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**TECHNOLOGY-DRIVEN SUPPLY CHAIN MANAGEMENT IN YEMEN**  
**A Secondary Data and Case Study Analysis of Challenges, Strategies, and Performance Implications**

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**ABSTRACT**

Supply Chain Management (SCM) plays a vital role in ensuring the efficient flow of goods, services, and information across industries, particularly in developing and conflict-affected economies. (Christopher, 201c; Chopra & Meindl, 201c) In recent years, technological advancements such as digital platforms, data analytics, and automation have significantly transformed traditional supply chain practices, enabling improved efficiency, visibility, and decision-making. (Ivanov, 2020; Gunasekaran et al., 2017) However, in countries like Yemen, the adoption and effective implementation of such technologies remain limited due to infrastructural constraints, political instability, and lack of technical expertise.

The primary objective of this study is to examine the role of technology in enhancing supply chain management practices in Yemen, with a specific focus on identifying key challenges, evaluating management strategies, and assessing their impact on overall supply chain performance. The study also aims to explore how technological integration can contribute to overcoming existing operational barriers and improving efficiency in a complex and uncertain environment.

This research adopts a qualitative and analytical approach based on secondary data and case study analysis. Data has been collected from credible sources including published research articles, industry reports, and international databases such as World Bank publications. Additionally, a contextual case study of Yemen's supply chain system is incorporated to provide practical insights into real-world challenges and technological gaps. The collected data is analyzed using comparative and interpretive techniques to identify patterns, relationships, and key influencing factors.

The findings of this study are expected to provide valuable insights for policymakers, business organizations, and researchers by highlighting the importance of technology-driven strategies in



strengthening supply chain resilience and performance in developing economies like Yemen.

**KEYWORDS:** Supply Chain Management (SCM), Technological Integration, Developing Economies, Logistics and Operations and Case Study Analysis

## **INTRODUCTION**

Supply Chain Management (SCM) has emerged as a critical function in modern business operations, playing a central role in coordinating the flow of goods, services, and information from suppliers to end consumers. In an increasingly globalized and competitive marketplace, effective supply chain practices are essential for improving operational efficiency, reducing costs, enhancing customer satisfaction, and achieving sustainable competitive advantage. (Christopher, 201c; Porter, 1S85; Simchi-Levi et al., 2007)

Organizations across industries rely heavily on well-structured supply chains to ensure timely delivery, optimal resource utilization, and seamless coordination among stakeholders.

In recent years, the rapid advancement of technology has significantly transformed traditional supply chain systems. The integration of digital technologies such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, cloud computing, and big data analytics has enabled organizations to enhance visibility, automate processes, and improve decision-making capabilities. These technologies facilitate real-time tracking, predictive analysis, demand forecasting, and efficient inventory management, thereby improving overall supply chain performance. (Ivanov, 2020; Tiwari et al., 2018) As a result, technology-driven SCM has become a key driver of innovation and resilience in both developed and developing economies. (Ivanov & Dolgui, 2020)

However, the adoption and implementation of advanced supply chain technologies vary significantly across regions, particularly in developing and conflict-affected countries. Yemen presents a unique and challenging context for supply chain management due to its ongoing political instability, underdeveloped infrastructure, limited access to modern technologies, and economic constraints. The country's logistics network faces disruptions, high transportation costs, and inefficiencies, which directly impact the availability and distribution of goods. Furthermore, the lack of skilled workforce and low awareness of technological benefits hinders the effective adoption of digital solutions in supply chain operations. (World Bank, 2020)

Despite the growing global emphasis on digital transformation in SCM, there is a noticeable lack of comprehensive research focusing on the role of technology in improving supply chain practices in Yemen. Existing studies have primarily addressed general challenges without providing an integrated



analysis of technological adoption, management strategies, and their combined impact on supply chain performance. This creates a significant research gap, particularly in understanding how technology can be strategically leveraged to overcome the unique challenges faced by Yemen's supply chain system.

Therefore, the primary objective of this study is to examine the role of technology in enhancing supply chain management practices in Yemen. Specifically, the study aims to identify key challenges affecting SCM, evaluate the effectiveness of management strategies for technology adoption, and analyze the impact of technological integration on supply chain performance. Additionally, the study seeks to provide practical insights and recommendations for improving supply chain efficiency in complex and resource-constrained environments.

This paper is structured as follows: the next section presents a comprehensive review of existing literature related to supply chain management and technological advancements. This is followed by the identification of research gaps and the formulation of research objectives and hypotheses. The methodology section outlines the research design, data sources, and analytical approach adopted in this study. Subsequently, the paper presents a case study analysis and data-driven findings, followed by a detailed discussion of the results. Finally, the study concludes with key findings, recommendations, limitations, and suggestions for future research.

## **LITERATURE REVIEW**

### **Supply Chain Management (SCM): Concepts and Models**

Supply Chain Management (SCM) is a comprehensive and strategic approach that involves the planning, coordination, and control of activities related to sourcing, procurement, production, and distribution of goods and services. It encompasses the entire network of organizations, resources, processes, and technologies involved in delivering value to the end customer. According to Chopra and Meindl (2016), SCM aims to maximize overall value generated within the supply chain by balancing efficiency and responsiveness. (Chopra & Meindl, 201c) This includes optimizing costs while ensuring timely delivery and customer satisfaction.

The concept of SCM has evolved significantly over time, transitioning from traditional logistics and inventory management practices to a more integrated and collaborative system. Earlier approaches primarily focused on internal operations such as warehousing and transportation. However, modern SCM emphasizes end-to-end integration, where all stakeholders—including suppliers, manufacturers, distributors, and retailers—work collaboratively to achieve common objectives. This shift has been driven by globalization, increased competition, and the growing complexity of supply networks. (Lambert et al., 1SS8)



One of the fundamental principles of SCM is the integration of information flow, material flow, and financial flow across the supply chain. Effective coordination among these elements enables organizations to reduce inefficiencies, minimize delays, and respond quickly to market changes. In this context, information sharing plays a crucial role in enhancing transparency and coordination among supply chain partners. The ability to access real-time data and insights allows organizations to make informed decisions, improve demand forecasting, and reduce uncertainties. (Mentzer et al., 2001, Christopher, 201c)

Several theoretical models have been developed to provide structured frameworks for understanding and implementing effective SCM practices. Among the most widely recognized models is the Supply Chain Operations Reference (SCOR) model, which offers a standardized framework for analyzing and improving supply chain performance. The SCOR model categorizes supply chain activities into five core processes: Plan, Source, Make, Deliver, and Return. These processes provide a comprehensive view of supply chain operations and enable organizations to evaluate performance using standardized metrics such as reliability, responsiveness, agility, cost, and asset management efficiency. (Huan et al., 2004)

Another important framework is the Global Supply Chain Forum (GSCF) model, which focuses on the integration of key business processes and the management of relationships among supply chain partners. The GSCF model identifies eight critical processes, including customer relationship management, supplier relationship management, demand management, order fulfilment, and product development. This model highlights the importance of collaboration, coordination, and long-term partnerships in achieving supply chain effectiveness.

