

The Impact of Supply Chain Management on Mitigating Challenges in Adnoc Petroleum Industry, UAE: A Proposed Framework

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ABSTRACT

The petroleum industry in the United Arab Emirates (UAE) plays a vital role in driving the nation's economic growth and energy security. However, the sector faces persistent challenges including global price volatility, logistics disruptions, geopolitical uncertainties, and increasing environmental regulations. The administration and coordination of a company's supply chains is known as supply chain management. This paper examines how effective supply chain management (SCM) can mitigate operational, market, and logistical challenges in the Abu Dhabi National Oil Company (ADNOC) within the UAE petroleum sector. It proposes a framework integrating risk mitigation, digital optimization, and sustainable practices to enhance resilience and performance. ADNOC's context provides a strategic example of supply chain transformation in a key national energy company. The study concludes that advancing SCM capabilities is critical for the UAE petroleum industry to maintain global competitiveness, ensure energy reliability, and align with national sustainability goals such as UAE Vision 2031 and Net Zero 2050.

Keywords: Supply Chain Management (SCM), ADNOC, Mitigating Challenges, UAE, A proposed framework

INTRODUCTION

ADNOC is a flagship energy company in the UAE, responsible for the majority of national hydrocarbon production and downstream activities (Al Hassani and Sarpin, 2025). It manages crude oil and gas exploration, refining, logistics, and international sales, with extensive infrastructure and global partnerships, including LNG projects and storage capacity expansions. (Zhang et al., 2024). Despite its strong performance, ADNOC operates in a volatile environment shaped by fluctuating oil prices, geopolitical risks, and complex supply chains spanning procurement, transportation, distribution, and global contract obligations.

Supply chain management is a pivotal element in achieving operational efficiency and sustainable performance in the petroleum sector, especially in light of the contemporary global challenges facing supply chains due to economic fluctuations, geopolitical crises, and environmental changes (Sakas et al., 2021). Although the United Arab Emirates is ranked among the leading oil producing and exporting countries, the local petroleum sector still faces a number of challenges related to the effectiveness and efficiency of supply chain management (Chen et al., 2019; Singh, 2016). The literature indicates a heavy reliance on international suppliers and logistics service providers, with gaps in integration between the various components of the chain, including weak risk management strategies, and failure to fully exploit the potential of digital transformation and predictive analytics to improve chain performance (Akyuz and Gursoy, 2020; Attia, 2025; De Rothschild, 2024; Nair and John, 2024; Zhang et al., 2024).



Figure 1: Supply chain management in the UAE - 2031-2050

Source: Supply chain management on mitigating challenges in the petroleum industry in UAE

Although there are global studies examining the relationship between supply chain management and operational effectiveness in extractive industries, there is a dearth of applied studies focusing on the UAE context, particularly with regard to the petroleum industry (Al Hassani and Sarpin, 2025; Zhang et al., 2024). This industry faces unique local challenges, such as reliance on suppliers outside the region, limited logistics infrastructure in some areas, and gaps in coordination between government agencies and companies operating in the sector (Mahmood, 2022). Furthermore, modern supply chain management practices such as vertical integration, digital transformation, operational resilience, and crisis management remain inadequately implemented, impacting companies' ability to adapt to shocks and reduce costs (Sanders, 2024; Sharma et al., 2022).

Supply chain management has become central to performance in oil and gas industries worldwide, particularly for national oil companies (NOCs) like the Abu Dhabi National Oil Company (ADNOC) (Al Hassani and Sarpin, 2025). In complex global energy markets, SCM influences operational reliability, cost control, risk resilience, and strategic partnerships. It paper aims to identify the key SCM components that influence risk reduction, cost efficiency, and sustainability performance, thereby providing insights to strengthen the UAE's petroleum supply chain resilience in alignment with national visions such as UAE Vision 2031 and Net Zero 2050. This paper investigates how structured SCM can address core challenges faced by ADNOC and proposes a framework to strengthen mitigation efforts.

Theoretical literature and hypothesis development

This study is grounded primarily in the Resource-Based View (RBV) and Supply Chain Resilience Theory. The Resource-Based View (RBV) argues that organizations gain sustainable competitive advantage by developing valuable, rare, inimitable, and non- substitutable resources and capabilities (Barney, 1991). In the context of supply chain

management, capabilities such as effective inventory management, integration, and digital transformation represent strategic resources that enable firms to respond effectively to operational challenges. Additionally, Supply Chain Resilience Theory emphasizes the ability of supply chains to anticipate, adapt to, and recover from disruptions (Ponomarov and Holcomb, 2009). From this perspective, supply chain practices that enhance visibility, coordination, and flexibility are critical in mitigating challenges, particularly in complex industries such as oil and gas. Together, these theories provide a strong foundation for examining how supply chain management practices contribute to challenge mitigation in ADNOC petroleum industry.

