

# Enhancing Supply Chain Visibility in Large Enterprises: A Literature Review

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**Abstract**— Supply Chain Visibility has become an increasingly crucial aspect for large enterprises in today's global and interconnected business landscape. Achieving comprehensive visibility across multiple layers of the supply chain can significantly impact operational efficiency, cost optimization, customer satisfaction and trust. However, attaining supply chain visibility presents various challenges including fragmented data systems, interoperability issues, diverse supplier networks, data quality concerns, and geographical dispersion. Emerging technologies have a great potential to play key role in solving these challenges and facilitating improved supply chain visibility for enterprises. This study aims to provide insights that can inform and guide enterprises to effectively leverage the power of emerging technologies to gain better visibility into their supply chain operations. This paper is based on a comprehensive examination of 30 literary works to provide a thorough analysis of the subject matter. By synthesizing extant research, and practical case studies of large enterprises, the review has uncovered critical insights into the implications of supply chains visibility for both theory and practice in the field of supply chain management, particularly emphasizing the role of technology solutions and case studies. In addition, the integration of case studies provides concrete examples of how leading enterprises are leveraging technology to overcome visibility challenges and achieve operational excellence.

**Keywords**— *Supply Chain Visibility, Supply Chain Transparency, Supply Chain Technology, Artificial Intelligence, Block Chain, Internet of Things, Operational Efficiency*

## 1. Introduction

Supply Chain Visibility has become an increasingly crucial aspect for large enterprises in today's global and interconnected business landscape. Achieving comprehensive visibility across multiple layers of the supply chain can significantly impact operational efficiency, cost optimization, customer satisfaction and trust [1] [2]. By leveraging real time insights about the different tiers of supply chains, enterprises can streamline processes, mitigate risks and ensure timely delivery of goods and services to customers.

In this highly competitive global marketplace, supply chain visibility can provide companies a distinct competitive advantage. With clear visibility into their supply chain processes, companies can proactively adapt to demand fluctuations, reduce uncertainties, and improve overall performance [3] [1].

However, achieving visibility across complex multi-tier supply chains presents numerous challenges to large enterprises. In the context of supply chain management, large enterprises are organizations with substantial market influence, extensive operational reach, and significant resource capabilities. Large enterprises often face fragmented data systems and interoperability issues, making it difficult to consolidate and analyse supply chain data from multiple data sources [4] [5] Moreover, diverse supplier networks and geographical dispersion across multiple countries and regions intensify the challenges in data collection and monitoring. Coordinating information flow across multiple tiers of suppliers and complex supply chain networks is challenging. Real time information is

essential for accurate monitoring across the supply chain network [4].

Emerging technologies have a great potential to play key role in solving these challenges and facilitating improved supply chain visibility for large enterprises. Technological advancements, such as the Internet of Things (IoT), Artificial Intelligence, Advanced Analytics, Block chain, cloud-based systems and RFID offer promising solutions for capturing and analysing vast amounts of data, and for ultimately achieving enhanced visibility throughout the supply chains [6].

These technologies enable large enterprises to gain greater levels of transparency, traceability and efficiency.

The central research question guiding this study is: “What role does technological infrastructure play in facilitating the improvement of supply chain visibility within large enterprises?”

By addressing this question, we seek to uncover the mechanisms through which technological advancements contribute to enhancing supply chain visibility and driving operational excellence in large enterprise supply chains. Through a comprehensive analysis of relevant literature and case studies, this paper aims to provide insights that can inform and guide enterprises to effectively leverage the power of emerging technologies to gain better visibility into their supply chain operations.

## 2. Literature Review

### 2.1 Definition of Supply Chain Visibility

Supply chain visibility has been defined by authors in different ways. Some authors have focussed on the process of exchanging information, and therefore defined Supply Chain visibility as the organization's ability to share and access information throughout the supply chain [7]. Some have further expanded this definition as the capability of sharing on-time and accurate data on customer demand, amount and location of inventory, cost of transportation, and other logistics dimensions throughout an entire supply chain [8] [9].