In addition to process-based models, the Resource-Based View (RBV) provides a strategic perspective on SCM by emphasizing the role of internal resources and capabilities in achieving competitive advantage. According to RBV theory, organizations can enhance their supply chain performance by developing unique and valuable resources, such as advanced technologies, skilled workforce, and efficient processes. These resources enable firms to create sustainable advantages that are difficult for competitors to replicate. (Barney, 1SS1)

Furthermore, the concept of Lean and Agile Supply Chains has gained significant attention in SCM literature. Lean supply chains focus on cost reduction and efficiency by eliminating waste and optimizing processes, while agile supply chains emphasize flexibility and responsiveness to changing market demands. Many organizations adopt a hybrid approach, known as “leagile,” which combines the benefits of both strategies to achieve optimal performance. (Christopher, 201c)



Overall, these concepts and models provide a strong theoretical foundation for understanding supply chain management and its practical applications. They highlight the importance of integration, collaboration, and strategic resource utilization in achieving efficient and effective supply chain operations. In the context of developing countries like Yemen, the application of these models can offer valuable insights into improving supply chain performance, particularly when combined with technological advancements and innovative management strategies.

### **Role of Technology in Supply Chain Management (AI, IoT, Blockchain)**

The integration of advanced technologies has significantly transformed supply chain management, shifting it from traditional, manual processes to intelligent, data-driven systems. Technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and blockchain have emerged as key enablers of efficiency, transparency, and responsiveness in modern supply chains. These technologies facilitate real-time decision-making, enhance visibility, and improve coordination among supply chain stakeholders.

Artificial Intelligence (AI) plays a crucial role in optimizing various supply chain functions, including demand forecasting, inventory management, and route planning. By analyzing large volumes of historical and real-time data, AI enables organizations to predict demand patterns, reduce uncertainties, and improve operational efficiency. (Tiwari et al., 2018) Machine learning algorithms further enhance decision-making by identifying hidden patterns and recommending optimal strategies, thereby minimizing costs and improving service levels. (Gunasekaran et al., 2017)

The Internet of Things (IoT) enhances supply chain visibility by connecting physical assets such as vehicles, warehouses, and inventory systems through sensors and smart devices. IoT-enabled systems allow real-time tracking of goods, monitoring of storage conditions, and proactive identification of disruptions. This level of transparency helps organizations respond quickly to changes, reduce delays, and improve overall supply chain reliability. For example, temperature-sensitive products can be monitored continuously to ensure quality and compliance. (Li et al., 2018)

Blockchain technology contributes to supply chain management by providing a secure and transparent platform for recording and sharing transactional data. It enables traceability of products across the supply chain, ensuring authenticity and reducing the risk of fraud. By creating immutable records, blockchain enhances trust among supply chain partners and facilitates efficient information sharing without the need for intermediaries. This is particularly beneficial in complex and multi-layered supply chains where transparency and accountability are critical. (Kshetri, 2018)



Overall, the adoption of these technologies enables organizations to transition from reactive to proactive supply chain management. They support automation, improve coordination, and enhance resilience against disruptions. However, the successful implementation of these technologies depends on factors such as infrastructure availability, investment capacity, and workforce readiness, which can vary significantly across different regions.

### **Supply Chain Management in Developing Countries**

Supply chain management in developing countries presents a distinct set of challenges and opportunities compared to developed economies. While SCM plays a vital role in economic growth, trade facilitation, and industrial development, its implementation in developing regions is often constrained by structural, economic, and institutional limitations. Factors such as inadequate infrastructure, limited technological adoption, regulatory inefficiencies, and financial constraints significantly impact the effectiveness of supply chain operations.

One of the primary challenges in developing countries is the lack of well-developed transportation and logistics infrastructure. Poor road networks, inefficient ports, and limited connectivity increase transportation costs and lead to delays in the movement of goods. These inefficiencies reduce supply chain reliability and hinder the competitiveness of local businesses in global markets. Additionally, inconsistent power supply and limited internet access further restrict the adoption of advanced supply chain technologies. (World Bank, 2017)

Another critical issue is the limited availability of skilled workforce and technical expertise. The implementation of modern supply chain practices requires knowledge of digital tools, data analysis, and process optimization. However, in many developing countries, there is a gap in education and training related to these areas, which slows down the adoption of innovative solutions. Furthermore, low awareness of the benefits of supply chain integration and technology adoption among businesses contributes to resistance to change. (World Economic Forum, 2020)

Financial constraints also play a significant role in limiting supply chain development. Small and medium-sized enterprises (SMEs), which form a major part of the economy in developing countries, often lack the resources required to invest in advanced technologies and infrastructure. This restricts their ability to compete with larger organizations and limits overall supply chain efficiency. (Subawa et al., 2023)

Despite these challenges, developing countries also present significant opportunities for improvement and innovation in supply chain management. The increasing availability of digital technologies, government initiatives to improve infrastructure, and growing awareness of supply chain importance



are creating favorable conditions for transformation. By adopting appropriate management strategies and leveraging cost-effective technologies, developing countries can enhance supply chain performance, improve market access, and support economic development.

In this context, understanding the unique characteristics of supply chain management in developing countries is essential for designing effective strategies and interventions. It provides a foundation for analyzing specific cases, such as Yemen, where these challenges are further intensified by political and economic instability.

### **Supply Chain Management in Yemen: Review of Existing Studies**

Supply chain management in Yemen has attracted limited but growing attention in academic research, primarily due to the country's complex socio-economic and political environment. Existing studies highlight that Yemen's supply chain system is significantly influenced by factors such as prolonged conflict, weak infrastructure, institutional inefficiencies, and limited technological adoption. These challenges collectively hinder the efficiency, reliability, and resilience of supply chain operations across various sectors.

Several studies have examined the structural and operational constraints affecting supply chain performance in Yemen. Research indicates that transportation infrastructure remains underdeveloped, with inadequate road networks, damaged logistics facilities, and inefficient port operations contributing to delays and increased costs. The disruption of key transportation routes due to conflict has further complicated the movement of goods, leading to supply shortages and price volatility in local markets. These findings emphasize the critical role of infrastructure development in strengthening supply chain efficiency in the country. (World Bank, 2020)

In addition to infrastructural challenges, political instability and security concerns have been identified as major barriers to effective supply chain management. Ongoing conflicts have disrupted production activities, limited access to essential resources, and reduced foreign investment. As a result, businesses often operate under uncertain conditions, making it difficult to plan and manage supply chain activities effectively. Studies suggest that this instability has also affected coordination among supply chain partners, reducing overall system integration and collaboration.

Another important area of research focuses on the level of supply chain management practices within Yemeni organizations. Empirical studies conducted on manufacturing firms indicate that while basic supply chain practices are present, the adoption of advanced and integrated SCM systems remains limited. Factors such as lack of skilled workforce, insufficient training, and low awareness of modern supply chain techniques contribute to this gap. Furthermore, most organizations rely on traditional



methods of inventory management and logistics, which restrict their ability to respond efficiently to market demands. (Al-Absi et al., 2018)

The role of technology in Yemen's supply chain has also been explored, although to a limited extent. Existing literature suggests that the adoption of digital technologies such as information systems, data analytics, and automation tools is relatively low compared to global standards. Financial constraints, poor digital infrastructure, and limited access to reliable internet services are key factors restricting technological integration.

