



Blockchain, IoT, and AI Technologies for Supply Chain Management

Apply Emerging Technologies to Address and Improve Supply Chain Management

—
Edited by

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Dr. A. Yovan Felix has mentored students in the project areas of big data, deep learning, and data mining. He has published technical papers in national and international journals. He has over 17 years of experience and expertise in data analytics, smart prediction systems, and deep learning algorithms. He has also coordinated several events at national and international levels.

Introduction

The book will examine the synergistic possibilities of combining blockchain, IoT, and AI technologies in supply chain management. The current state of supply chain management involves several challenges, including lack of transparency, limited visibility into product movements, inefficient inventory management, and difficulty in tracking and tracing products. Blockchain, IoT, and AI are three emerging technologies that can potentially address some of these challenges and improve supply chain management.

This book will also address the difficulties and possibilities of integrating these technologies and offer helpful implementation advice. Case studies and actual instances of businesses implementing or experimenting with blockchain, IoT, and AI technology in their supply chains will be included in the book. It will provide helpful advice on implementation and highlight successful deployments, lessons learned, and the impact of these technologies on supply chain visibility, agility, sustainability, and customer experience. It will further elaborate the fundamental concepts of AI and ML algorithms and demonstrate how AI can process enormous volumes of supply chain data to produce actionable insights, improve inventory control, forecast demand, and increase forecasting precision.

The book will serve as a comprehensive guide for supply chain professionals, researchers, and technology enthusiasts interested in understanding the potential of blockchain, IoT, and AI technologies in revolutionizing supply chain management practices.

What You Will Learn

- You will explore the evolving landscape of technology, potential advancements, and how Blockchain, IoT, and AI can shape the future of supply chains.
- You will gain insight into upcoming developments and prepare for changing dynamics in the industry.
- You will learn the intricate details of blockchain, IoT, and AI technologies in real-life scenarios.
- You will explore the convergence of blockchain, IoT, and AI technologies to improve supply chain operations.

Who Is This Book For

This book is for industry professionals working in the domain of supply chain management including supply chain managers, logistics managers, procurement officers, and operations managers. It's also for academics, research scholars, and university students at the graduate and post-graduate levels who are interested in understanding how these technologies can enhance efficiency, transparency, and optimization in supply chains.

CHAPTER 1

Supply Chain Management Strategy and Practices: Traditional vs. Advanced

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CHAPTER 1 SUPPLY CHAIN MANAGEMENT STRATEGY AND PRACTICES: TRADITIONAL VS. ADVANCED

When an abundance of articles and books on the subject emerged in the mid-1990s, the term “supply chain management” (SCM) gained popularity. SCM involves the centralized coordination of the flow of goods and services to and from a business. It encompasses the entirety of the processes required to convert raw materials and components into finalized products. Companies may save costs and deliver items to customers faster and more efficiently by optimizing the supply chain. A well-managed supply chain can assist in avoiding costly product recalls, lawsuits, and negative press by ensuring quality control, selecting reliable suppliers, maintaining transparency, complying with regulations, managing risks, fostering communication, and continuously improving processes. SCM’s five most important phases are planning, sourcing, production, distribution, and returns. A supply chain manager is responsible for regulating and reducing expenses as well as avoiding supply shortages.

While traditional supply chains focus on the accessibility, transportation, and cost of physical assets, contemporary supply chains prioritize the administration of data, services, and products packaged as integrated solutions. Contemporary supply chain management systems extend beyond the mere tracking of the location and timing of product deliveries. They play a pivotal role in influencing product and service quality, pricing, customer experience, and, ultimately, the overall profitability of a business. In 2017, a standard supply chain processed 50 times more data than it did just five years earlier. Despite this surge in data, only about a quarter of it has been thoroughly analyzed. As a result, crucial and time-sensitive information such as weather conditions, unexpected labor shortages, political unrest, and sudden spikes in demand might go unexplored, posing potential risks to the supply chain efficiency. Modern supply networks are curated by analytical professionals and data scientists and take advantage of large volumes of data created by the chain process. Future supply chain leaders and the ERP systems they run will almost certainly focus on maximizing the usefulness of this data by analyzing it in real time with minimal latency.

