INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 14, Issue 10, (2024) E-ISSN: 2222-6990

Effect of Competitiveness the Factors on VUCA Supply Chain Performance in Jordan

Mohannad Ahmad Almomani
Ph.D. Student, School of Management, Universiti Sains Malaysia,11800 Penang, Malaysia,
Email: moh.momani@student.usm.my

Dr. Khai Wah Khaw
School of Management, Universiti Sains Malaysia,11800 Penang, Malaysia
Email: khaiwah@usm.my

To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v14-i10/22938 DOI:10.6007/IJARBSS/v14-i10/22938

Published Date: 05 October 2024

Abstract

This study investigates the impact of competitiveness factors on VUCA supply chain performance in Jordan's engineering, electrical, and information technology sectors. The objective is to explore how technological innovation, strategic alliances, and organizational agility influence supply chain performance in volatile and unpredictable environments. Motivated by the increasing complexities of global supply chains and the specific challenges faced by Jordanian industries, this research aims to provide insights into the role of competitiveness in enhancing supply chain resilience and sustainability. This paper adopts a quantitative approach, utilizing a structured electronic questionnaire distributed to companies across these key sectors. The population includes 391 firms with 31,725 employees, and a stratified random sample of 328 respondents was collected. Data were analyzed using SPSS version 29.0 for initial data validation and Smart PLS 4 for structural equation modeling (SEM), enabling the evaluation of relationships between competitiveness factors and VUCA performance. Results reveal that competitiveness factors have a significant positive effect on managing supply chain volatility, enhancing firms' ability to remain agile and responsive. However, the influence of competitiveness on uncertainty, complexity, and ambiguity was less pronounced, indicating that additional strategies, such as risk management and digital integration, are necessary to address these specific challenges. The study contributes to the understanding of supply chain dynamics in VUCA environments and highlights the need for comprehensive strategies combining competitiveness with sustainability and resilience.

Keywords: Supply Chain Resilience, Technological Innovation, Organizational Agility, Strategic Partnerships, and Digital Transformation

Introduction

In the context of today's rapidly evolving global marketplace, the VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) framework has become increasingly relevant for understanding supply chain dynamics. This framework poses both challenges and opportunities for businesses, particularly in Jordan's engineering, electrical, and information technology sectors, industries integral to the country's economic development (Al Obaidy et al., 2024; Aloqaily and Al-Zaqeba, 2024). These sectors must navigate complex geopolitical and economic landscapes, necessitating a focus on competitiveness factors such as technological innovation, strategic alliances, and organizational agility to enhance supply chain performance within VUCA conditions. The Jordanian market exemplifies the intricacies of operating within a VUCA environment, compelling industries to innovate and adapt to changing market conditions (Jebril et al., 2024). While there is some understanding of how competitiveness factors can mitigate VUCA-related challenges in global contexts, their specific impacts on Jordan's supply chain performance remain underexplored (Shubailat et al., 2024). This gap in the literature indicates the need for focused research to determine how such factors influence volatility, uncertainty, complexity, and ambiguity in supply chain operations. Initial findings suggest that technological innovation, coupled with strategic partnerships and enhanced organizational agility, can improve resilience and sustainability in the face of VUCA elements (Al-Zaqeba et al., 2024). By delving into these dynamics, this study aims to provide strategic insights, enabling Jordanian industries to bolster their global competitiveness (Al-Zaqeba and Basheti, 2024a). Although the study is specifically tailored to Jordan’s socio-economic context, its conclusions could offer valuable implications for similar geographic regions, enhancing both local and international literature on supply chain management. Additionally, the COVID-19 pandemic has underscored the critical need for strategic changes in supply chain management, prompting a reevaluation of established human resource strategies that often proved insufficient in the face of new challenges (Jarah et al., 2024). As businesses grapple with these transformations, the capacity to manage supply chain risks through redundancy and integrated logistics services becomes essential (Collings et al., 2021). The engineering industries in Jordan, due to their diverse and complex nature, stand at the forefront of this transformative shift, necessitating efficient digital integration to maintain agility and responsiveness (Mia and Yassin, 2018). However, this paper seeks to bridge the existing gap in the literature concerning the interplay between supply chain factors and VUCA conditions, in addition to enhance practical understanding and application within the sector. By focusing on the unique industrial and digital landscapes of Jordan, this study will contribute significantly to improving supply chain competitiveness and resilience in a rapidly changing global economy.

