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Supply Chain and Logistics in Indian Markets; Challenges and Future Scope

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Abstract

The logistics sector in India is rapidly expanding, contributing around 14% to the country's GDP. This growth is driven by the rise of logistics and government initiatives like "Make in India," offering significant opportunities for Logistics Service Providers (LSPs). However, LSPs must adapt their strategies to seize these opportunities, as they face several challenges in delivering shipments on time and in good condition. Despite government efforts through large-scale projects, the sector still grapples with fragmentation, unorganized operations, infrastructure bottlenecks, and rising costs, all of which affect service quality. As India emerges as a global manufacturing hub, increasing demand in domestic and international markets is creating new opportunities for Indian industries. Globalization has intensified competition, compelling industries to produce cost-effective, high-quality goods under tight delivery schedules. However, issues like delayed shipments, poor quality supplies, and cost escalation threaten the credibility and business prospects of Indian manufacturers. Supply chain disruptions, in particular, can lead to significant losses.

Keywords

Logistics, Supply Chain, Logistics Service Provider (LSP), Supply Chain Management, Infrastructure bottlenecks.

1. Introduction

In the age of e-commerce and intense global competition, the range of services offered by logistics service providers (LSPs) in developing countries like India has expanded significantly. Currently, the logistics sector contributes approximately 14% to India's GDP and is projected to grow at 1.5 to 2 times its current rate. According to the Logistics Performance Index (LPI) Survey 2014, India ranks 54th out of 160 countries with a score of 3.08. For LSPs to thrive and expand in this competitive environment, maintaining high service quality across all logistics functions is crucial. They must deliver top-notch services to ensure business continuity and future growth.

India presents substantial growth opportunities for LSPs, driven by the rise in e-businesses and the Indian government's “Make in India” initiative. Additionally, technological advancements and increasing globalization compel organizations to revamp their strategies and develop products that cater to global demands through enhanced logistics capabilities. However, LSPs face numerous challenges in meeting the rising expectations of businesses. The current capacities of LSPs do not align with industry requirements, particularly in developing countries like India where infrastructural bottlenecks are a major concern. Issues such as poor road conditions, inadequate air and sea port capacities, limited connectivity, heavy congestion, and inefficiencies at check posts and tolls are prevalent. National highways account for only 2% of India's roads but handle around 40% of total road freight movement. Similarly, five major airports and twelve major seaports in metropolitan areas manage approximately 85% of air freight traffic. Furthermore, the lack of advanced IT tools and a limited skilled workforce hinder the growth of LSPs. High investment costs combined with low profit margins, exacerbated by delayed payments from Indian shippers, slow down the

progress of logistics providers. Additionally, subpar government policies and inspection strategies pose significant obstacles to the success of LSPs, often leading to the failure of desired logistics services (Figure 1-Figure 4).

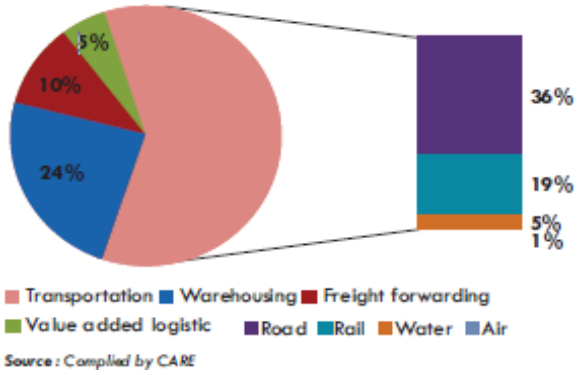

Figure 1. Percentage Share of the Logistics Service Providers in India

Despite these challenges, the logistics sector in India continues to grow, fuelled by increases in the retail, e-commerce, and manufacturing sectors. Rising domestic and global consumption opens up numerous new opportunities for LSPs. To ensure seamless services, it is essential to identify and eliminate these challenges. This study attempts to identify and develop a structural relationship among these challenges. In today's competitive landscape, supply chain management (SCM) is of paramount importance, demanding focused research as companies strive to meet escalating customer expectations while managing costs effectively. Businesses must identify non-competitive aspects of their supply chain processes, understand unmet customer needs, set improvement goals, and swiftly implement necessary changes.