On the other hand, some researchers have focussed on the properties of the information which is exchanged and conceptualized in the visibility of the

supply chain. Williams et al. provided the following definition of Supply Chain visibility: “Access to high-quality information that describes various factors of demand and supply. For information to be of high quality, it must be accurate, timely, complete, and in useable forms.” [10] [5]. Thus, they emphasized the quality of demand and supply information, through accuracy, timeliness, completeness, and usability. Kalaiarasan et al. have combined the aspects from various definitions, and came up with a valuable definition of Supply chain visibility: “the extent to which actors within a supply chain have visual access to the timely and accurate demand and supply information that they consider to be key or useful to their operations and supply chains” [5].

### 2.2 Importance of Supply Chain Visibility

Supply Chain Visibility holds utmost importance for large enterprises in today's competitive and complex business environments. By leveraging the valuable insights gained through supply chain visibility, enterprises can improve decision making, make informed decisions and mitigate the uncertainties in business environments [11]. Enhanced visibility enables these enterprises to proactively monitor and manage their supply chain activities, thereby leading to several benefits.

#### 2.2.1 Optimized Resource Utilization

Supply Chain Visibility achieved through information sharing ensures that there are no supply chain disruptions. This enables organizations to swiftly meet all the demands across entire supply chains [12]. As a result, organizations can optimize resource allocation and utilization.

#### 2.2.2 Enhanced Risk Management

Supply chain risks are regarded as the risk associated with incidents such as an unanticipated supply chain event and the associated negative outcomes of that event on the supply chain. To properly assess supply chain risks and respond to disruptions, having visibility across the supply chain operations is required [13]. Large enterprises are often exposed to various types of risk such as supply disruptions, geopolitical risks, and regulatory changes. By leveraging supply chain visibility, enterprises can identify potential risks early on and proactively mitigate and monitor risks. This will ensure to

minimize disruptions and safeguard business continuity.

### 2.2.3 Improved Overall Performance

When enterprises have enhanced Supply Chain Visibility, they can efficiently manage their operations, respond to future demands, and make sure they are meeting their future goals. The overall performance will be optimized through efficient communication with all the partners throughout the supply chain [12].

### 2.2.4 Compliance and Ethical Considerations

Large enterprises are often subject to stringent regulatory requirements and ethical standards concerning supply chain practices. With increased supply chain visibility and transparency, enterprises can comply with various governance and regulations [14].

When enterprises have visibility into their supply chain operations, they can be transparent about their supply chain practices to customers, investors, and various stakeholders. Transparency has become crucial for large companies. If they are not transparent about their supply chain practices, there is less willingness from potential business partners, regulators, investors, and employees to work with them. Companies known to disclose their supply chain practices tend to attract and retain talent. For example, Patagonia's employee turnover rate is less than 4% per year. [14]

Utilizing the insights from supply chain visibility, companies can collect information around ethical considerations in supply chain such as reports of labor abuse and environmental violations. This can enable companies to understand where to make changes and streamline their supply chain operations [14].

## 2.3 Challenges in achieving Supply Chain Visibility

Although the importance of achieving supply chain visibility is well-recognized, large enterprises often face numerous obstacles and complexities in their efforts to obtain visibility across their extended supply chain networks. Existing literature has identified several challenges that hinder enterprises in achieving supply chain visibility.

### 2.3.1 Complexity of Global Supply Chain Networks

Large enterprises often operate extensive and intricate supply networks involving multiple tiers of suppliers, manufacturers, distributors, and logistics providers across various geographic regions. Due to the complexities of supply chain networks, uncertainties are caused in information flows and poses great challenges [4].

### 2.3.2 Data Fragmentation and Silos

Many enterprises operate with fragmented and legacy systems where data is stored in different silos across different platforms. This lack of integrated data hinders seamless flow of data, making it difficult to track and monitor the supply chain operations in real-time [15].

### 2.3.3 Lack of Interoperability and Standardization

Another challenge to realizing supply chain visibility is limited or lack of interoperability and standardization among systems and data formats utilized by various entities in supply chains. For example, barcodes do not provide rewritable data storage, and data loggers do not provide an identification function [16] [4]. Moreover, information and data storage technologies, such as cloud systems, might not always be compatible with other key information systems [17] [4].

### 2.3.4 Data Quality and Accuracy issues

Ensuring data quality and accuracy of data poses a significant challenge in achieving supply chain visibility. Multiple studies have highlighted that poor information quality in supply chains limits the extent of Supply chain visibility, since data quality plays an importance role in Supply Chain Visibility [5] [18].

## 2.4 Technological solutions for Supply Chain Visibility

To overcome the challenges hindering Supply Chain Visibility, emerging technologies offer promising solutions to enterprises.