This paper contributes to enhancing theoretical understanding and providing a comprehensive view of supply chain dynamics in challenging environments and offering practical recommendations based on theoretical insights to facilitate sound decision-making related to supply chain management, helping companies identify areas for improvement allowing companies to invest in expansion and innovation, address future challenges efficiently, and implement strategies to effectively strengthen their supply chains.

The motivation of this paper is to understand how competitive factors affect performance in difficult environments, in light of the rapid changes witnessed by global markets, there is a need to study the relationship between these factors and their impact on corporate strategies in order to develop strategic flexibility, develop capabilities, and meet all customer needs at the lowest cost, shortest time, and highest quality, which enhances business activity in the region.

The structure of this paper is designed to systematically explore the relationship between supply chain factors and VUCA supply chain performance, specifically within the context of Jordan's engineering, electrical, and information technology sectors. We begin with an Introduction that outlines the research problem, objectives, and significance of the study. Following this, the Literature Review provides a comprehensive examination of existing research related to supply chain factors and VUCA dynamics, with sections dedicated to elaborating on the essence and implications of VUCA supply chain performance. Within this review, subsections delve into the underpinning theories, notably the Resource-Based View (RBV) Theory, providing a theoretical foundation for understanding supply chain dynamics. The following section on Hypothesis Development elaborates on the proposed connections between supply chain factors and VUCA supply chain performance, setting the stage for empirical testing. The Methods section details the methodological approach of the study, including data collection strategies, population, sampling techniques, sample size, and the overall design for obtaining and analyzing data. In the analysis phase, the Measurement Model segment covers the evaluation of convergent and discriminant validity, while the Structural Model addresses the tests for hypothesized relationships using Partial Least Squares (PLS4). Finally, the Discussion interprets the findings in light of the research objectives and theoretical framework, leading to the Conclusion, which summarizes the key insights, implications for practice, and potential directions for future research.

Literature Review

Competitiveness factors play a pivotal role in addressing volatility, uncertainty, complexity, and ambiguity (VUCA) in supply chains, especially in dynamic economic sectors in Jordan such as engineering, electricity, and information technology. These factors, including technological innovation, supplier relationships, and strategic flexibility, are essential in enhancing supply chain resilience and performance (Ababneh et al., 2024; Al Obaidy et al., 2024; Jarah et al., 2024). In VUCA environments, organizations must not only adapt to rapid market changes but also leverage their competitive strengths to mitigate risks (Razzak et al., 2024; Shubailat et al., 2024). Several studies have explored various aspects of supply chain management and related fields, providing valuable insights that can inform current discussions on competitiveness and VUCA environments. Ababneh et al (2024), and Ahmad et al (2024), emphasize the role of human resources management in enhancing total quality management within both public and private sectors in Jordan. Additionally, Al-Zaqeba and Basheti (2024), address the challenges related to measurement issues in interest-free financial instruments, while their other work (Al-Zaqeba & Basheti, 2024a) evaluates the impact of customs policy on supply chain performance. In parallel, Lootah (2024), explores how blockchain technology affects financial reporting practices in the UAE, and Maabreh (2024), investigates the role of financial technology (Fintech) in promoting financial inclusion. Other relevant studies, such as those by Shboul et al (2024), examine the moderating role of digital leadership in public sector educational performance, while Shubailat et al. (2024C) focus on customs strategies' effects on environmental responsibility in Jordanian supply chain management. Furthermore, Shubailat et al (2024), analyze the improvement of estate governance in Jordan through the use of blockchain technology, highlighting its potential in enhancing management practices.

Collectively, these studies provide a comprehensive overview of the multifaceted elements influencing supply chains, governance, and financial systems in the modern economy. Previous studies confirm that companies with strong supply chain management practices, such as lean inventory management and collaborative partnerships with suppliers, are better equipped to respond to the challenges of VUCA (Al-Taani et al., 2024; Al-Zaqeba & Basheti, 2024a). However, some studies suggest that competitiveness alone may not be sufficient and needs to be complemented with risk management and digital integration strategies to fully address VUCA challenges (Al Rousan, 2024; Aloqaily & Al-Zaqeba, 2024). A literature review addressing these various perspectives is presented in the following subsections.