Supply Chain Management encompasses not only logistics activities and the planning and control of material and information flows within and between companies but also strategic, inter-organizational issues. It explores alternative organizational forms to vertical integration, defines relationships with suppliers, and addresses purchasing and supply perspectives. SCM represents a shift from traditional practices where manufacturers dictated product supply to customers. Now, customers influence suppliers on how and when inventory is delivered. The primary objective of SCM is to eliminate inefficiencies, reduce excess costs and inventories, and optimize the supply pipeline from the customer back through the supply chain. Although sales incentives and category management programs motivate major suppliers, the success of SCM largely depends on effective logistics. Functional Areas of Logistics include:

1. Network Design
2. Information Technology
3. Transportation
4. Inventory and Storage
5. Warehousing
6. Materials Handling, Loading, and Unloading
7. Packaging and Re-packaging

SCM integrates both "hard" (technical) and "soft" (people) aspects, intersecting various disciplines such as marketing, procurement, management, operations research, and logistics. Social network analysis, rooted in social psychology, can be particularly useful on the soft side of SCM by elucidating how personal relationships translate into competitive advantages through information diffusion, social control of opportunism, coordination, and support. The initial benefits of SCM primarily accrue to customers, who drive down inventories by eliminating excess stock that they otherwise need to purchase, store, and manage. For suppliers, the benefits are less straightforward and may include fewer initial orders as customers reduce excess inventories, smaller and more frequent orders, the responsibility of carrying inventory shifting to suppliers, increased warehousing and freight costs due to handling smaller and more frequent shipments, penalties for failing to meet customer requirements, and potential loss of business if customer expectations are not met.

Suppliers are critical in helping Indian firms enhance supply chain cost efficiency, responsiveness, reliability, and competitiveness. Effective sourcing management, particularly concerning supply risks such as delays, quantity mismatches, inferior quality materials, or altered commercial terms, is essential. Supply risk is defined as the potential for incidents related to inbound supply from individual supplier failures or the supply market, leading to an inability to meet customer demand or posing threats to customer safety and satisfaction. Managing supply delays by addressing supply risks is crucial for ensuring the availability of required materials at the right time, despite having placed orders in advance and agreeing on delivery dates, quantities, and costs. Companies with numerous customers face the challenging task of maintaining satisfaction across diverse customer practices. Currently, emphasis is placed on the initial customer-supplier link, but the impact of supply chain decisions can ripple throughout the entire chain, often leading to confusion among suppliers about their roles and responsibilities. Customers now demand higher quality, design innovation, greater choice, convenience, and superior service while seeking to minimize costs, effort, time, and risk. A company's supply chain encompasses various departments, from procurement to customer service, making SCM the process of transforming the entire supply chain into an optimally efficient, customer-centric operation where the effectiveness of the whole chain outweighs the effectiveness of individual departments.

Historically, manufacturers drove the supply chain by managing the production and distribution pace. Today, customers lead, prompting manufacturers to quickly adapt to demands for diverse options, quick order fulfilment, and fast delivery. As manufacturing quality becomes standardized across the industry, the ability to meet specific customer delivery demands has emerged as a key competitive advantage. Companies that excel in managing their supply chains are poised to become successful in the global marketplace. Benchmarking studies reveal significant cost differences between organizations with best-in-class performance and those with average performance. Traditionally, SCM has integrated various aspects from logistics and transportation to operations management, materials distribution, marketing, purchasing, and information technology (IT). Ideally, SCM adopts a comprehensive philosophy that encompasses all these functions to develop an overarching supply chain strategy, thereby enhancing overall firm performance. However, the literature remains fragmented, with most research focusing on individual links or specific components of the supply chain performance mix. The evolution of SCM studies can be categorized into six major phases: Creation, Integration, Globalization, Specialization Phases One and Two, and SCM 2.0. Each phase emphasizes different strategies, such as the prioritization of information technology in the sixth era, highlighting its significance in enabling an effective supply chain (Table 1).