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In contrast to supply chain management, a supply chain refers to a network of companies collaborating to transport materials in a directional manner. It represents a collective of organizations intricately connected through upstream and downstream flows of products, services, funds, or information, extending from a source to a client. The administration of such a chain is known as supply chain management (La Londe, B. and Masters, J. M., 2023). Supply chain professionals play pivotal roles in shaping and overseeing supply chain operations. Their responsibilities extend to determining whether a company produces a product or service internally (insourcing) or outsources it to another entity. They orchestrate manufacturing processes across multiple providers, ensuring seamless production and transportation with minimal challenges related to quality control and inventory. The ultimate aim of a well-designed and efficiently managed product supply chain is to achieve the production of goods at the most economical cost possible. Such a well-structured supply network can be viewed as a competitive advantage for a company, as highlighted by Enver Yücesan (2007) and David Blanchard (2007). Companies engage in ongoing efforts to enhance the efficiency and cost-effectiveness of their supply chains, making SCM a continuous and vital undertaking.

SCM aims to centrally control or link a product's manufacturing, shipment, and distribution. Companies can reduce superfluous expenses and unnecessary stages in the supply chain, allowing them to deliver items to customers faster. Achieving this involves exercising more stringent control over internal inventories, internal manufacturing, distribution, sales, and vendor stocks. SCM operates on the principle that nearly every product entering the market is the outcome of collaborative efforts from various organizations within a supply chain. Although supply networks have existed for centuries, most businesses have only recently seen them as a value-add. The following five important components of SCM are commonly referred to by experts and practitioners:

CHAPTER 1 SUPPLY CHAIN MANAGEMENT STRATEGY AND PRACTICES: TRADITIONAL VS. ADVANCED

- **Planning:** Develop strategies and oversee the allocation of resources to meet the product or service demand of a company. Establish metrics to assess the efficiency, effectiveness, customer value, and alignment with the organizational goals of the formed supply chain.
- **Sourcing:** Select suppliers to provide the items and services required to manufacture the product. Then, create systems for monitoring and managing supplier relationships. Ordering, receiving, and maintaining inventory and authorizing supplier payments are all critical operations.
- **Manufacturing:** Organize the actions required to accept raw materials, make the product, test for quality, package for shipping, and deliver on time.
- **Logistics and delivery:** Customer orders must be coordinated, delivery must be scheduled, cargo must be dispatched, customers must be invoiced, and payments must be received.
- **Returns:** Establish a system or framework to handle the return of damaged, surplus, or unwanted goods. SCM holds considerable importance in achieving various corporate objectives. For instance, exerting control over manufacturing processes can enhance product quality, mitigate the risk of recalls and legal issues, and contribute to the development of a robust consumer brand. Similarly, managing shipping methods can enhance customer service by averting costly shortages or instances of excess inventory. In essence, SCM provides organizations with multiple avenues to boost profit margins, particularly pertinent for large-scale

and global businesses. Within the production cycle, efficient SCM solutions result in reduced costs, waste, and time. The adoption of a just-in-time supply chain, where retail sales automatically trigger replenishment requests to manufacturers, has become an industry standard. This facilitates rapid replenishment of retail shelves, keeping pace with product sales. An additional strategy to enhance this process involves analyzing data from supply chain partners to identify areas for improvement.

The Concept of SCM

SCM involves overseeing the movement of goods and services to and from a company, encompassing the entire process from converting raw materials and components into finished products to delivering them to the end customer. A well-executed SCM process enables a company to optimize its operations, minimize waste, enhance customer value, and gain a competitive edge in the market. SCM encompasses a comprehensive framework that includes procurement, operations management, logistics, and marketing channels. These elements collectively contribute to the transformation of raw materials into finished products, which are then delivered to end customers (Kozlenkova, Irina; et al., 2015; Ghiani, Gianpaolo; Laporte, Gilbert; Musmanno, Roberto., 2004). A more specific definition of SCM is “the design, planning, execution, control, and monitoring of supply chain activities with the goal of creating net value, building a competitive infrastructure, leveraging global logistics, synchronizing supply with demand, and measuring global performance.”