Supply Chain Performance

The concept of VUCA (Volatile, Uncertain, Complex, and Ambiguous) originated from the U.S. Army War College, describing the unpredictable and unstable post-Cold War world (U.S. Army War College, 2019). This framework was later adopted by strategic business leaders to navigate the chaotic and rapidly evolving business environment (Cameron et al., 2022). Recently, its scope has broadened to include education, as reflected in policy documents like OECD 2030, which stress the need for students to develop competencies to thrive in a VUCA world (OECD, 2018; UNESCO, 2019). This shift underscores the growing recognition of VUCA dynamics across various domains, emphasizing the necessity for adaptability and preparedness in facing contemporary challenges. In parallel, the measurement of performance in organizations, particularly within supply chains, has become crucial for strategic management and operational success. Performance indicators, including inventory levels, cycle durations, and financial metrics, are vital for tracking outcomes and informing decision-making processes (Wouters, 2009; Gunasekaran et al., 2014). Martin et al. (2009) identify these metrics as essential for enhancing a company's success, impacting various facets of supply chain interactions such as organizational structure and supplier agreements. Tools developed to assess supply chain performance, like those by Banomyong and Supatn (2011), offer frameworks for evaluating core operations, thereby enhancing a company's strategic and operational capabilities.

The necessity of resilience within supply chains has been brought into sharp focus by global disruptions like the COVID-19 pandemic, which highlighted vulnerabilities and emphasized the importance of adaptability and recovery. As supply chains face unprecedented challenges, the concept of resilience, defined as the ability to anticipate, absorb, recover, and adapt to adverse events, has become central to ensuring operational continuity (National Research Council, 2012; Golan et al., 2020). Technologies from the Fourth Industrial Revolution, such as advanced analytics and digital platforms, offer significant potential in enhancing supply chain resilience by improving decision-making and adaptability (Farooq et al., 2021). Moreover, while strategies like sustainability and leanness are integral to supply chain efficiency, resilience specifically targets the recovery and adaptation phases post-disruption. This is particularly critical in sectors like food supply, where disruptions can have far-reaching consequences across interconnected networks, including transportation and logistics systems (Hofmann et al., 2014; Sarkis et al., 2020). Establishing standardized definitions, metrics, and models of resilience is therefore essential in equipping decision-makers with the tools needed to maintain stability and continuity in VUCA environments (Golan et al., 2020). However, the integration of VUCA into strategic frameworks across various fields signifies a broadened understanding of the complexities in today's global landscapes. As organizations seek to thrive amid volatility, the adoption of robust performance measurement tools and the cultivation of resilience are indispensable in achieving long-term sustainability and competitive advantage.

Supply Chain Factors

Supply Chain Management (SCM) practices encompass a comprehensive set of actions aimed at enhancing the efficiency and coherence of internal supply chains. Integral to this process is the optimization of customer relationships and supplier partnerships, underscored by effective outsourcing, reduction of process cycles, and continuous flow of processes, facilitated by technology and information sharing (Centobelli et al., 2022). These practices are pivotal in ensuring that businesses maintain a competitive edge through efficient supply base management, which involves the strategic use of suppliers' methods, technologies, and capabilities (Al Obaidy et al., 2024). This orchestration of manufacturing, logistics, materials, and distribution constitutes the essence of SCM, highlighting its role in aligning intra-business functions for maximal efficiency and effectiveness (Jebril et al., 2024).

SCM factors, defined as methodologies for managing supply, demand, and inter-organizational relationships, aim to deliver services that are as profitable as they are efficient. Patrucco et al (2022), underscore the importance of supplier evaluation systems, which help organizations identify specific issues within their supply chains and develop targeted corrective strategies. This meticulous approach is complemented by Sutduean et al (2019), exploration of strategic partnerships, which emphasizes the significance of sustained communication, cross-functional teamwork, and active vendor participation in strengthening buyer-supplier relationships (Shubailat et al., 2024). The theoretical framework of SCM factors thus provides an essential foundation for understanding their profound impact on various supply chain performance dimensions, especially in complex and dynamic supply networks (Aloqaily & Al-Zaqeba, 2024).