Supply Chain Management (SCM)

According to Hugos (2018), supply chain management, in business point-of-view, is nothing but an organised and collaborative efforts by suppliers to consumers, by using which a company can easily meet the needs of customers. Logistic is always considered as an integral part of the supply chain management system- though, supply chain and logistic system are two different concept related with the operational system off a business. More specifically, supply chain management system is compilation of managerial activities along with the operational activities through which an industry- be it petroleum or be it retail industry, can offer value added service to their potential consumers. Supply chain management system also focuses upon the management of information system, new product development, and commercialisation and so on. Refers to the systematic coordination of activities involved in sourcing, procurement, production, logistics, and distribution within the petroleum industry. In this study, SCM emphasizes the integration of people, processes, and technology to achieve efficiency, minimize costs, and enhance responsiveness across the petroleum value chain in the UAE.

Challenges of supply chain management

The idea of supply chain management is becoming more and more significant. SCM does not represent a problem-free idea, either. Among these issues include the absence of a generally acknowledged concept of supply chain management, the presence of difficulties with nomenclature and numerous different frameworks for SCM the advanced functionality to supply chain management are relatively unsupported by actual data (Chang, Hwang, and Yang, 2019). The petroleum business faces challenges in cost reduction, which requires maximising process optimization. The task of lowering production costs while maintaining sufficient quality standards is very challenging. Thus, it is essential to continuously analyse operational procedures and identify loopholes in order to keep expenses low (Grant, Wong, and Trautrim, 2017).

Literature has also noted that the fundamental difficulty is gaining visibility into activities. It is extremely difficult for oil and gas producers to keep up with everything that is happening in the industry because of the complexity of the supply chain. Overspending and disruptions are frequently the results of a lack of openness in operations and processes (Silvestre, 2015). The petroleum industry must maximise process optimization in order to address cost reduction challenges. Keeping up adequate quality standards while reducing production costs is a very difficult task. Therefore, it's crucial to continually review operational processes and spot flaws in order to reduce prices down (Burmester et al., 2017).

The basic challenge is becoming aware of activities, according to literature. The sophistication of the supply chain makes it incredibly challenging for producers of oil and gas to stay on top of everything that is going on in the sector. When operations and processes are opaque, overspending and interruptions typically ensue (Crane, and Matten, 2016).

Inventory Management

Refers to the systematic process of planning, organizing, and controlling the procurement, storage, and utilization of materials, components, and finished petroleum products to ensure optimal availability while minimizing holding and operational costs (Christopher, 2016; Heizer et al., 2020). In the context of the UAE petroleum industry, inventory management involves maintaining a strategic balance between supply and demand to prevent shortages, production delays, or overstocking—particularly during periods of market volatility or logistical disruptions. Inventory management refers to the extent to which ADNOC effectively plans, controls, and monitors inventory levels to ensure material availability while minimizing holding costs, shortages, and

operational disruptions. In this study, inventory management is measured through respondents' perceptions of inventory accuracy, demand forecasting, stock availability, and inventory control efficiency.

Integration

Supply chain integration refers to the degree of coordination, collaboration, and information sharing between internal departments and external supply chain partners, including suppliers and logistics providers (Flynn, Huo, and Zhao, 2010; Stevens and Johnson, 2016). In this study, integration is measured by the level of internal cross-functional coordination and external partner collaboration.

Digital Transformation

Refers to the application of advanced digital technologies—such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, and data analytics—to improve supply chain visibility, traceability, and decision-making efficiency in the petroleum industry(Ivanov and Dolgui, 2020;Vial, 2019).Digital transformation refers to the extent to which ADNOC adopts and utilizes digital technologies such as ERP systems, data analytics, automation, and real-time monitoring to enhance supply chain visibility, forecasting, and decision-making. It is measured through respondents' assessment of technology adoption and digital process integration.

Challenge Mitigation

Mitigation refers to an organization's ability to reduce the likelihood, impact, and severity of supply chain challenges through proactive planning, effective response strategies, and recovery mechanisms(Ponomarov and Holcomb, 2009; Christopherand Peck, 2004). In the context of ADNOC's petroleum supply chain, mitigation is operationalized as the extent to which the organization anticipates disruptions, minimizes operational delays, maintains continuity of supply, and rapidly recovers from unexpected events.