### 2.4.1 *Internet of Things (IoT)*

Internet of Things (IoT) solutions have emerged as enablers of Supply Chain Visibility. These technologies facilitate the integration and sharing of data from diverse sources, such as sensors, RFID systems, and enterprise systems, providing a centralized, accessible repository for supply chain data [19].

With IoT sensors attached to containers, supply-chain managers can retrieve data needed to track the location and condition of assets, as well as the security of the shipment. IoT devices can transmit real-time information on temperature, humidity, shock, and tilt. This will help to ensure that both timely delivery of goods and the arrival of goods undamaged and safe to consume [20].

Retail giant Walmart has implemented Internet of Things (IoT) technology at a massive scale across its 4,600+ U.S. stores, managing over 7 million IoT data points and 1.5 billion daily messages. The company's proprietary IoT software monitors refrigeration units to ensure food quality, tracks HVAC and energy systems for optimizing consumption, and enables remote equipment control across locations. During the COVID-19 pandemic, Walmart leveraged its IoT capabilities to rapidly adapt equipment scheduling to changing store hours without manual intervention. This large-scale IoT deployment has allowed Walmart to enhance supply chain visibility, improve operations, and respond swiftly to disruptions, showcasing the transformative potential of IoT for supply chain management in large enterprises [21].

### 2.4.2 *Artificial Intelligence (AI) and advanced analytics techniques*

Artificial Intelligence (AI) and advanced analytics techniques have also emerged as powerful tools for improving supply chain visibility. AI technologies in Supply chain enable end-to-end visibility and transparency leading to quick and responsive decision making [20] [21] [22]. By implementing AI in their Supply Chain Management systems, organizations can effectively predict bottlenecks for streamlining production planning, smart maintenance, smart service operations, smart manufacturing, and scheduling [23] [24] [22]. Based on real time information, enterprises can predict

seasonal fluctuations and improve resource planning [22].

The hardware giant Lenovo implemented an AI-powered solution called Supply Chain Intelligence (SCI) to gain real-time visibility across its global supply chain operations. SCI integrates over 800 data sources and performs 1,500 daily data-related tasks, using machine learning to continuously analyze supply chain data, identify potential issues, and generate recommendations. The AI system provides predictive analytics on demand forecasting, intelligent procurement, and quality management capabilities to ensure supplier compliance, and smart logistics insights to track order status and locations. With SCI, Lenovo has broken down data silos, enabling cross-functional collaboration and faster decision-making cycles that have boosted on-time delivery performance and reduced manufacturing and logistics costs [27].

### 2.4.3 *Blockchain technology*

Blockchain technology, with its distributed and immutable ledger, has shown enormous potential for enhancing transparency and traceability within supply chain networks. By creating a shared, tamper-proof record of transactions and events, blockchain can provide visibility into the provenance, movement, and custody of goods throughout the supply chain, enabling better monitoring of compliance, quality, and sustainability [25][26].

Enhanced supply chain visibility can be particularly effective in industries involving materials prone to unethical sourcing such as diamonds. Mining of diamonds often occurs in countries with corrupt or weak regimes, where there is a significant risk of human rights abuses, including forced labor and child labor. De Beers, one of the largest diamond producers in the world, has implemented a blockchain-based tracking system called Tracr. Tracr allows De Beers to track diamonds from the point where they are mined, through the cutting and polishing process, and ultimately to the end consumer. This technology provides tamper-proof source assurance at scale, encourages consumers' confidence in the ethical sourcing of their diamonds, and helps to combat the trade in conflict diamonds [28] [29].

#### 2.4.4 Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) technology has been widely adopted for its ability to automatically identify and track assets, products, and materials as they move through the supply chain. In the initial years, RFID was regarded as a crucial technology, whereas blockchain technology has emerged as the predominant solution since 2019 [5].

### 3. Methodology

This study incorporates a systematic literature review. The review process began with an extensive search for relevant academic publications on Google Scholar. The search terms used were a combination of keywords such as "supply chain visibility," "supply chain transparency," "large enterprises," "supply chain visibility importance," "supply chain visibility challenges" and "technologies for supply chain visibility." The initial search yielded a substantial number of articles, which were further filtered based on relevance, publication date, and citation count.