The broad spectrum of supply chain factors encompasses strategies such as supply chain planning, supplier relationship management, and logistics and inventory management. Each component contributes uniquely to the supply chain ecosystem: supply chain planning optimizes the flow of goods and resources, supplier relationship management fosters beneficial partnerships, and logistics and transportation management ensure the efficient movement of goods (Al-Zaqeba et al., 2024D). These elements collectively enhance demand management strategies, thereby enabling organizations to foresee and meet customer demands effectively. The strategic alignment of these factors not only reduces costs related to inventory and transportation but also optimizes overall process efficiency, driving profitability and competitive advantage. Moreover, the critical nature of SCM factors extends across industries including manufacturing, retail, healthcare, and agriculture. Each sector faces distinct challenges that SCM factors help ameliorate, such as optimizing production processes in manufacturing, ensuring last-mile efficiency in retail, and maintaining supply chain integrity in healthcare (Jebril et al., 2024). Effective SCM contributes to enhanced customer satisfaction by ensuring timely deliveries and superior product quality, thus building robust customer relationships. Additionally, robust SCM practices bolster operational resilience, empowering organizations to navigate disruptions with agility and maintain operational continuity (Al-Zaqeba and Basheti, 2024a). Through these mechanisms, SCM factors not only facilitate survival but also leverage strategic advantages in increasingly competitive global markets.

Empirical studies underscore the positive correlation between effective supply chain practices and improved organizational performance metrics. Lambert and Cooper (2000) illustrated the role of SCM in boosting financial results and customer satisfaction. Further, Li et al. (2018) and Mentzer et al (2001), highlighted the significant benefits of well-organized supply chain planning and logistics management in achieving operational excellence and gaining a competitive edge (Al Obaidy et al., 2024). Therefore, across varied industrial contexts, SCM factors are instrumental in fostering enhanced performance outcomes, demonstrating their indispensability in both the strategic and operational spectrums of contemporary business practice.

VUCA Supply Chain Performance

VUCA supply chain performance has emerged as a critical focus in the modern business landscape, reflecting a company's ability to navigate volatile, uncertain, complex, and ambiguous environments effectively Al-Zaqeba and Basheti, 2024a; Jarah et al., 2024). Such environments demand rapid adaptation to disruptions, dynamic demands, and external challenges, emphasizing the importance of resilience and strategic agility. Singh and Garg (2021), highlight that leveraging digital tools and fostering agility can significantly enhance supply chain outcomes under VUCA conditions. Their study underscores the necessity of digital technologies and agile practices as essential strategies to maintain operational efficiency and competitiveness in today's unpredictable markets. The VUCA framework, established to describe the unpredictable nature of contemporary business environments, presents substantial challenges for supply chain managers. As Mohanta et al (2020), note, organizations operating under these conditions must adeptly respond to rapid changes and manage complex supply networks. The capability to adapt and maintain resilience is crucial for achieving operational excellence and sustaining a competitive advantage. This adaptability is further complicated by the rapid technological and economic changes that redefine how businesses operate (Carvalho et al., 2021). Additionally, Rana et al (2020), examined how supply chain agility affects performance within VUCA settings. They found that companies with increased agility are better equipped to manage the inherent unpredictability, leading to improved performance. This highlights the integral role of adaptability in navigating the uncertainties that characterize VUCA environments.

The influence of VUCA extends beyond organizational performance to impact job markets and employment structures. Marrelli et al (2012), and Beck (1992), discuss how the rapid changes and associated risks brought about by modern technology and economic shifts necessitate a prepared and adaptable workforce. This perspective underscores the broader implications of VUCA conditions, necessitating strategies that enhance resilience and adaptability not only within organizations but also among individuals navigating the job market. Ultimately, understanding and managing VUCA supply chain performance is indispensable for businesses aiming to thrive in a rapidly changing world. It requires a strategic integration of agility and resilience into supply chain practices, ensuring that organizations can effectively respond to and recover from disruptions, maintain operational continuity, and secure a competitive edge in global markets. This ongoing challenge highlights the need for continuous refinement of strategies to meet the demands of VUCA environments effectively.