Figure 2. Technologies offering efficient solutions for Supply Chain Management

Table 1. Constraints facing by the Logistics Providers

Modes of Transport	Infrastructure	Key Constraints
Road	• Total road network – over 5,472,144 kms (3,400,233 miles) in 2015 • National Highways include 2% of the Indian roads, they handled 40% of the traffic	• Bad condition of roads • Low average speed (30 – 40 km/hr) • Low daily average distance travelled (250 kms) • Issues at check post and toll – post
Railways	• Total track length – 119,630 kms (74,330 miles) in 2016	• Low service guarantee • No dedicated freight corridors • Low connectivity to industry • No fixed schedule for departure/arrival
Airports	• Domestic / International Airport 125% • 5 main metros account for over 85% of total freight traffic	• Only major airport has infrastructure to handle air cargo • High waiting time • Poor warehouse infrastructure
Ports	• Ports – 212(Major 12 & Minor 200) • Capacity Major Ports at 500 Mn MT and Minor ports at 230 Mn MT	• Heavy congestion in ports • Lack of good connectivity with roads • Outdated equipment and technology • Low port capacities and number of berths

2. Literature Review

Over the past two decades, the fields of supply chain management (SCM) and logistics have undergone significant transformations driven by globalization, technological advancements, shifting consumer demands, and increasing emphasis on sustainability. This literature review synthesizes key developments, trends, and scholarly contributions in supply chain and logistics from 2018 to 2024, drawing upon research published in prominent academic journals accessible via platforms like Google Scholar.

2.1 Evolution of Supply Chain Management

2.1.1 Integration and Collaboration:

In the early 2000s, literature emphasized the critical importance of integrating various supply chain functions to enhance efficiency (Sharma & Verma, 2021). This period marked a significant shift from linear to network-based supply chains, highlighting the necessity for collaboration among suppliers, manufacturers, and retailers to achieve a competitive advantage (Sharma & Verma, 2021).

2.1.2 Strategic Importance

More recent scholars have underscored Supply Chain Management (SCM) as a strategic function essential to organizational success (Kumar & Singh, 2022). Aligning supply chain strategies with overall business objectives has become a recurring theme, focusing on areas such as cost leadership, differentiation, and responsiveness to maintain competitiveness in the global market (Kumar & Singh, 2022).

2.2 Technological Advancements

2.2.1 Enterprise Resource Planning (ERP) Systems

The adoption of ERP systems has been pivotal in integrating supply chain processes. Studies have demonstrated that ERP implementation enhances data visibility, facilitates informed decision-making, and improves operational efficiency within supply chains (Rao & Gupta, 2021).

2.2.2 Artificial Intelligence and Big Data Analytics

The utilization of Artificial Intelligence (AI) and Big Data Analytics has revolutionized supply chain management by enabling more sophisticated demand forecasting, route optimization, and risk management (Das & Mehta, 2023). Machine learning algorithms, for instance, can predict market trends and optimize supply chain performance, thereby increasing overall efficiency and responsiveness (Das & Mehta, 2023).

2.3 Sustainability and Green Logistics

2.3.1 Environmental Impact

Growing environmental concerns have directed research towards sustainable supply chain practices. Initial studies laid the groundwork for integrating environmental considerations into supply chain strategies, which has since expanded to focus on reducing carbon footprints, effective waste management, and sustainable sourcing (Nair & Saha, 2019).

2.3.2 Circular Economy

The concept of the circular economy has gained significant traction, promoting the reuse and recycling of materials within supply chains. Research discusses how supply chains can be restructured to support circularity, thereby enhancing sustainability and resource efficiency (Sharma & Bhagat, 2022).

2.4 Globalization and Supply Chain Complexity

2.4.1 Global Supply Networks

The expansion of global supply networks has introduced complexities related to coordination, cultural differences, and geopolitical risks. Studies have analysed the dynamics of global supply chains, emphasizing the need for flexible and resilient strategies to manage international operations effectively (Chopra & Sharma, 2022).