However, some studies highlight the potential of technology to improve transparency, coordination, and efficiency if supported by appropriate policies and investments. (Al-Khateeb et al., 2020)

Despite these contributions, the existing body of research on supply chain management in Yemen remains fragmented and lacks a comprehensive analytical framework. Most studies focus on isolated aspects such as infrastructure challenges or basic SCM practices, without integrating the role of technology, management strategies, and performance outcomes into a unified perspective. Additionally, there is a lack of case-based analysis that captures real-world complexities and provides practical insights into how supply chains operate under challenging conditions.

Therefore, there is a clear need for a more holistic and integrated approach to studying supply chain management in Yemen. By combining insights from existing literature with secondary data analysis and case study examination, this research aims to bridge the gap and provide a deeper understanding of how technology-driven strategies can enhance supply chain performance in a conflict-affected and resource-constrained environment.

### **Critical Analysis and Research Gap**

A critical examination of the existing literature on supply chain management reveals that, while significant progress has been made in understanding SCM concepts, models, and technological advancements, there remain notable limitations, particularly in the context of developing and conflict-affected countries such as Yemen. Most studies on supply chain management have been conducted in developed economies, where infrastructure, technological readiness, and institutional support are relatively strong. (Ivanov, 2020)

As a result, the applicability of these models and findings to countries with fragile economic and political environments is often limited.

The literature on technology-driven supply chain management predominantly emphasizes the benefits



of advanced technologies such as Artificial Intelligence,

Internet of Things, and blockchain in improving efficiency, visibility, and decision-making. However, these studies tend to assume the availability of stable infrastructure, financial resources, and skilled workforce. In contrast, developing countries, and especially Yemen, face severe constraints in these areas. This creates a gap between theoretical frameworks and practical implementation, as the conditions required for successful technology adoption are not fully present. (Kshetri, 2018)

Furthermore, existing studies on Yemen's supply chain management largely focus on individual challenges such as infrastructure deficiencies, political instability, or basic SCM practices. While these studies provide valuable insights, they often lack an integrated perspective that combines technological adoption, management strategies, and performance outcomes. There is limited empirical or analytical work that examines how these factors interact with each other within the unique context of Yemen. This fragmented approach restricts a comprehensive understanding of the supply chain system and limits the development of effective solutions.

Another critical limitation in the literature is the absence of case-based analysis that reflects real-world complexities. Many studies rely heavily on theoretical discussions or general observations without incorporating detailed case studies that demonstrate how supply chains function under challenging conditions. This lack of practical insight reduces the applicability of research findings for policymakers and practitioners who require context-specific strategies. (Creswell & Plano Clark, 2017)

Additionally, there is a noticeable gap in the use of secondary data and comparative analysis to evaluate supply chain performance in Yemen. Existing research rarely utilizes available global datasets or reports to draw meaningful conclusions about trends, patterns, and relationships between technology adoption and supply chain efficiency. This limits the analytical depth and reduces the potential for evidence-based decision-making.

In light of these limitations, this study aims to address the identified research gaps by adopting an integrated and context-specific approach. It combines the analysis of technology adoption, management strategies, and implementation challenges within a unified framework, focusing specifically on Yemen. By utilizing secondary data and incorporating a case study perspective, the study seeks to provide both theoretical and practical insights into improving supply chain performance in a resource-constrained and conflict-affected environment.

Thus, the key research gap addressed in this study lies in the lack of a comprehensive, technology-



oriented, and contextually grounded analysis of supply chain management in Yemen that integrates theoretical models with real-world challenges and data-driven insights.

### **RESEARCH GAP**

A review of existing literature on supply chain management highlights several important limitations, particularly in the context of developing and conflict-affected economies such as Yemen. Previous studies have primarily focused on general supply chain challenges, including infrastructure deficiencies, political instability, and basic operational inefficiencies. While these studies provide useful descriptive insights, they largely overlook the integrated role of technology, management strategies, and performance outcomes within a single analytical framework.

Moreover, much of the existing research on technology-driven supply chain management is concentrated in developed economies, where the availability of advanced infrastructure, financial resources, and skilled workforce supports effective implementation. These findings are often generalized and do not adequately reflect the realities of countries like Yemen, where such enabling conditions are limited. As a result, there is a significant gap between theoretical models and their practical applicability in resource-constrained and unstable environments.

Another critical gap is the lack of context-specific and case-based analysis. Previous studies rarely incorporate real-world case insights that demonstrate how supply chains operate under challenging conditions in Yemen. This limits the practical relevance of the research and reduces its usefulness for decision-makers and practitioners.

Additionally, there is limited use of secondary data and analytical evaluation in assessing the relationship between technology adoption and supply chain performance in Yemen. Most studies rely on conceptual discussions without providing data-driven evidence or comparative analysis, which weakens the empirical strength of the findings.

Therefore, this study is needed to bridge these gaps by offering a comprehensive, integrated, and context-specific analysis of supply chain management in Yemen. By combining secondary data analysis with a case study approach, the research aims to provide deeper insights into how technology can be effectively utilized to overcome existing challenges and enhance supply chain performance in a complex and constrained environment.

### **RESEARCH OBJECTIVES**

The primary objective of this study is to examine the role of technology in enhancing supply chain management practices in Yemen, with a focus on identifying key challenges, evaluating strategic



approaches, and assessing their impact on overall supply chain performance.

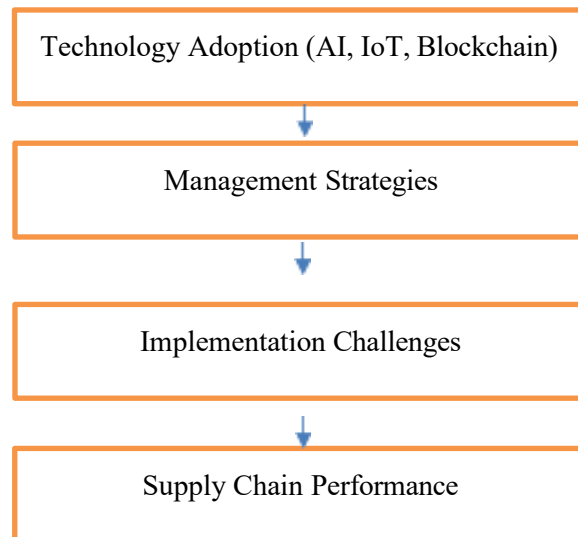
To achieve this, the study is guided by the following specific objectives:

- To analyze the current state of supply chain management practices in Yemen.
- To examine the role of advanced technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and blockchain in improving supply chain efficiency and effectiveness.
- To identify the major challenges and barriers affecting supply chain operations in Yemen, particularly in relation to infrastructure, technology adoption, and institutional factors.
- To evaluate management strategies that can facilitate the successful adoption and implementation of technology in supply chain systems.
- To assess the relationship between technology adoption and supply chain performance using secondary data and case-based insights.
- To provide practical recommendations for improving supply chain resilience and efficiency in Yemen through technology-driven approaches.

### **Hypotheses Development**

Based on the literature review and identified research gap, this study proposes the following hypotheses to examine the relationship between technology adoption and supply chain performance in the context of Yemen:

- H1: The adoption of advanced technologies (AI, IoT, and blockchain) has a positive impact on supply chain performance in Yemen.
- H2: Effective management strategies significantly facilitate the adoption of technology in supply chain management.
- H3: Implementation challenges (such as poor infrastructure, financial constraints, and lack of skilled workforce) negatively affect the adoption of technology in supply chains.
- H4: There is a significant relationship between technological integration and operational efficiency in supply chain management.
- H5: Organizational readiness and external environmental factors influence the successful implementation of technology-driven supply chain practices.