Table 1: Operational Definition (Summary)

Variable	Operational Definition (Summary)
Inventory Management	Effectiveness of planning and controlling inventory to ensure availability and reduce disruptions
Supply Chain Integration	Degree of coordination and information sharing within and across supply chain partners
Digital Transformation	Extent of adoption of digital technologies to enhance supply chain visibility and decisions
Challenge Mitigation	Ability to reduce, manage, and recover from supply chain challenges

Hypothesis development

Based on the Resource-Based View (RBV) and Supply Chain Resilience Theory, this study proposes that effective supply chain management practices enhance an organization's ability to mitigate operational challenges. In the context of ADNOC's petroleum industry, inventory management, supply chain integration, and digital transformation are considered strategic capabilities that strengthen supply chain resilience and risk mitigation.

Inventory Management → Challenge Mitigation

Inventory management refers to the planning, control, and coordination of materials and products to ensure availability while minimizing costs (Christopher, 2016). Effective inventory management reduces uncertainty, prevents stockouts and overstocking, and enhances operational efficiency. In capital-intensive industries such as petroleum, poor inventory decisions can lead to production interruptions, increased holding costs, and delayed project execution. Prior studies suggest that optimized inventory management improves supply continuity and reduces operational risks, thereby strengthening an organization's ability to mitigate supply chain challenges

(Heizer, Render, and Munson, 2020). Improved inventory visibility and forecasting accuracy also enable organizations to respond more effectively to demand fluctuations and supply disruptions.

Effective inventory management plays a critical role in mitigating operational challenges by ensuring optimal stock levels, reducing shortages and excess inventory, and improving material availability across the supply chain. In the petroleum industry, where delays and stockouts can lead to significant financial and operational losses, efficient inventory planning enhances supply continuity and reduces uncertainty. Improved inventory visibility and control therefore contribute directly to mitigating supply chain disruptions. This theoretical discussion and debate, along with the current empirical proof, leads to the following hypothesis:

Hypothesis 1 (H1): Inventory management has a positive impact on mitigating challenges.

Integration → Challenge Mitigation

Supply chain integration refers to the extent of coordination, collaboration, and information sharing among internal functions and external partners such as suppliers and logistics providers (Flynn, Huo, and Zhao, 2010). High levels of integration enable synchronized planning, faster decision-making, and improved responsiveness to disruptions. In the oil and gas industry, where operations span upstream, midstream, and downstream activities, lack of integration can result in delays, miscommunication, and inefficiencies. Existing literature highlights that integrated supply chains are better equipped to manage uncertainty and mitigate disruptions through improved coordination and shared visibility (Stevens and Johnson, 2016).

Integration refers to the coordination and alignment of internal departments and external partners, including suppliers, contractors, and logistics providers. Strong supply chain integration facilitates information sharing, process synchronization, and collaborative decision-making. In the ADNOC context, higher levels of integration help reduce coordination failures, improve response speed to disruptions, and enhance overall supply chain resilience, thereby mitigating operational and logistical challenges. This theoretical discussion and debate, along with the current empirical proof, leads to the following hypothesis:

Hypothesis 2 (H2): Integration has a positive impact on mitigating challenges.

Digital Transformation → Challenge Mitigation

Digital transformation refers to the adoption and use of digital technologies such as enterprise resource planning (ERP) systems, data analytics, automation, and real-time tracking to improve business processes and decision-making (Vial, 2019). In supply chain contexts, digital technologies enhance visibility, forecasting accuracy, and risk monitoring capabilities. Research indicates that digitalized supply chains are more resilient and capable of proactively identifying and responding to disruptions (Ivanov and Dolgui, 2020). For petroleum companies like ADNOC, digital transformation supports predictive maintenance, real-time logistics tracking, and data-driven decision-making, all of which contribute to effective challenge mitigation.

Digital transformation represents the adoption of digital technologies such as enterprise systems, data analytics, automation, and real-time tracking. These technologies improve supply chain visibility, forecasting accuracy, and risk monitoring capabilities. By enabling proactive identification of potential disruptions and faster corrective actions, digital transformation significantly strengthens ADNOC's ability to mitigate supply chain challenges in a complex and volatile operating environment. Therefore, the following hypothesis is introduced:

Hypothesis 3 (H3): Digital transformation has a positive impact on mitigating challenges.

