimize their supply chains while concurrently fostering profit growth. Advanced supply chain technologies, including AI and machine learning, empower businesses to identify risks, discern patterns, and seize opportunities, enabling them to minimize waste and enhance overall efficiency.

- **Transparent supply chain:** Supply chain transparency denotes a business's capacity and inclination to openly share information regarding the origin of goods, labor, and comprehensive supply chain practices. Numerous businesses dedicate substantial time and resources to establish and uphold ethical and environmentally responsible standards.

However, despite well-intentioned efforts, enforcing and reliably implementing these standards has historically posed challenges. Fortunately, the advent of digital technologies like blockchain and RFID sensors now empowers supply chain managers to acquire a precise and indisputable record of all products and suppliers throughout the entire supply chain journey.

- **Circular supply chain:** Within a circular supply chain, products undergo disassembly or are transformed back into their raw material state before being remade into marketable products. This approach not only enables businesses to reap the environmental advantages of recycling but also facilitates cost recovery in the process. Modern technologies supporting these initiatives encompass the utilization of recycled plastics in 3D printing and the application of advanced analytics to chart the most efficient logistics routes for reintroducing products into the supply chain loop. Additionally, businesses are progressively embracing circular product design principles, embedding waste reduction into the inherent makeup of products and their component parts.<sup>4</sup>

### **Modern technological components used in sustainable supply chain**

- **Artificial intelligence (AI):** AI technologies enable the collection and analysis of diverse data sets throughout the supply chain. A noteworthy advantage that AI offers to the sustainable supply chain is its capability for synchro modality and collaborative shipping. This involves real-time tracking of package status and location, allowing for immediate optimization opportunities, such as combining shipments or utilizing more resource-efficient logistics when time permits.
- **Machine learning:** as an AI application, leverages Big Data to enable systems and connected devices to adapt in real-time. It involves discovering patterns, learning from experience, and automating agile and responsive workflows. In the context of supply chain management, the operational optimization measures derived from this process can notably diminish waste and reduce energy usage.
- **Robots and automated technologies:** The surge in online shopping, with a notable increase of over 149% since the beginning of 2020, has heightened the demand for swift or next-day delivery. This has strained the existing capabilities of warehousing and last-mile logistics services. Automated tools such as electronic drones and inventory management robots exemplify technologies that can be enhanced with intelligent automation. This optimization contributes to improved workflow efficiency, energy optimization, and reduced fossil fuel usage within the logistics network.
- **Industrial Internet of Things (IIoT):** The integration of unique identifiers and digital data exchange capabilities into connected devices and machines within a business forms an IIoT network. Within a sustainable supply chain, leveraging asset intelligence through IIoT facilitates the optimization of machine performance and the automation of maintenance processes. This, in turn, leads to a reduction in energy usage and the elimination of redundancies in workflows.
- **Sensors:** Small and cost-effective devices such as RFID and other sensors can be seamlessly integrated into products and raw materials, either at their origin or at various points along the supply chain. When partners and suppliers adhere to the mandatory attachment of sensors, an unparalleled level of transparency is realized, particularly in regions that may have posed challenges for consistent monitoring in the past.
- **Modern databases and ERP (Enterprise Resource Planning):** Optimal sustainability solutions rely on in-memory databases and ERP systems adept at handling Big Data and intricate processes. The technologies and automated elements integral to a sustainable supply chain hinge on predictive and advanced analytics, leveraging the real-time insights facilitated by these contemporary, centralized business systems.<sup>4</sup>

### **Findings**

- Integrating a variety of transport options, such as train freight and inland water transport alongside road freight, enhances journey efficiency in sustainable logistics. This not only reduces air pollution but also contributes to faster and more efficient cargo transit.
- Sustainable logistics pursues a dual objective of minimizing environmental impact while maintaining competitiveness. This involves strategic route planning to reduce the carbon footprint in transportation and effective fleet management to enhance efficiency.
- Improving warehouse management and increasing operational throughput are crucial for advancing sustainable logistics. A lower error rate in order picking and consolidation significantly reduces product returns, reducing the environmental impact of warehousing processes.
- McKinsey's study highlights the pivotal role of technology in advancing sustainable logistics. Innovations like logistics process automation and digitalization through Warehouse Management Systems (WMS) play a crucial role in eradicating operational errors and enhancing sustainability.

- The sustainable logistics landscape is evolving with innovations like electric lorries and route management programs. There is a pressing need to scale up technologies such as electric vehicles, fast-charging infrastructure, and hydrogen fuel cells to enhance the sustainability and resilience of the freight transport system.
- Artificial intelligence (AI), machine learning, robots, the Industrial Internet of Things (IIoT), and sensors are key technological components enhancing sustainability in supply chains. These technologies provide real-time insights, optimize energy usage, and contribute to reduced waste in logistics processes. These findings collectively highlight the multifaceted approach and the crucial role of technology in advancing sustainable logistics and supply chain practices.

## Conclusion

In summary, the exploration of sustainable logistics practices reveals a dynamic and interconnected framework where diverse transport options, such as the integration of train freight and inland water transport, significantly contribute to heightened journey efficiency and reduced environmental impact. This emphasis on eco-friendly transportation aligns with the dual objectives of sustainable logistics, aiming to minimize environmental footprints while ensuring competitiveness. Strategic route planning, coupled with effective fleet management, emerges as a pivotal strategy in achieving these objectives.

Furthermore, advancements in warehouse management prove instrumental in advancing sustainability by reducing errors, improving operational throughput, and ultimately decreasing product returns. The conscientious effort to curtail unnecessary material use, guided by well-designed logistics programs, not only enhances productivity but also mitigates risks and errors within warehouse operations. The adoption of these sustainable logistics practices is not isolated; it is part of a larger landscape where innovative technologies play a central role.

The transformative impact of technology, including logistics process automation and digitalization through Warehouse Management Systems (WMS), is evident in eradicating operational errors and elevating sustainability. The evolution of the sustainable logistics landscape is further underscored by innovations like electric lorries and route management programs, emphasizing the urgency to scale up technologies such as electric vehicles, fast-charging infrastructure, and hydrogen fuel cells. As supply chains embrace green, transparent, and circular principles, the integration of modern technologies, such as Artificial Intelligence (AI), machine learning, robots, the Industrial Internet of Things (IIoT), and sensors, emerges as a cornerstone in providing real-time insights, optimizing energy usage, and contributing to waste reduction within logistics processes. Collectively, these findings illuminate the comprehensive and technology-driven approach needed to propel the sustainability agenda in logistics and supply chain management.

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