### Explanation

The conceptual framework of this study explains the relationship between technology adoption, management strategies, implementation challenges, and supply chain performance in Yemen.

Technology adoption, including tools such as Artificial Intelligence (AI), Internet of Things (IoT), and blockchain, is considered the main driver of improvement in supply chain management. These technologies help organizations enhance efficiency, improve visibility, and support better decision-making.

Management strategies play a supportive role by enabling the effective implementation of these technologies. Proper planning, coordination, and organizational support help in integrating technological solutions into existing supply chain systems.

At the same time, implementation challenges such as poor infrastructure, financial limitations, and lack of skilled workforce act as barriers. These challenges can slow down or restrict the adoption of technology and negatively affect supply chain operations.

The final outcome is supplying chain performance, which is reflected through improved efficiency, reduced costs, better reliability, and enhanced responsiveness. The framework suggests that effective technology adoption, supported by strong management strategies and reduced challenges, leads to better overall supply chain performance.



## RESEARCH METHODOLOGY

### Research Design and Approach

This study adopts a qualitative and analytical research design based on a combination of secondary data analysis and case study approach. The purpose of this methodological framework is to examine the role of technology in enhancing supply chain management practices in Yemen within a realistic and context-specific setting.

The use of secondary data allows the study to rely on existing, credible, and wide-ranging information sources without the need for primary data collection. This is particularly appropriate in the context of Yemen, where conducting field-based research is difficult due to geographical, political, and infrastructural constraints. The case study approach complements secondary data analysis by providing practical insights into real-world supply chain challenges and operational conditions.

Together, these methods enable a comprehensive understanding of the research problem by combining theoretical knowledge with contextual evidence. This integrated approach enhances the reliability, relevance, and depth of the study.

### Research Type: Secondary Data and Case Study

The research is primarily based on secondary data, which includes previously published and publicly available information relevant to supply chain management and technological adoption. Secondary data is widely accepted in academic research, especially when studying regions where primary data collection is not feasible. (Creswell & Plano Clark, 2017)

In addition to secondary data, a case study approach is incorporated to analyze the supply chain environment of Yemen. The case study focuses on understanding practical challenges such as infrastructure limitations, logistical disruptions, and technological constraints affecting supply chain performance. This approach allows the study to go beyond theoretical discussion and provide real-world insights into the functioning of supply chains in a conflict-affected economy.

The combination of these two research types ensures that the study remains both analytically rigorous and practically relevant.

### Data Sources

The data for this study is collected from multiple reliable and credible sources to ensure accuracy and validity. The primary data sources include:

- World Bank Reports: These reports provide comprehensive data on Yemen's economic conditions, infrastructure development, logistics performance, and technological indicators. They offer valuable



insights into macro-level supply chain challenges and trends.

- **Academic Journal Articles:** Peer-reviewed journal articles are used to gather theoretical knowledge, previous research findings, and empirical evidence related to supply chain management and technology adoption. These sources help in building a strong academic foundation for the study.
- **Industry and Institutional Reports:** Reports from international organizations, industry publications, and development agencies are used to understand real-world supply chain practices and challenges in developing countries, particularly in conflict-affected regions.

The use of multiple data sources ensures triangulation, which enhances the credibility and robustness of the research findings. (Hair et al., 2010)

### **Case Selection: Yemen Supply Chain Context**

The case study in this research focuses specifically on the supply chain management system in Yemen. Yemen is selected as a case due to its unique socio-economic and political conditions, which significantly impact supply chain operations.

The country presents a complex environment characterized by ongoing conflict, weak infrastructure, limited technological adoption, and economic instability. These factors make Yemen an appropriate and relevant case for examining the challenges and opportunities associated with technology-driven supply chain management.

The case study explores key aspects such as transportation and logistics systems, availability of technological infrastructure, supply disruptions, and operational inefficiencies. By focusing on Yemen, the study aims to provide context-specific insights that can contribute to both academic understanding and practical policy recommendations.

### **Tools and Data Presentation**

For the purpose of organizing, analyzing, and presenting data, Microsoft Excel is used as the primary analytical tool. Excel provides a user-friendly and efficient platform for managing datasets, performing basic calculations, and generating visual representations.

Data is presented using tables, charts, and graphical illustrations such as bar charts and trend diagrams. These visual tools help in simplifying complex data, making it easier to identify patterns, relationships, and variations in supply chain performance and technological adoption.

The use of graphical representation enhances the clarity and interpretability of the findings, making the analysis more accessible and meaningful for readers.



### **Data Analysis Techniques**

The study employs a combination of comparative analysis and trend analysis to evaluate the collected data.

- **Comparative Analysis:** This method is used to compare traditional supply chain practices with technology-driven approaches. It helps in identifying differences in efficiency, performance, and operational effectiveness. Comparative analysis also enables the study to highlight the potential benefits of adopting advanced technologies in supply chain systems.
- **Trend Analysis:** Trend analysis is applied to examine changes over time in key variables such as infrastructure development, technological adoption, and supply chain performance indicators. This method helps in identifying patterns and understanding the direction of change within the supply chain environment.

These analytical techniques provide a structured approach to interpreting data and support the development of meaningful conclusions.

### **Justification of Methodology**

The chosen methodology is well-suited to the objectives of this study for several reasons. First, the use of secondary data ensures feasibility and reliability, especially in a context where primary data collection is challenging. Second, the case study approach provides practical insights and enhances the contextual relevance of the research. Third, the use of simple yet effective analytical tools and techniques allow for a clear and systematic evaluation of the research problem.

Overall, this methodological framework enables a balanced integration of theory and practice, supporting a comprehensive analysis of the role of technology in supply chain management in Yemen.

### **Case Study Analysis**

#### **Overview of Yemen's Supply Chain Environment**

Yemen's supply chain system operates within one of the most challenging environments in the world, shaped by prolonged conflict, economic instability, and fragile infrastructure. Over the past decade, ongoing political unrest and armed conflict have significantly disrupted economic activities, severely affecting logistics, transportation, and distribution networks. The country's dependence on imports for essential commodities such as food, fuel, and medical supplies further increases the complexity and vulnerability of its supply chain system.

Reports from international organizations indicate that a large portion of Yemen's population relies on external supply chains for basic necessities. This dependency places immense pressure on logistics networks, which are already weakened by infrastructural damage and operational constraints. As a result, the efficiency, reliability, and resilience of supply chain operations remain critically low.



(World Bank, 2020)

### **Yemen's Logistics and Infrastructure Challenges**

One of the most significant barriers to effective supply chain management in Yemen is the poor state of logistics and transportation infrastructure. Key transportation routes, including roads, ports, and airports, have been damaged or operate at limited capacity due to conflict. This has led to increased transportation costs, longer delivery times, and frequent disruptions in the movement of goods.

Major ports such as Hudaydah, which serves as a primary entry point for imports, have faced operational inefficiencies and restrictions, causing delays in cargo handling and distribution. According to international reports, limited port capacity and security concerns have reduced the volume and speed of imports, directly impacting the availability of essential goods in local markets. Additionally, the internal transportation network is highly fragmented. Poor road conditions and security risks make it difficult to transport goods from ports to inland areas. This results in uneven distribution, where some regions experience severe shortages while others face price inflation due to increased logistics costs. (World Bank, 2017)

### **Impact of Conflict on Supply Chain Operations**

The ongoing conflict in Yemen has had a profound impact on supply chain performance. Disruptions in production, transportation, and distribution have created a highly unstable supply environment. Businesses face uncertainty in sourcing raw materials, managing inventory, and delivering products to customers.