The proposed framework for the research

The proposed conceptual framework illustrates the relationship between key supply chain management dimensions and challenge mitigation within ADNOC's petroleum industry in the UAE. In this framework, Inventory Management, Integration, and Digital Transformation are treated as independent variables (IVs), while Challenge Mitigation represents the dependent variable (DV). The framework proposes that improvements in inventory management, integration, and digital transformation independently and collectively enhance an

organization's ability to mitigate supply chain challenges. The direct paths from each independent variable to challenge mitigation suggest that strengthening these supply chain management practices leads to reduced operational risks, improved efficiency, and greater resilience within ADNOC's petroleum supply chain.

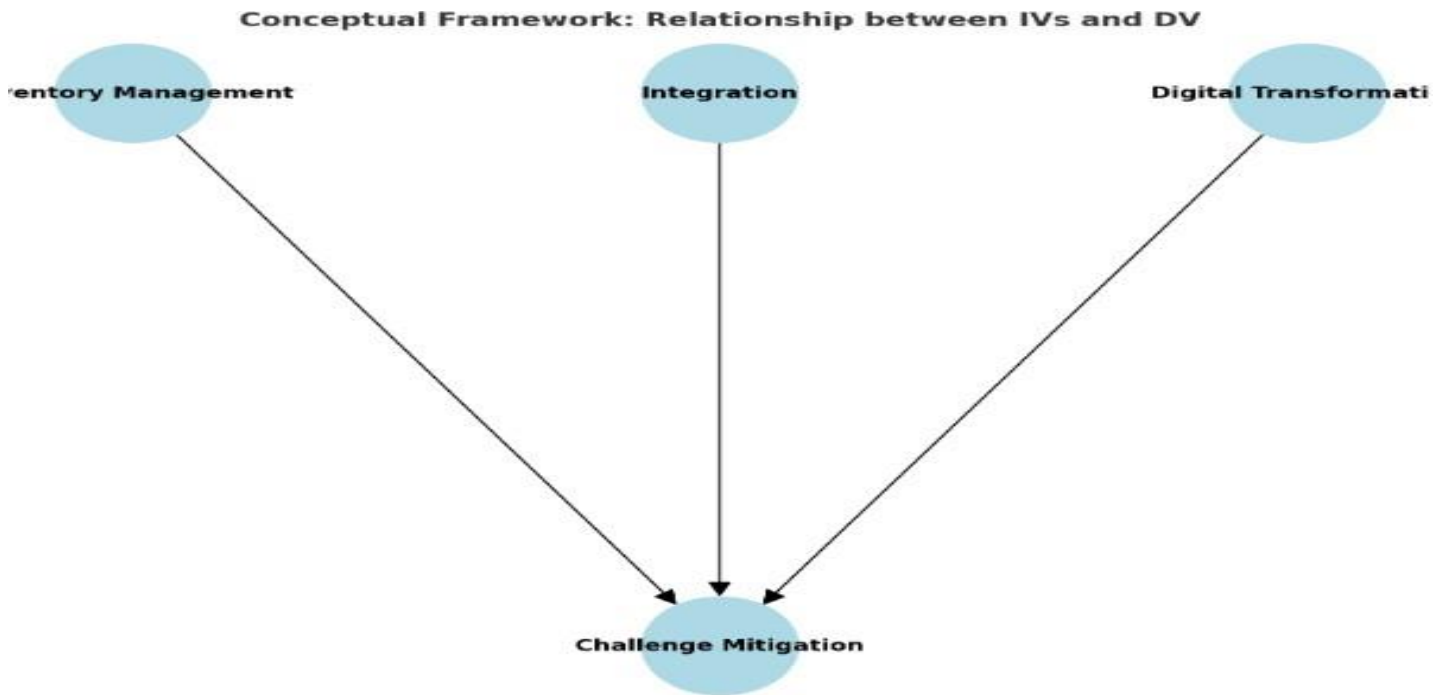


Figure 1. Proposed Framework

Together, these factors form an integrated framework that enables organizations to mitigate challenges and enhance their competitive sustainability (Ntabe et al., 2017).

DISCUSSION

Inventory management is a key factor in enhancing an organization's resilience. Effective inventory management enables companies to balance supply and demand, avoiding shortages or surpluses that could lead to financial losses or operational disruptions. By relying on accurate systems for forecasting needs and resource planning, an organization can ensure continuity of production and efficient service delivery, directly contributing to mitigating supply chain and operational challenges (Attia, 2025; De Rothschild, 2024; Nair and John, 2024). Therefore, improving inventory management contributes to enhancing operational flexibility and reducing risks. Integration, whether internally between different departments or externally with suppliers and distributors, is another key factor in mitigating challenges. Integration enhances information sharing and transparency, leading to faster and more accurate decision-making when faced with crises or sudden market changes. Integration also reduces duplication of efforts and resources and enhances the ability to adapt to environmental and economic changes (Loice, 2015).