This paper is based on a comprehensive examination of selected thirty literary works to provide a thorough analysis of the subject matter. By combining academic literature, industry expert perspectives, and an evaluation of technological solutions and case studies, the study aims to provide a holistic and practical view of this critical area of supply chain management. The research methodology employed in this study ensured a comprehensive and multifaceted approach to understanding the strategies and techniques for enhancing supply chain visibility in large enterprises.

### 4. Discussion

The literature review conducted in this study has provided a thorough examination of the significance of enhancing supply chain visibility in large enterprises. By synthesizing extant research, and practical case studies of large enterprises, the review has uncovered critical insights into the implications of supply chain visibility for both theory and practice in the field of supply chain management, particularly emphasizing the role of technology solutions and case studies.

#### 4.1 Role of Technology in achieving Supply Chain Visibility

Advanced technologies have emerged as pivotal drivers of enhanced visibility [6]. Among the array

of technological solutions, several solutions stand out for their significant impact on enhancing supply chain visibility. Internet of Things (IoT) stands out as a crucial technology. It allows for gathering and sending data in real-time from various sources like sensors, RFID systems, and company networks. This continuous data flow provides a centralized repository for supply chain data, facilitating comprehensive visibility into operations.

Artificial Intelligence (AI) and advanced analytics techniques enable companies to leverage the vast amounts of data generated by IoT sensors. By employing machine learning algorithms, AI enables predictive analytics, anomaly detection, and optimization of supply chain processes. These capabilities empower enterprises to anticipate and mitigate risks, optimize resource allocation, and enhance decision-making accuracy [30].

Blockchain technology provides novel ways to improve supply chain visibility by making data sharing more secure and transparent. It creates an unchangeable record of transactions and activities, ensuring trust and accountability among supply chain partners [29]. This technology solves challenges like data fragmentation and lack of transparency, allowing for better tracking and tracing of products throughout the supply chain. Ultimately, blockchain enhances supply chain visibility by enabling stakeholders to access reliable and transparent information, leading to improved decision-making and operational efficiency.

#### 4.2 Addressing Key Challenges & Barriers

Leveraging Advanced technologies effectively addresses several challenges identified in the literature review. The complexity of global supply chain networks, caused by multiple tiers of suppliers and geographic dispersion, is mitigated through IoT-enabled visibility solutions. Real-time monitoring and data analytics enable enterprises to navigate the intricacies of global supply chains, identify bottlenecks, and optimize logistics operations.

Data fragmentation and silos, a common hindrance to visibility, are overcome through integrated technological platforms that enable seamless data exchange and interoperability. AI-driven analytics further enhance data quality and accuracy, ensuring that decision-making processes are based on reliable insights.

### 4.3 Comparative Analysis & New Insights

Comparing these findings with extant literature reveals both consistencies and new insights. While previous studies have highlighted the importance of supply chain visibility and technological advancements, our analysis offers a more nuanced understanding of the specific components driving this enhancement. Additionally, the integration of case studies provides concrete examples of how leading enterprises are leveraging technology to overcome visibility challenges and achieve operational excellence.

### 5. Conclusion

In conclusion, the findings of this study underscore the importance of investing in technological innovation to enhance supply chain visibility in large enterprises. The novelty of this paper lies in its unique integration of theoretical insights with practical case studies, offering a comprehensive view of the challenges and opportunities in enhancing supply chain visibility. By embracing advanced technologies and adopting best practices, organizations can navigate the complexities of modern supply chains, drive operational excellence, and gain a competitive edge in today's dynamic business environment.

The novel contributions of this paper are as follows:

- *Integration of Emerging Technologies:* This paper presents an integrated framework combining IoT, AI, blockchain, and RFID to address visibility challenges holistically
- *Case Study Analysis:* Detailed case studies from enterprises like Walmart, Lenovo, and De Beers highlight practical implementations and benefits of advanced technologies.
- *Addressing Key Challenges:* The study directly targets challenges such as data fragmentation, lack of interoperability, and data quality issues with technological solutions.
- *Comprehensive Literature Review:* A synthesis of findings from 30 literary works offers a solid theoretical foundation for understanding the importance of supply chain visibility.
- *Practical Implications:* The study provides actionable recommendations grounded in both theoretical insights and practical case studies for enhancing supply chain visibility.

Moving forward, continued research and innovation in supply chain visibility will be essential to address emerging challenges and capitalize on new opportunities for growth and sustainability.

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