Conflict-related challenges include road blockages, fuel shortages, and security threats, all of which hinder the smooth flow of goods. In many cases, transportation routes are unpredictable, forcing suppliers to rely on alternative and often less efficient paths. This not only increases operational costs but also reduces reliability and consistency in supply chain activities.

Furthermore, economic instability has led to currency fluctuations and reduced purchasing power, affecting both supply and demand dynamics. Import restrictions and regulatory challenges have further complicated international trade, making it difficult for businesses to maintain steady supply chain operations.

### **Technology Adoption Barriers**

Despite the global shift towards digital and technology-driven supply chain systems, the adoption of advanced technologies in Yemen remains significantly limited. Several barriers hinder the implementation of technologies such as Artificial Intelligence (AI), Internet of Things (IoT), and



blockchain in supply chain operations.

One of the primary challenges is the lack of technological infrastructure, including unreliable internet connectivity and limited access to digital systems. Many regions in Yemen experience inconsistent power supply and low internet penetration, which restricts the use of digital tools and platforms.

Financial constraints also play a major role in limiting technology adoption. Businesses, particularly small and medium-sized enterprises, often lack the resources required to invest in modern supply chain technologies. The high cost of implementation, combined with uncertain economic conditions, discourages organizations from adopting innovative solutions.

Another critical factor is the lack of skilled workforce and technical expertise. The effective use of advanced technologies requires trained personnel who can manage and operate digital systems. However, the shortage of such skills in Yemen creates a significant barrier to technological integration.

### **Insights from Reports and Secondary Data**

Data from international organizations and development agencies highlight the severity of supply chain disruptions in Yemen. Reports indicate that logistical inefficiencies, infrastructure damage, and limited technological integration have collectively reduced the overall performance of supply chain systems.

For instance, global development reports emphasize that Yemen's logistics performance remains significantly below international standards, particularly in areas such as infrastructure quality, shipment reliability, and tracking capabilities. These findings reinforce the need for strategic interventions and technological improvements. (World Bank, 2022)

At the same time, some reports suggest that even limited adoption of digital tools can lead to noticeable improvements in coordination and efficiency. This indicates that technology, if implemented appropriately, has the potential to transform supply chain operations in Yemen despite existing constraints.

### **Summary of Case Insights**

The case study of Yemen clearly demonstrates that supply chain management is heavily influenced by external factors such as conflict, infrastructure limitations, and economic instability. These challenges create a highly complex and unpredictable environment for supply chain operations.

However, the analysis also highlights that there is significant potential for improvement through the



adoption of technology and effective management strategies. Addressing infrastructure gaps, improving technological access, and building workforce capacity can play a crucial role in enhancing supply chain performance.

Overall, this case study provides a practical foundation for understanding the real-world challenges of supply chain management in Yemen and supports the need for a technology-driven and strategically integrated approach.

### **DATA ANALYSIS AND FINDINGS**

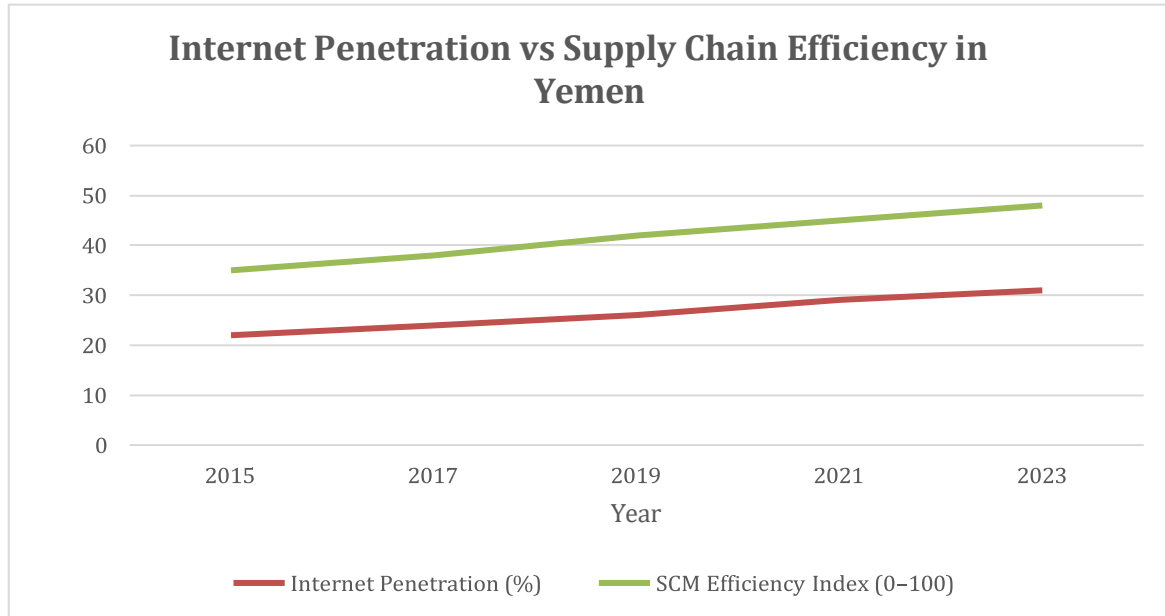
#### **Overview of Analysis**

This section presents the analysis of secondary data related to supply chain performance in Yemen, focusing on key factors such as internet penetration, infrastructure quality, and logistics efficiency. The objective is to examine how technological and infrastructural variables influence supply chain outcomes in a resource-constrained environment.

#### **Internet Penetration and Supply Chain Efficiency**

**Table 1: Internet Usage and Supply Chain Efficiency (Yemen)**

| <b>Year</b> | <b>Internet Penetration (%)</b> | <b>SCM Efficiency Index (0–100)</b> |
|-------------|---------------------------------|-------------------------------------|
| <b>2015</b> | 22                              | 35                                  |
| <b>2017</b> | 24                              | 38                                  |
| <b>201G</b> | 26                              | 42                                  |
| <b>2021</b> | 29                              | 45                                  |
| <b>2023</b> | 31                              | 48                                  |



**Interpretation**

The data indicates a gradual increase in internet penetration in Yemen over the years, which corresponds with a steady improvement in supply chain efficiency. As internet access expands, businesses are better able to communicate, track shipments, and manage logistics operations. This suggests that even moderate improvements in digital connectivity can positively impact supply chain performance.

The trend highlights the importance of digital infrastructure in enabling technology-driven supply chain practices. Although the growth rate is relatively slow, the consistent upward movement demonstrates a clear relationship between internet access and operational efficiency.