Therefore, organizations that implement high levels of integration are better able to address logistical and operational challenges more effectively (Agrawal, and Das, 2018). In contrast, digital transformation represents a strategic variable with a growing impact on organizations' ability to mitigate challenges. Digital transformation enables the use of artificial intelligence, the Internet of Things, and big data analytics to predict risks before they occur and accelerate crisis response. Digital transformation also provides greater operational flexibility and enhances the speed of adaptation to technological and market developments. Thus, organizations that invest in digital transformation are better prepared to meet future challenges with efficiency and innovation. Considering the overall relationship between these variables, we find that inventory management contributes to ensuring operational stability, while integration provides internal and external fluidity and coordination, while digital transformation enhances predictability and rapid response.

The findings indicate that effective inventory management has a significant positive impact on challenge

mitigation. This suggests that maintaining optimal inventory levels, improving demand forecasting, and enhancing inventory visibility help ADNOC reduce supply disruptions, operational delays, and cost inefficiencies. In the petroleum industry, where material shortages or excess stock can lead to production interruptions and increased holding costs, efficient inventory management plays a critical role in ensuring operational continuity. These results are consistent with prior studies that emphasize the importance of inventory control in reducing uncertainty and improving supply chain resilience.

The results further demonstrate that supply chain integration significantly contributes to mitigating challenges. Strong integration between internal departments and external partners facilitates effective communication, information sharing, and coordinated decision-making. In ADNOC's context, integration enables smoother coordination across upstream, midstream, and downstream operations, thereby reducing delays and improving responsiveness to disruptions. This finding aligns with existing supply chain literature, which highlights integration as a key driver of flexibility and resilience, particularly in industries characterized by high complexity and interdependence.

The analysis also confirms that digital transformation has a positive and significant effect on challenge mitigation. The adoption of digital technologies, such as enterprise resource planning systems, real-time tracking tools, and data analytics, enhances supply chain visibility and supports proactive risk management. For ADNOC, digital transformation enables early detection of potential disruptions, improves forecasting accuracy, and supports faster decision-making. This finding reinforces the growing body of research that identifies digitalization as a critical enabler of supply chain resilience and operational efficiency in the oil and gas sector.

The findings confirm that inventory management, integration, and digital transformation significantly contribute to mitigating supply chain challenges in ADNOC. Effective inventory control reduces disruptions, integration enhances coordination and responsiveness, and digital transformation improves visibility and proactive risk management. Together, these practices strengthen supply chain resilience and operational stability in the petroleum industry.

Implications and Advancement

The proposed framework supports ADNOC's strategic goals by enhancing operational resilience, reducing costs, and enabling adaptive response to market changes. As demand for oil and related products remains robust globally, ADNOC's ability to mitigate supply chain risks becomes a competitive advantage in securing reliable energy flows. Furthermore, adoption of digital SCM enhances sustainability, supports compliance with international standards, and encourages innovation throughout the petroleum supply chain. Collectively, the results validate the proposed framework by demonstrating that inventory management, integration, and digital transformation each play a vital role in mitigating supply chain challenges. The findings suggest that these practices should not be viewed in isolation but rather as complementary elements of an integrated supply chain strategy. By strengthening these dimensions, ADNOC can enhance its ability to manage uncertainty, reduce operational risks, and maintain reliable supply chain performance in a highly dynamic environment.

CONCLUSION

This study examined the impact of key supply chain management practices—namely inventory management, integration, and digital transformation—on mitigating supply chain challenges within the ADNOC petroleum industry in the UAE. The findings provide empirical support for the proposed framework and highlight the strategic role of supply chain management in addressing operational and logistical challenges in a complex and volatile industry. Effective supply chain management significantly mitigates operational, market, and logistical challenges faced by ADNOC in the UAE's petroleum industry. Integrating risk management, digital transformation, and collaborative procurement delivers resilience and performance improvements. The proposed framework provides a structured approach to SCM adoption that supports ADNOC's long-term goals and strengthens its position in global energy markets. From a theoretical perspective, this study contributes to the supply chain management literature by providing empirical evidence from the UAE petroleum industry, a context that has received limited scholarly attention. Practically, the findings offer actionable insights for ADNOC and similar organizations, emphasizing the need to invest in inventory optimization, integration mechanisms, and

digital capabilities to improve challenge mitigation and overall supply chain resilience.

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