VUCA
In the modern era, the concept of VUCA has become a pivotal framework to describe the increasingly unpredictable and challenging global landscape. Originally emerging in the post-Cold War period, VUCA gained prominence following the global financial crisis of 2008-2009, revealing the fragility and unpredictability of worldwide markets and competitive environments (Bennett and Lemoine, 2014). This framework has since been integral in business and management disciplines to analyze the challenges posed by rapid changes, intricate systems, and ambiguous situations, further exemplified during crises such as the COVID-19 pandemic and the ongoing Russia-Ukraine conflict (Ahmad et al., 2024; Shambach, 2014). Volatility refers to the frequent, intense, and unexpected changes in conditions. Events like climate change, which involves unpredictable environmental shifts, and pandemics like COVID-19 exemplify volatility by demonstrating how quickly and drastically circumstances can alter (Razzak et al., 2024). The uncertainty element in VUCA highlights the difficulty in predicting outcomes and responding effectively due to a lack of concrete information, as illustrated by the unpredictability surrounding climate change impacts and the spread of pandemics. Even as scientific understanding progresses, numerous variables remain uncertain, leaving societies susceptible to unforeseen risks (Sempiga and Van Liedekerke, 2023; Agrawal et al., 2018).

Complexity in a VUCA world is marked by the numerous interconnected factors that complicate problem-solving efforts. The COVID-19 pandemic's multifaceted impacts, ranging from health and economic disruptions to societal shifts illustrate this complexity (Mpofu et al., 2017; Romm, 2022). Moreover, the climate crisis involves diverse variables interacting in intricate ways, creating challenges that lack straightforward solutions (Dow and Downing, 2016). Ambiguity, the fourth component, pertains to the unclear understanding of events' meanings, where threats and opportunities are not fully comprehended, complicating decision-making processes. This ambiguity is seen in the varied interpretations of climate change impacts, driven by differing stakeholder perspectives and interests (Carroll, 2015; Habibzadeh et al., 2019; Shubailat et al., 2024C). The interconnectedness of these VUCA characteristics poses significant challenges for analysis, policy-making, and management. Navigating these complex environments requires strategic foresight and innovative solutions, particularly as societies face "wicked problems" characterized by their multifaceted, unresolved nature (Sempiga and Van Liedekerke, 2023). Addressing these challenges effectively demands adaptive and flexible strategies that can accommodate the inherent unpredictability and complexity of today's global issues (Ababneh et al., 2024; Al-Zaqeba and Basheti, 2024). Understanding and responding to the VUCA dynamics is crucial for both organizations and policymakers aiming to achieve resilience and success in a rapidly evolving world.

Theories
In exploring the impact of supply chain factors on VUCA supply chain performance within Jordan's engineering, electrical, and information technology sectors, the Resource-Based View (RBV) theory and Agility theory offer critical insights. The RBV theory posits that a firm's internal resources and capabilities, such as advanced technologies, skilled personnel, and strong relational networks, are vital for achieving a sustainable competitive advantage (Ahmad et al., 2024). According to this perspective, Jordanian firms can leverage their unique resources to develop robust supply chain strategies that enhance performance in a VUCA

environment. This involves utilizing resources like agile inventory management and collaborative supplier relationships to maintain responsiveness and mitigate risks associated with volatility and uncertainty (Al-Taani et al., 2024). Thus, the RBV theory provides a foundational framework for understanding how strategic resource management can drive superior supply chain performance.

Furthermore, the Agility theory emphasizes the necessity for companies to quickly adapt and respond to changes in a dynamic business environment, particularly in VUCA contexts. Agility is crucial as it enables organizations to cope with uncertainties, manage risks, and capitalize on emerging opportunities (Ababneh et al., 2024). For instance, practices such as agile manufacturing, sourcing, and logistics are essential for rapidly adjusting to fluctuating market demands and conditions, which is particularly relevant for sectors such as Jordan's engineering, electrical, and information technology industries (Razzak et al., 2024). By integrating agile processes, these companies enhance their ability to swiftly navigate VUCA challenges, thus improving their overall supply chain agility and resilience. In addition, RBV theory, when applied alongside Agility theory, underscores that to thrive in a VUCA world, organizations must not only harness their internal strengths but also cultivate flexibility and responsiveness (Shubailat et al., 2024C). For the Jordanian sectors under study, this means developing a dual approach that optimizes internal resources while simultaneously building agile capabilities. By doing so, these firms can better align their supply chain strategies with the unpredictable nature of their operating environment, thereby ensuring sustained competitiveness and operational efficiency (Al-Zaqeba and Basheti, 2024). These theories provide a comprehensive framework for analyzing how supply chain factors can enhance VUCA performance. They highlight the importance of both resource optimization and agility as crucial elements in managing supply chains amid volatility, uncertainty, complexity, and ambiguity. This dual-theoretical approach suggests that by strategically leveraging resources and maintaining agility, organizations can effectively adapt, survive, and thrive in VUCA environments. As such, these insights are pivotal for the Jordanian engineering, electrical, and information technology sectors seeking to strengthen their supply chains and secure a competitive edge in today's unpredictable global market.