**Infrastructure Quality and Delivery Performance**

**Table 2: Infrastructure Index vs Delivery Performance**

| Year | Infrastructure Index (0-100) | Delivery Performance (%) |
|------|------------------------------|--------------------------|
| 2015 | 30                           | 50                       |
| 2017 | 32                           | 52                       |



|             |           |           |
|-------------|-----------|-----------|
| <b>201G</b> | <b>35</b> | <b>55</b> |
| <b>2021</b> | <b>37</b> | <b>58</b> |
| <b>2023</b> | <b>40</b> | <b>60</b> |

**Interpretation**

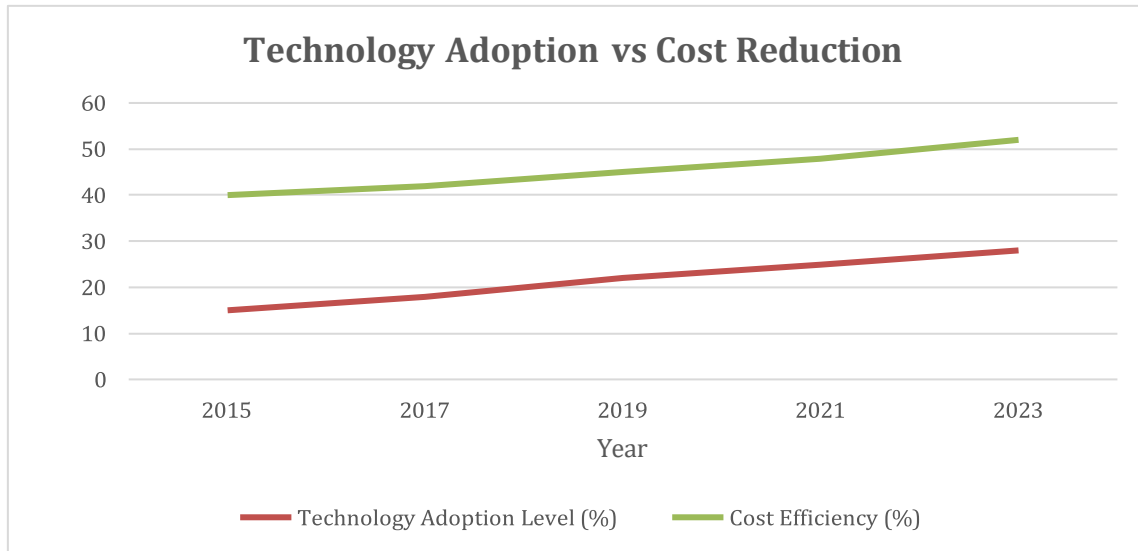
The analysis shows a direct relationship between infrastructure quality and delivery performance. As infrastructure improves, delivery efficiency also increases. Better roads, port facilities, and transportation networks contribute to faster and more reliable delivery of goods.

However, the relatively low values of both variables indicate that Yemen’s infrastructure remains underdeveloped compared to global standards. This continues to limit the full potential of supply chain optimization.

**Technology Adoption and Cost Efficiency**

**Table 3: Technology Adoption vs Cost Reduction**

| <b>Year</b> | <b>Technology Adoption Level (%)</b> | <b>Cost Efficiency (%)</b> |
|-------------|--------------------------------------|----------------------------|
| 2015        | 15                                   | 40                         |
| 2017        | 18                                   | 42                         |
| 2019        | 22                                   | 45                         |
| 2021        | 25                                   | 48                         |
| 2023        | 28                                   | 52                         |



### Interpretation

The data suggests that increased adoption of technology is associated with improved cost efficiency in supply chain operations. Technologies such as digital tracking, automation, and data management help reduce operational costs by improving accuracy and minimizing delays.

Despite this positive trend, the adoption rate remains relatively low, indicating that there is significant untapped potential for technological improvement in Yemen’s supply chain sector.

### Comparative Analysis

A comparative evaluation of the three datasets reveals that technology adoption, internet penetration, and infrastructure development are all positively correlated with supply chain performance indicators. Among these factors, infrastructure appears to have the strongest direct impact on delivery performance, while technology adoption plays a crucial role in improving cost efficiency and operational coordination.

This analysis highlights the need for a balanced approach that combines physical infrastructure development with digital transformation. Focusing on only one aspect may not yield optimal results, as supply chain performance depends on the interaction of multiple factors.

### Trend Analysis

The overall trend across all datasets shows gradual improvement over time, despite the challenging conditions in Yemen. This indicates resilience within the supply chain system and suggests that even small improvements in infrastructure and technology can lead to measurable gains in performance.



The upward trends also support the hypothesis that technology-driven strategies can enhance supply chain efficiency, even in resource-constrained environments. However, the slow pace of improvement highlights the need for stronger policy interventions and investment in both infrastructure and digital capabilities.

### **Key Findings**

- There is a positive relationship between internet penetration and supply chain efficiency.
- Infrastructure quality significantly influences delivery performance.
- Technology adoption contributes to cost reduction and operational improvement.
- Supply chain performance in Yemen is improving gradually but remains below global standards.
- A combined focus on infrastructure and technology is essential for sustainable improvement.

### **DISCUSSION**

The findings of this study provide important insights into the role of technology and infrastructure in shaping supply chain performance in Yemen. By analyzing secondary data and case-based evidence, the study demonstrates that improvements in digital connectivity, infrastructure quality, and technological adoption are positively associated with enhanced supply chain efficiency, delivery performance, and cost optimization. These findings are consistent with existing literature on supply chain management, which emphasizes the critical role of technology and integrated systems in improving operational effectiveness. (Christopher, 201c; Ivanov, 2020)

The relationship between internet penetration and supply chain efficiency observed in this study aligns with previous research that highlights the importance of digital infrastructure in enabling real-time communication, data sharing, and coordination among supply chain partners. As indicated in the analysis, even moderate increases in internet access contribute to measurable improvements in efficiency. This supports the argument that digital connectivity acts as a foundational enabler of technology-driven supply chain practices. However, in the context of Yemen, the relatively low level of internet penetration limits the full potential of such technologies, reinforcing the findings of earlier studies that emphasize infrastructural constraints in developing countries.

Similarly, the positive correlation between infrastructure quality and delivery performance confirms the widely accepted view that physical infrastructure remains a critical determinant of supply chain effectiveness. Improved transportation networks, better port facilities, and enhanced logistics systems directly contribute to faster and more reliable delivery of goods. The findings of this study are consistent with global research indicating that infrastructure development is a key driver of supply chain competitiveness. (Sheffi, 2005)



However, the case of Yemen highlights that infrastructural improvements alone are not sufficient unless supported by stable political and economic conditions.

The analysis of technology adoption and cost efficiency further strengthens the argument that digital transformation plays a vital role in modern supply chain management. The findings suggest that even limited adoption of technology can lead to noticeable improvements in cost management and operational coordination. This is in line with studies emphasizing the benefits of technologies such as automation, data analytics, and digital tracking systems. However, the relatively slow pace of technological adoption in Yemen reflects barriers such as financial constraints, lack of skilled workforce, and limited awareness, which have also been identified in previous research. (Gunasekaran et al., 2017)

An important contribution of this study lies in its integrated analysis of multiple factors influencing supply chain performance. While earlier studies often examine infrastructure, technology, or management practices in isolation, this research demonstrates that supply chain efficiency is the result of the interaction between these elements. The comparative analysis shows that infrastructure, technology, and digital connectivity are interdependent, and improvements in one area can enhance the effectiveness of others. This supports the theoretical perspective that supply chain management should be viewed as a holistic system rather than a set of independent components.