2.4.2 Risk Management and Resilience

Over the past two decades, there has been an increased focus on managing supply chain risks, including disruptions from natural disasters, political instability, and pandemics. Recent studies, particularly those examining the impact of COVID-19, highlight strategies for enhancing supply chain resilience through diversification, redundancy, and adaptive planning (Chatterjee & Banerjee, 2019).

2.5 E-commerce and Logistics Innovations

2.5.1 Growth of E-commerce

The exponential growth of e-commerce has significantly impacted logistics and supply chain strategies in India. Researchers have examined the challenges and opportunities presented by online retailing, including last-mile delivery optimization, inventory management, and enhancements in customer service (Reddy & Rao, 2022).

2.5.2 Last-Mile Delivery Innovations

With the rise of e-commerce, last-mile delivery has become a critical area of focus. Innovations such as drone deliveries, autonomous vehicles, and crowdsourced delivery models have been extensively researched for their potential to enhance efficiency and customer satisfaction (Khan & Halder, 2018).

2.6 Collaboration and Partnerships

2.6.1 Public-Private Partnerships

In certain industries, collaboration between public entities and private firms has been essential for managing supply chain challenges. Research examines how these partnerships can address infrastructure limitations, regulatory compliance, and emergency response coordination (Iyer & Joshi, 2021).

2.6.2 Supplier Relationship Management

Building strong relationships with suppliers has been identified as a key factor for supply chain success. Studies focus on trust-building, effective communication, and performance evaluation as critical components of robust supplier relationship management (Nair & Bhattacharya, 2020).

2.7 Challenges and Future Directions

2.7.1 Supply Chain Resilience

The COVID-19 pandemic underscored the importance of building resilient supply chains capable of withstanding unprecedented disruptions. Future research is likely to focus on strategies for enhancing resilience, including diversification, digital transformation, and adaptive supply chain design (Das & Mehta, 2023).

2.7.2 Digital Transformation

As digital technologies continue to evolve, their integration into supply chain operations remains a critical area of study. Emerging technologies such as artificial intelligence, blockchain, and augmented reality present new opportunities and challenges for supply chain management (Reddy & Rao, 2022).

2.7.3 Sustainability Integration

Achieving a balance between economic performance and sustainability remains a persistent challenge. Future research may explore innovative approaches to integrating sustainability into all aspects of supply chain management, from procurement to end-of-life product management (Sharma & Bhagat, 2022).

3. Challenges Faced by The Indian Supply Chain System

Despite the critical role of logistics in economic development and urbanization, the Indian logistics sector faces numerous challenges that impede its efficiency and growth. Over the past two decades, researchers have identified several key bottlenecks that need to be addressed to enhance the sector's performance and support India's expanding role in global trade.

3.1 Infrastructural Bottlenecks

Logistics infrastructure is a pivotal enabler for economic growth and urbanization. Globalization has propelled India into a more prominent position in world trade, resulting in a significant increase in transport volume (Venkatesh et al., 2017). The Indian government has initiated efforts to expand and upgrade road and rail networks, as well as modernize harbours and airports (Mitra, 2013). However, the expansion of logistics infrastructure has not kept pace with industry demands. In developed countries, vehicles typically travel 800-1,000 km daily, whereas in India, the average is only 250-300 km (Sanyal, 2006b). This disparity leads to a mismatch between transport capacities and industry requirements. Additionally, poor road conditions, inadequate connectivity, high toll rates, corruption on highways and hinterlands, and insufficient air and seaport capacities further exacerbate infrastructural challenges (Sahay & Mohan, 2006).

3.2 Lack of Efficient Technical Systems

Although advanced IT tools like GPS, shipment tracking, and tracing systems are available, only about 2% of Logistics Service Providers (LSPs) in India currently use them (Luisa et al., 2013). Even with ongoing technical advancements, the adoption rate remains low due to several factors:

- Many IT tools—such as ERP systems, IoT devices, AI-powered analytics, and blockchain solutions—require substantial initial costs. Small- and medium-sized enterprises (SMEs) often lack the necessary funds or hesitate to invest without a clear return on investment (ROI).
- In rural and semi-urban areas, logistics and supply chain sectors struggle with limited infrastructure. Issues like unstable internet, unreliable power, and poor integration across systems hinder smooth IT implementation, making adoption more difficult.
- Some players in the supply chain, especially smaller or traditional businesses, are not fully aware of how IT tools can benefit them or the practical ways to use them. This knowledge gap, along with limited technical expertise, results in hesitation and slow adoption.
- Many logistics firms in India have operated traditionally for decades, making it challenging to implement change. There is often reluctance to adopt new technology due to concerns about disruption, complexity, and the need for employee training and upskilling.
- India's logistics and supply chain market is highly fragmented, with a mix of large, organized companies and a vast number of smaller, informal operators. This fragmentation makes standardization and coordinated IT adoption more difficult.
- Complex regulatory requirements and frequently changing compliance standards can discourage companies from investing in IT. Additionally, the lack of streamlined policies to support digitalization in supply chains adds to the reluctance.

3.3 Inefficient Inspection Strategies

Customs and border authorities in India often lack clear inspection guidelines and standardized policies (Mitra, 2013; Rajesh et al., 2011). Repeated handling at check posts results in delays and sometimes damages goods. Previously, various direct and indirect taxes slowed the movement of goods within and outside the country. Since the introduction of GST, transportation and customs processes for logistics providers have been impacted in the following ways:

- Adapting to GST required companies, particularly small and medium-sized enterprises (SMEs), to revamp their tax systems. Integrating GST-compliant software and training staff on new processes created initial disruptions and increased operational challenges.
- Although the e-way bill system promotes transparency, it requires logistics companies to generate proper documentation promptly. Delays or discrepancies in e-way bill generation can lead to penalties or customs delays, which can be especially challenging for smaller logistics providers.
- Constant changes in GST rates, invoicing rules, and filing requirements have increased administrative burdens, particularly on smaller businesses with fewer resources. Many SMEs face difficulties in keeping up with the technical and financial demands of GST compliance, affecting their operational efficiency.
- The GST system depends heavily on digital platforms, and technical issues like server downtimes, glitches in the GST portal, and difficulties in accessing the e-way bill system often led to delays in customs and disruptions in logistics schedules.
- While larger companies can absorb the costs of digital infrastructure, tax filings, and ongoing staff training, these requirements can be burdensome for smaller firms, which may struggle to keep up with consistent GST compliance.
- Non-compliance with GST regulations can result in penalties, increasing pressure on businesses to stay up-to-date. However, frequent changes in GST rules, rates, and deadlines sometimes lead to confusion and unintentional non-compliance, resulting in fines.

3.4 Lack of Government Support Policies

The logistics sector in India is not officially recognized as an industry, despite its substantial contribution of approximately 14% to the GDP (Luthra et al., 2011). This sector generates millions of employment opportunities and is considered the backbone and a key driver of economic and industrial growth by various industries. However, there is a notable lack of governmental focus on policy frameworks, development initiatives, and the formal recognition of the logistics business as a distinct industry (Govindan et al., 2014).

3.5 Fragmented and Unorganized Sector

India's logistics sector is highly fragmented and predominantly unorganized, comprising numerous small and large players. Over 90% of LSPs own fewer than two trucks, and 95% own fewer than five trucks, which compromises the quality of services (Mitra, 2006). Large LSPs tend to serve well-established organizations with more resources, while smaller players often operate on low margins, creating significant obstacles for larger firms.

3.6 Conventional Way of Operations

The adoption of automation in India's logistics sector is slow due to high costs and limited availability. Operations are largely manual, including loading and unloading of goods, warehousing, use of pallets, and network connectivity (Mitra, 2006). Increased automation could facilitate the creation of a nationwide broadband logistics IT network, accelerating processes and enhancing customer satisfaction (Sharma et al., 2011).

3.7 Cost Implications

The logistics sector requires substantial investments in resources such as vehicles, skilled manpower, and warehouses. It is characterized by high costs and low margins (Mitra, 2013). Additionally, untimely payments from Indian shippers result in inadequate working capital for LSPs. Poor physical and communication infrastructure further deters investment, while high operational costs and delays in compliance with varying documentation requirements make the business unattractive.