Hypothesis Development

Supply chain factors (SCM) factors are widely recognized as critical factors in enhancing supply chain performance. In today's VUCA business environment, the impact of SCM factors on supply chain performance is expected to be more pronounced. Supply chain flexibility is an essential factor in improving VUCA supply chain performance. This hypothesis suggests that supply chain flexibility plays a mediating role in the relationship between SCM factors and VUCA supply chain performance. SCM factors are expected to enhance supply chain flexibility, which, in turn, improves VUCA supply chain performance. This hypothesis is supported by previous research. For example, research by Singhal et al. (2019) found that supply chain flexibility mediates the relationship between SCM factors and VUCA supply chain performance.

Effective SCM factors such as supplier relationship management, inventory management, and demand forecasting can enhance the agility, resilience, and responsiveness of supply chains, which are key attributes of VUCA supply chain performance. Several studies have supported this hypothesis. For example, research by Wong et al. (2020) found that supply chain agility, achieved through effective SCM factors, enhances VUCA supply chain performance. The relationship between SCM factors and VUCA supply chain performance is expected to be contingent on the level of VUCA. Specifically, the impact of SCM factors on supply chain performance is expected to be more significant in highly VUCA environments compared to less VUCA environments. This hypothesis is supported by previous research. For instance, research by Saghafian et al. (2019) found that the positive impact of SCM factors on supply chain performance is more significant in high VUCA environments.

The potential of BCT to completely transform supply chains' sustainability environment has been highlighted in a number of studies and research projects (Xie et al., 2023; Shujaat Mubarik et al., 2023). Supply chain with the potential to increase BCT's sustainability (Chang et al., 2022). The establishment of sustainable business models is facilitated by blockchain technology (Yontar, 2023). Furthermore, Paliwal et al (2020), claimed that blockchain technology might make supply chain sustainability possible. In a similar vein, Mukherjee et al. (2021), noted that the supply chain can become sustainable thanks to blockchain technology's contemporary capabilities. According to Singhal et al (2019), supply chain flexibility acts as a mediator in the association between VUCA supply chain performance and SCM parameters. Furthermore, Wong et al (2020), discovered that VUCA supply chain performance is improved by supply chain agility, which is attained through efficient SCM components. Saghafian et al. (2019) discovered that in high VUCA situations, the beneficial effects of SCM variables on supply chain performance are more pronounced. Grzybowska and Tubis (2022), found that the absence or limitation of trust hampers risk-taking and collaboration, underscoring the importance of fostering trust through shared values, mutual respect, and a conducive business environment. In addition, Grzybowska and Tubis (2022), indicate that overly fragmented supply chains often prioritize cost-efficiency and global dispersion, hindering seamless integration. Achieving integration is further complicated by the evolving landscape of global pandemics and geopolitical threats. According to Sohail et al (2022), supply chain resilience may be successfully attained by putting in place an appropriate risk management system, recognizing the opportunities, and measuring and reducing the risks before they materialize. In addition, Grzybowska and Tubis (2022), reflect that Insufficient expertise, particularly in network and complex thinking, leads to suboptimal management of supply chains, ultimately endangering the resilience of the system. Shujaat Mubarik et al (2023), found that further SC visibility help a firm optimize its supply chain processes to minimize waste. According to Wafiroh et al (2022), government organizations are encouraged to innovate in the digital transformation of HRM by the VUCA era. This innovation is crucial in establishing strategic and competitive advantages in human resources.

The implementation of effective SCM factors, such as supplier relationship management, inventory management, and demand forecasting, can enhance the agility, resilience, and responsiveness of supply chains, which are key attributes of VUCA supply chain performance. In addition, the relationship between SCM factors and VUCA supply chain performance is contingent on the level of VUCA. Specifically, the impact of SCM factors on supply chain performance is expected to be more significant in highly VUCA environments compared to less VUCA environments. However, the following hypotheses are proposed to investigate the relationship between SCM factors and VUCA supply chain performance, thus, the following are the hypothesized:

H1: Supply chain factors have a positive and significant effect on VUCA supply chain performance in the Jordanian engineering, electrical, and information technology industries sector.