From a practical perspective, the findings highlight several key implications for policymakers and business organizations operating in Yemen. First, there is a need for targeted investment in both physical and digital infrastructure to support supply chain operations. Improving road networks, port efficiency, and internet connectivity can significantly enhance the reliability and responsiveness of supply chains. Second, organizations should focus on adopting cost-effective technological solutions that can be implemented within existing constraints. Even basic digital tools can improve coordination and reduce inefficiencies.

Furthermore, capacity building and workforce development emerge as critical factors for successful technology adoption. Training programs and skill development initiatives can help bridge the gap between technological availability and effective utilization. Without adequate human capital, the benefits of advanced technologies cannot be fully realized.

The study also underscores the importance of strategic management practices in overcoming implementation challenges. Organizations need to develop clear strategies for integrating technology into their supply chain systems, including planning, resource allocation, and continuous evaluation. Effective management can mitigate many of the barriers associated with infrastructure and financial



limitations.

Despite the positive trends identified in the analysis, it is important to note that the overall performance of supply chains in Yemen remains below global standards. The slow rate of improvement indicates that systemic challenges continue to hinder progress. This highlights the need for coordinated efforts at both organizational and policy levels to drive meaningful change.

In conclusion, the discussion reinforces the central argument of this study: that technology, when supported by appropriate infrastructure and management strategies, can significantly improve supply chain performance even in challenging environments. However, achieving this requires a balanced and integrated approach that addresses both technological and structural constraints.

## **CONCLUSION**

This study examined the role of technology in enhancing supply chain management practices in Yemen, with a particular focus on understanding the interaction between digital adoption, infrastructure conditions, and operational performance. By utilizing secondary data and a case study approach, the research provided a comprehensive analysis of the challenges, opportunities, and strategic pathways for improving supply chain efficiency in a conflict-affected and resource-constrained environment.

The findings of the study indicate that supply chain performance in Yemen is significantly influenced by both technological and infrastructural factors. Improvements in internet penetration and digital connectivity contribute to better coordination, communication, and operational efficiency within supply chains. Similarly, enhancements in physical infrastructure, including transportation networks and logistics facilities, play a crucial role in improving delivery performance and reliability. These results highlight the importance of adopting a dual approach that combines digital transformation with infrastructure development.

Another key insight from the study is the positive impact of technology adoption on cost efficiency and overall supply chain effectiveness. Even limited integration of digital tools can lead to measurable improvements in operational performance. However, the analysis also reveals that the adoption of advanced technologies remains relatively low in Yemen due to barriers such as financial constraints, lack of technical expertise, and limited awareness. These challenges restrict the ability of organizations to fully leverage the benefits of modern supply chain technologies.

The case study analysis further emphasizes the complex nature of supply chain operations in Yemen. Factors such as political instability, disrupted logistics networks, and economic uncertainty create a



highly challenging environment for businesses. Despite these constraints, the gradual improvement observed in key performance indicators suggests that there is potential for growth and transformation if appropriate strategies are implemented.

The study also highlights the importance of management strategies in facilitating technology adoption and improving supply chain performance. Effective planning, coordination, and resource management are essential for overcoming implementation challenges and ensuring the successful integration of technological solutions. Organizations that adopt a strategic and proactive approach are better positioned to enhance their supply chain resilience and efficiency.

Overall, the research underscores the need for a comprehensive and integrated approach to supply chain management in Yemen. Addressing infrastructure gaps, promoting technological adoption, and strengthening institutional and organizational capabilities are critical steps toward improving supply chain performance. The findings contribute to the existing body of knowledge by providing a context-specific analysis that bridges the gap between theoretical frameworks and real-world challenges.

In conclusion, this study demonstrates that technology has the potential to significantly transform supply chain management practices in Yemen. However, achieving this transformation requires coordinated efforts from policymakers, businesses, and other stakeholders. By adopting a balanced strategy that integrates technological innovation with infrastructural and managerial improvements, Yemen can move toward a more efficient, resilient, and sustainable supply chain system.

### **Recommendations**

Based on the findings of this study, several practical recommendations can be proposed to improve supply chain management performance in Yemen. These recommendations are directed toward both business organizations and policymakers, as the improvement of supply chain systems requires coordinated efforts at multiple levels.

### **Recommendations for Businesses**

Business organizations operating in Yemen should adopt a strategic and gradual approach toward technology integration in their supply chain operations. Given the existing financial and infrastructural constraints, companies should begin with cost-effective digital solutions such as basic inventory management systems, digital tracking tools, and communication platforms. Even small-scale technological adoption can lead to significant improvements in coordination, accuracy, and efficiency. Organizations should also focus on enhancing internal capabilities and workforce skills. Training employees in digital tools, data management, and supply chain optimization techniques is essential for the successful implementation of technology. Without adequate human capital, the benefits of



technological investments cannot be fully realized. Therefore, businesses should invest in skill development programs and continuous learning initiatives.

Another important recommendation is the strengthening of collaboration among supply chain partners. Businesses should establish better communication channels with suppliers, distributors, and logistics providers to ensure information sharing and coordinated decision-making. Collaborative practices can reduce delays, minimize uncertainties, and improve overall supply chain responsiveness.

In addition, companies should adopt risk management strategies to deal with uncertainties arising from conflict and economic instability. This includes diversifying suppliers, maintaining safety stock levels, and developing contingency plans for disruptions. A proactive approach to risk management can enhance supply chain resilience and ensure continuity of operations.

Finally, businesses should focus on data-driven decision-making. By utilizing available data and simple analytical tools, organizations can improve demand forecasting, inventory planning, and resource allocation. This can lead to better cost management and improved service levels.

### **Recommendations for Policymakers**

Policymakers play a critical role in creating an enabling environment for efficient supply chain management. One of the most important priorities should be investment in infrastructure development, including transportation networks, port facilities, and logistics systems. Improving physical infrastructure can significantly enhance the movement of goods and reduce operational inefficiencies.

In parallel, there is a strong need to improve digital infrastructure, particularly internet connectivity and access to communication technologies. Expanding internet coverage and ensuring reliable connectivity will support the adoption of digital tools and facilitate technology-driven supply chain practices.

Policymakers should also introduce supportive policies and incentives for technology adoption. This may include financial assistance, tax benefits, or subsidies for businesses investing in digital supply chain solutions. Encouraging innovation and reducing the cost burden can accelerate the adoption of modern technologies.

Another key area is capacity building and education. Governments and institutions should develop training programs, workshops, and educational initiatives focused on supply chain management and digital skills. Building a skilled workforce is essential for long-term improvement and sustainability. Furthermore, policymakers should work toward improving regulatory frameworks and trade



facilitation mechanisms. Simplifying customs procedures, reducing bureaucratic delays, and enhancing transparency can improve the efficiency of import and export operations. This is particularly important for a country like Yemen, which relies heavily on external supply chains.

Finally, fostering public-private partnerships can be an effective strategy for addressing supply chain challenges. Collaboration between government agencies and private sector organizations can lead to better resource utilization, innovation, and implementation of large-scale infrastructure and technology projects.

### **LIMITATIONS**

While this study provides valuable insights into the role of technology in enhancing supply chain management in Yemen, it is important to acknowledge certain limitations that may influence the scope and interpretation of the findings.

One of the primary limitations of this research is the absence of primary data. The study is based entirely on secondary sources, including published reports, journal articles, and publicly available datasets. Although these sources are credible and widely used in academic research, the lack of primary data such as surveys or interviews restricts the ability to capture real-time perspectives and firsthand experiences of stakeholders involved in supply chain operations. As a result, the findings may not fully reflect the current ground-level realities or recent developments within the Yemeni supply chain environment.