3.8 Shortage of Skilled Workforce

The logistics sector in India suffers from a shortage of skilled manpower due to the sector's relatively low emphasis on specialized training, education, and technical knowledge (Govindan et al., 2014). Despite its significant contribution to GDP, the lack of a skilled workforce remains a major barrier to delivering high-quality logistics services (Abdulrahman et al., 2014).

3.9 Limited Awareness of Sustainability Measures

There is a general lack of awareness among LSPs regarding sustainability, leading to low implementation of sustainable practices. Only a few LSPs in India prioritize environmental concerns by using reusable and recyclable pallets, eco-friendly vehicles, and green processes. Increasing awareness is essential to encourage more LSPs to adopt sustainable practices and optimize resource utilization.

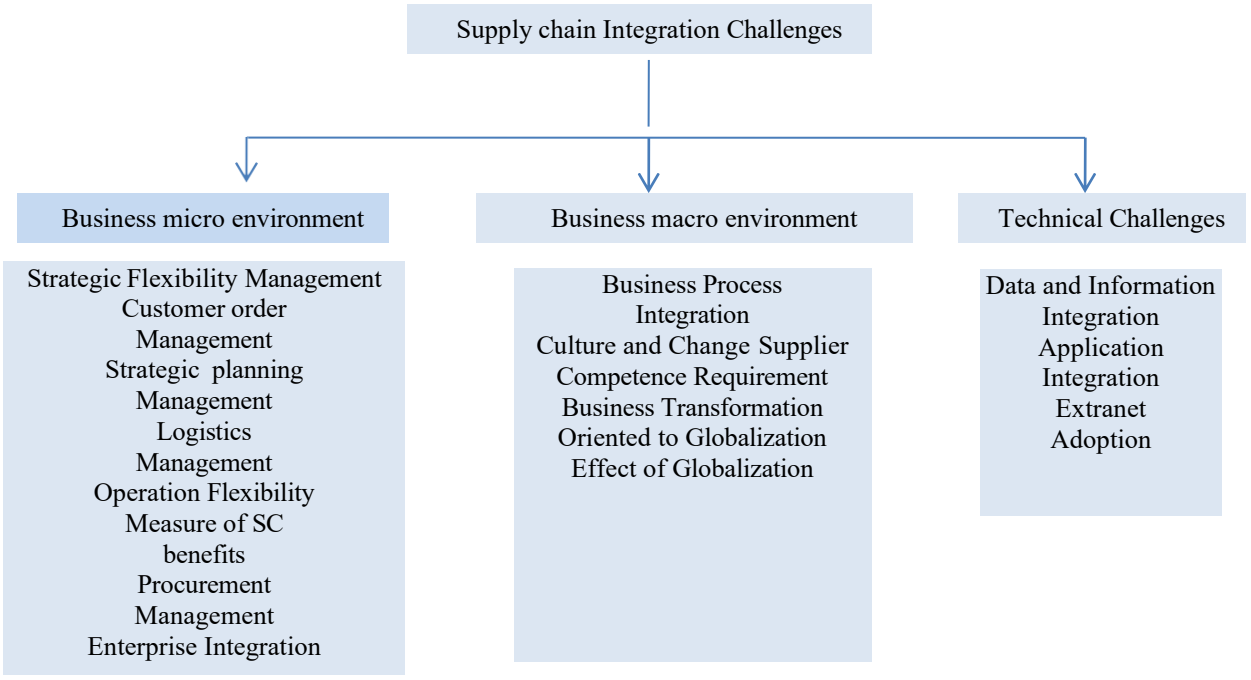

Figure 3. Challenges faced by the Indian Supply Chain Management

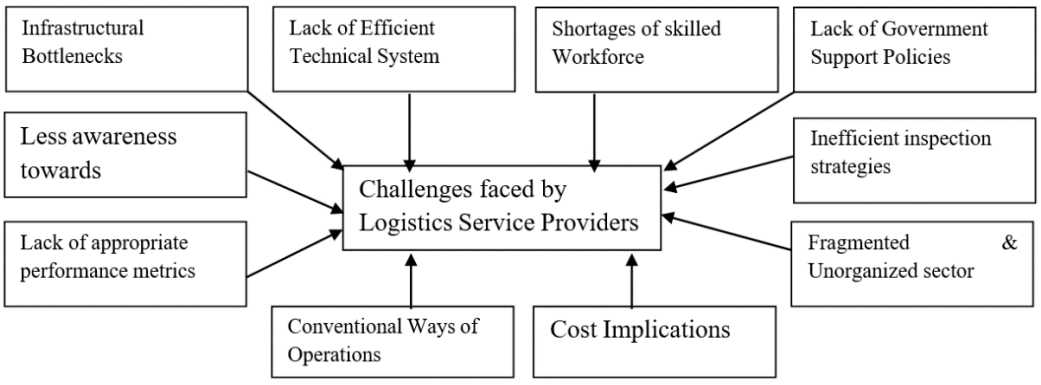

Figure 4. Challenges faced by the Logistics Service Providers (LSPs)

4. Methods

4.1 Reducing Waste in Supply Chain Management Through Process Improvement

A significant proportion of purchase orders, more than 25%, are either not shipped or not delivered as planned. This presents a major opportunity to reduce waste within supply chains. Supplier performance and lead times are critical areas for improvement and can contribute to reducing inefficiencies. Additionally, many distribution networks are outdated, having been designed with different customer needs, product types, and operational focuses in mind. In the past, emphasis was placed on storing inventory in warehouses, but today's logistics stress inventory velocity. Storing products often only adds unnecessary time, contributing to waste rather than value. Eliminating excess handling and storage by using cross-docking or other transfer facilities at ports can reduce time and inventory. Advanced supply chain execution technology can provide visibility across the entire process—from purchase order to delivery—and enable the allocation of products in transit. Integrating these technologies into modern supply chains can help reduce