CHAPTER 1 SUPPLY CHAIN MANAGEMENT STRATEGY AND PRACTICES: TRADITIONAL VS. ADVANCED

SCM is a pivotal facet of business operations, entailing the orchestration and integration of diverse activities, processes, and stakeholders throughout the entire supply chain. This encompasses activities ranging from the procurement of raw materials to the ultimate delivery of finished products to end consumers. The primary goal of SCM is to optimize the overall efficiency, effectiveness, and responsiveness of the supply chain to meet customer demands while minimizing costs. The following is a list of additional key concepts:

- **Supply chain components**
 - **Upstream:** Involves activities such as sourcing, procurement, and inbound logistics
 - **Internal operations:** Encompasses the processes related to manufacturing, assembly, and quality control
 - **Downstream:** Encompasses distribution, outbound logistics, marketing, sales, and customer service
- **Supplier relationship management:**
 - Fostering strong relationships with suppliers is crucial for a smooth and efficient supply chain.
 - Collaboration, communication, and trust-building are essential elements of SRM.
- **Demand planning and forecasting:**
 - Accurate demand forecasting helps organizations anticipate customer needs and align production and distribution accordingly.
 - Advanced analytics and data-driven insights play a significant role in demand planning.

CHAPTER 1 SUPPLY CHAIN MANAGEMENT STRATEGY AND PRACTICES: TRADITIONAL VS. ADVANCED

- **Inventory management:**
 - Balancing the costs of holding inventory against the costs of stockouts is crucial.
 - Just-in-time (JIT) and economic order quantity (EOQ) are common inventory management strategies.
- **Logistics and transportation:**
 - Efficient transportation and logistics ensure timely delivery of products.
 - Mode selection, route optimization, and carrier selection are key considerations.
- **Information flow:**
 - Real-time information sharing is essential for effective decision making.
 - Technologies like enterprise resource planning (ERP) and advanced analytics enhance information flow.
- **Risk management:**
 - Identifying and mitigating risks throughout the supply chain is crucial.
 - External factors like natural disasters, geopolitical events, and supply chain disruptions can impact operations.

CHAPTER 1 SUPPLY CHAIN MANAGEMENT STRATEGY AND PRACTICES: TRADITIONAL VS. ADVANCED

- **Sustainability:**
 - Consideration of environmental and social factors in supply chain operations
 - Green and sustainable practices are becoming increasingly important.
- **Globalization and outsourcing:**
 - Many organizations operate on a global scale, necessitating the management of complex international supply chains.
 - Outsourcing certain processes can lead to cost efficiencies but requires careful oversight.
- **Continuous improvement:**
 - Regular evaluation of supply chain performance and implementation of process improvements
 - Lean and Six Sigma principles are often applied for continuous improvement.

Effective SCM can contribute to increased customer satisfaction, reduced costs, improved product quality, and enhanced overall competitiveness in the market. The dynamic nature of markets and technologies requires supply chain professionals to stay adaptable and responsive to changes to maintain a competitive edge.

Traditional SCM

Conventional SCM pertains to the traditional practices and methodologies historically utilized by businesses to oversee the movement of goods and services from their origin to the point of consumption. While there

CHAPTER 1 SUPPLY CHAIN MANAGEMENT STRATEGY AND PRACTICES: TRADITIONAL VS. ADVANCED

have been advancements in technology and methodologies, many organizations still operate with some aspects of traditional SCM. Here are key features of traditional SCM: linear and sequential, silos and functional departments, forecast-driven planning, bulky inventory, long lead times, manual processes, limited visibility, risk management challenges, limited use of technology, and less emphasis on collaboration.

Traditional SCM often follows a linear and sequential process where each stage in the supply chain is viewed as a distinct and separate function. It typically starts with procurement of raw materials, followed by manufacturing, distribution, and finally, reaching the end customer. Each stage of the supply chain is often treated as a separate functional unit, and departments may operate in isolation. Siloed communication can lead to inefficiencies and a lack of coordination across different functions. Forecasting is a crucial element in traditional SCM where companies rely on historical data and predictions to plan production and distribution. The focus is on producing large quantities to meet anticipated demand. Traditional SCM tends to involve holding larger inventories as a buffer to meet potential demand fluctuations. Warehousing is a significant aspect of this approach, with large storage spaces used to stockpile goods. Due to the sequential nature of traditional SCM, lead times can be long, particularly when sourcing materials from different suppliers or when relying on a make-to-order production model (an approach where product is not built until confirmed order for product is received). Manual processes, paperwork, and human intervention are common in traditional SCM, leading to potential errors and delays. This can include manual order processing, inventory tracking, and communication. Limited real-time visibility into the entire supply chain is a characteristic of traditional SCM. Companies may lack the tools and technologies to monitor and respond quickly to changes or disruptions. Traditional SCM may face challenges in effectively identifying and managing risks, especially in a global and dynamic business environment. Issues such as