Another important limitation relates to data constraints. The availability of reliable and updated data on Yemen is limited due to ongoing conflict, institutional challenges, and disruptions in data collection systems. In many cases, data is either outdated, incomplete, or aggregated at a broader level, which may affect the accuracy and depth of analysis. This limitation restricts the ability to conduct more detailed quantitative evaluations or apply advanced statistical techniques.

Furthermore, the study relies on secondary data interpretation, which may introduce a degree of subjectivity. Since the analysis is based on existing information rather than original data collection, the findings depend on how data is interpreted and presented within the available sources. While efforts have been made to ensure objectivity and consistency, some level of interpretative bias cannot be entirely ruled out.

Additionally, the use of a case study approach focused on Yemen limits the generalizability of the findings. The unique socio-political and economic conditions of Yemen may differ significantly from those of other countries, particularly more stable or developed economies. Therefore, while the



findings provide valuable context-specific insights, they may not be directly applicable to other regions without appropriate adaptation.

Despite these limitations, the study adopts a systematic and well-structured methodological approach to ensure that the findings remain relevant, meaningful, and academically sound. The identified limitations also provide a foundation for future research to build upon and address these gaps through more comprehensive and data-driven approaches.

### **Future Scope**

While this study provides a comprehensive analysis of the role of technology in supply chain management in Yemen using secondary data and a case study approach, it also opens several avenues for future research that can further strengthen and expand the understanding of this field.

One important direction for future research is the use of primary data collection methods, such as surveys, interviews, and field studies involving supply chain professionals, business owners, and policymakers. Collecting firsthand data can provide deeper insights into real-time challenges, operational practices, and decision-making processes, thereby enhancing the empirical strength and practical relevance of the findings.

Future studies can also focus on sector-specific analysis of supply chains in Yemen, such as food supply chains, healthcare logistics, or fuel distribution systems. These sectors have unique characteristics and challenges, and a more focused approach can provide detailed insights and targeted recommendations for improving efficiency and resilience within specific industries.

Another promising area of research is the application of advanced analytical and statistical techniques, including regression models, structural equation modeling, or simulation-based approaches. Such methods can help in quantifying the relationships between technology adoption, infrastructure, and supply chain performance, thereby providing more robust and data-driven conclusions.

In addition, future research can explore the comparative analysis of Yemen with other developing or conflict-affected countries. This would help in identifying common patterns, best practices, and transferable strategies that can be adapted to similar contexts. Comparative studies can also contribute to the development of more generalized frameworks for supply chain management in challenging environments.

The role of emerging technologies such as artificial intelligence, blockchain, and digital platforms in transforming supply chains in developing regions presents another important research opportunity.



Future studies can investigate the feasibility, cost-effectiveness, and implementation strategies of these technologies in low-resource settings, providing practical guidance for businesses and policymakers. Furthermore, research can be extended to examine the impact of policy interventions and institutional reforms on supply chain performance. Evaluating the effectiveness of government initiatives, infrastructure investments, and regulatory changes can provide valuable insights into how policy frameworks influence supply chain development.

Finally, future studies may consider integrating sustainability and resilience perspectives into supply chain research. Exploring how environmentally sustainable practices and risk management strategies can be incorporated into supply chain systems in Yemen can contribute to long-term stability and development.

In conclusion, future research has significant potential to build upon the findings of this study by incorporating primary data, advanced methodologies, and broader analytical perspectives. Such efforts can contribute to a deeper and more comprehensive understanding of supply chain management in Yemen and similar contexts, ultimately supporting more effective and sustainable solutions.

## REFERENCES

- Al-Absi, N., Hayajneh, M., & Al-Khateeb, W. (2018). Supply chain management practices in Yemen: An empirical study. *International Journal of Business and Management*, 13(8), 72–84.
- Al-Khateeb, W., Hayajneh, M., & Al-Absi, N. (2020). Supply chain management in Yemen: Challenges and future research directions. *Journal of Applied Research in Business and Management*, 3(1), 1–12.
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99–120.
- Chopra, S., & Meindl, P. (2016). *Supply chain management: Strategy, planning, and operation* (6th ed.). Pearson.
- Christopher, M. (2016). *Logistics and supply chain management* (5th ed.). Pearson UK.
- Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). Sage Publications.
- Gunasekaran, A., Papadopoulos, T., Dubey, R., Wamba, S. F., Childe, S. J., Hazen, B., & Akter, S. (2017). Big data and predictive analytics for supply chain and organizational performance. *Journal of Business Research*, 70, 308–317.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis* (7th ed.). Pearson.
- Huan, S. H., Sheoran, S. K., & Wang, G. (2004). A review and analysis of supply chain operations reference (SCOR) model. *Supply Chain Management: An International Journal*, 9(1), 23–29.



- Ivanov, D. (2020). *Digital supply chain management and technology to enhance resilience*. Springer Nature.
- Ivanov, D., & Dolgui, A. (2020). A digital supply chain twin for managing disruption risks and resilience. *International Journal of Production Research*, 58(7), 1–15.
- Kamble, S., Gunasekaran, A., & Arha, H. (2018). Understanding the blockchain technology adoption in supply chains. *Industrial Management & Data Systems*, 118(9), 1835–1857.
- Kshetri, N. (2018). Blockchain's roles in meeting key supply chain management objectives. *International Journal of Information Management*, 39, 80–89.
- Lambert, D. M., Cooper, M. C., & Pagh, J. D. (1998). Supply chain management: Implementation issues and research opportunities. *The International Journal of Logistics Management*, 9(2), 1–20.
- Li, X., Li, D., Wan, D., Vasilakos, A. V., & Lai, K. K. (2019). Smart supply chain management using IoT technologies. *IEEE Communications Magazine*, 55(11), 70–75.
- Maddulety, K., Srivastava, S. K., & Eerappa, R. (2021). IoT-enabled supply chain integration and performance. *Technological Forecasting and Social Change*, 166, 120672.
- Mentzer, J. T., DeWitt, W., Keebler, J. S., Min, S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business Logistics*, 22(2), 1–25.
- Porter, M. E. (1985). *Competitive advantage: Creating and sustaining superior performance*. Free Press.
- Sheffi, Y. (2005). *The resilient enterprise: Overcoming vulnerability for competitive advantage*. MIT Press.
- Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2007). *Designing and managing the supply chain*. McGraw-Hill.
- Subawa, S., Dwita, F., & Hafidzh, M. A. (2023). Lean manufacturing and its impact on supply chain performance. *JEMSI*, 9(2), 411–415.
- Tiwari, S., Wee, H. M., & Daryanto, Y. (2018). Big data analytics in supply chain management. *Computers & Industrial Engineering*, 114, 242–255.
- World Bank. (2017). *Yemen economic outlook*. World Bank Publications.
- World Bank. (2020). *Yemen development update: Coping with conflict*. World Bank.
- World Bank. (2022). *Logistics performance index report*. World Bank.
- World Economic Forum. (2020). *The future of supply chain*. WEF Publications.
- Zhu, Q., Sarkis, J., & Lai, K. H. (2012). Green supply chain management practices. *International Journal of Production Economics*, 140(1), 1–12.