two key types of waste: time and inventory. In global supply chains, time is often "built in" due to the distances involved, a contrast to domestic supply chains. This extended time can increase uncertainty, leading companies to build up extra inventories. However, time and inventory are both areas where lean practices can improve efficiency. Lean logistics, particularly in an international context, faces challenges due to the complexity and breadth of global operations. Identifying non-value-added activities that increase time, inventory, and costs is critical to improving supply chain effectiveness. One useful tool for identifying waste is value stream mapping, which helps visualize both internal and external processes. By mapping current processes and identifying areas of waste, companies can create actionable plans to streamline their supply chains. This is especially important for high-volume and high-margin products, where inefficiencies can significantly impact profitability. Effective collaboration within the company and among trading partners is essential for removing waste across the entire supply chain. Reducing cycle times, increasing inventory velocity, and cutting costs in high-margin products can improve return on investment and make the benefits of lean management more visible. Value stream mapping also offers an important means of understanding current supply chain operations and designing new, more efficient processes. For successful supply chain management (SCM), support from top management is crucial. SCM should be seen as integral to a company's strategy for customer retention, growth, competitive advantage, and profitability. Often, waste in global supply chains manifests as unnecessary cycle time, inventory, and costs, particularly in transportation and warehousing. Companies need to examine their own processes critically, rather than simply blaming external parties, to identify where their actions may contribute to inefficiencies. Redesigning supply chains requires thoughtful analysis and innovation beyond traditional logistics practices. Without this, one flawed process may be replaced by another, continuing the cycle of inefficiency and waste (Figure 5).

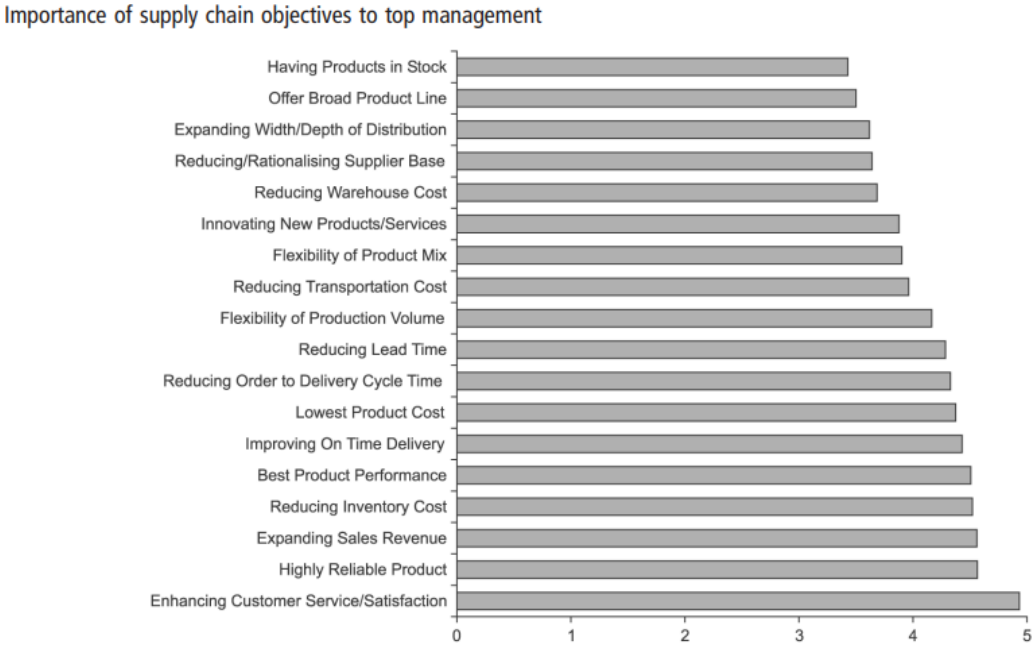

Figure 5. Benefits of Supply Chain for top management to reduce waste in the system

5. Conclusions and Future Scope

Conclusions:

1. Fragmented Market and Infrastructure Issues: India's supply chain and logistics sectors remain highly fragmented, with varied levels of development across regions. Inadequate infrastructure, such as roads, ports, and warehousing facilities, continue to be major obstacles, increasing costs and delays.

2. Regulatory and Policy Barriers: Regulatory bottlenecks, including inefficient customs processes, complex taxation structures, and the lack of coordination between different governing bodies, have hindered smooth supply chain operations. However, reforms like the Goods and Services Tax (GST) have simplified interstate trade, reducing logistical complexities.

3. Technological Gaps: While there are increasing investments in digital technologies like IoT, AI, and blockchain, their adoption is still limited across the industry. This technological lag affects the efficiency, transparency, and scalability of supply chain operations.

4. Dependence on Unorganized Sectors: A significant portion of logistics, such as transportation and warehousing, still relies on the unorganized sector. This leads to inconsistencies in service quality and pricing, affecting overall efficiency.

5. Resilience in Post-Pandemic Era: The COVID-19 pandemic has highlighted the need for more resilient and adaptive supply chains. Many businesses have re-evaluated their strategies, leading to a greater focus on local sourcing and the creation of more flexible logistics networks.

Future Scope and Insights:

1. Infrastructure Development: Continued investment in infrastructure—such as the development of dedicated freight corridors, smart cities, and modern warehousing—will be crucial. This will help improve connectivity, reduce transit times, and lower logistics costs.
2. Adoption of Advanced Technologies: The future of Indian supply chains will likely be shaped by the adoption of advanced technologies such as artificial intelligence, machine learning, blockchain, and the Internet of Things (IoT). These technologies can streamline operations, enhance transparency, and improve decision-making.
3. Policy and Regulatory Reforms: Simplification and harmonization of policies across states, along with further improvements in customs procedures, are necessary for enhancing trade efficiency. The government's role will be critical in fostering an ecosystem conducive to streamlined operations and innovation.
4. Integration of E-Commerce and Retail Supply Chains: As e-commerce continues to grow, particularly in Tier II and Tier III cities, there will be a significant focus on last-mile delivery solutions, hyper-local logistics, and faster fulfilment strategies. Companies will need to adopt agile models that cater to the changing demands of digital consumers.
5. Skill Development and Workforce Optimization: As supply chains evolve, there will be a greater need for a skilled workforce proficient in handling modern technologies and managing complex supply chain operations. Upskilling and training initiatives will be critical to ensuring workforce adaptability.

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