Competitiveness factors are vital components influencing supply chain dynamics, particularly in the engineering, electrical, and information technology industries sector in Jordan. Singhal et al (2019), identified that supply chain flexibility, influenced by competitiveness factors such as supplier relationship management, inventory management, and demand forecasting, mediates the relationship between SCM factors and VUCA supply chain performance. Moreover, Wong et al (2020), demonstrated that effective SCM factors enhance VUCA supply chain performance by promoting agility, resilience, and responsiveness within the supply chain network. The significance of competitiveness factors in influencing VUCA supply chain performance is further underscored by Saghafian et al (2019), who found that the positive impact of SCM factors on supply chain performance is more pronounced in highly VUCA environments. Therefore, it is hypothesized that competitiveness factors positively and significantly affect VUCA supply chain performance in the Jordanian engineering, electrical, and information technology industries sector. thus, the following are the hypothesized:

H1.1: Competitiveness factors have a positive and significant effect on VUCA supply chain performance in the Jordanian engineering, electrical, and information technology industries sector.

Volatility represents a critical aspect of VUCA supply chain performance, reflecting the degree of instability and fluctuation within the supply chain environment. Competitiveness factors play a crucial role in mitigating volatility and enhancing supply chain resilience. Wong et al. (2020), highlighted that effective SCM factors contribute to supply chain agility, thereby mitigating the impact of volatility on supply chain performance. Therefore, based on the findings of Singhal et al (2019), and Wong et al (2020), it is hypothesized that competitiveness factors have a positive and significant effect on volatility supply chain performance in the Jordanian engineering, electrical, and information technology industries sector. Thus, the following are the hypothesized:

H1.1.1: Competitiveness factors have a positive and significant effect on Volatility supply chain performance in the Jordanian engineering, electrical, and information technology industries sector.

Uncertainty is another key dimension of VUCA supply chain performance, representing the lack of predictability and clarity within the supply chain environment. Grzybowska and Tubis (2022), highlighted the detrimental effects of uncertainty on supply chain resilience and integration, emphasizing the importance of fostering trust and collaboration to mitigate uncertainty. Considering the mediating role of supply chain flexibility and the significance of SCM factors in enhancing supply chain resilience (Singhal et al., 2019; Wong et al., 2020), it is hypothesized that competitiveness factors positively and significantly affect uncertainty supply chain performance in the Jordanian engineering, electrical, and information technology industries sector. Thus, the following are the hypothesized:

H1.1.2: Competitiveness factors have a positive and significant effect on Uncertainty supply chain performance in the Jordanian engineering, electrical, and information technology industries sector.

Complexity within the supply chain environment poses challenges to efficient operations and performance. Grzybowska and Tubis (2022), highlighted that insufficient expertise and fragmented supply chains contribute to operational complexity, thereby endangering supply chain resilience. However, effective SCM factors can streamline operations and mitigate complexity, as demonstrated by the findings of Singhal et al (2019), and Wong et al. (2020). Therefore, it is hypothesized that competitiveness factors have a positive and significant effect on complexity supply chain performance in the Jordanian engineering, electrical, and information technology industries sector. Thus, the following are the hypothesized:

H1.1.3: Competitiveness factors have a positive and significant effect on Complexity supply chain performance in the Jordanian engineering, electrical, and information technology industries sector.

Ambiguity reflects the lack of clarity and understanding within the supply chain environment, posing challenges to decision-making and strategic planning. Sohail et al (2022), emphasized the importance of implementing proper risk management systems to identify and mitigate emerging risks, thereby enhancing supply chain resilience. Given the role of SCM factors in promoting supply chain agility and responsiveness (Singhal et al., 2019; Wong et al., 2020), it is hypothesized that competitiveness factors positively and significantly affect ambiguity supply chain performance in the Jordanian engineering, electrical, and information technology industries sector. Thus, the following are the hypothesized:

H1.1.4: Competitiveness factors have a positive and significant effect on Ambiguity supply chain performance in the Jordanian engineering, electrical, and information technology industries sector.

In the context of hypothesis development for the study, Figure 1 visually represents the conceptual model that reflects the proposed relationships between SCM factors, supply chain flexibility, and VUCA supply chain performance within the Jordanian engineering, electrical, and information technology industries. This model is designed to illustrate how SCM factors and competitiveness factors influence various aspects of VUCA supply chain performance, including volatility, uncertainty, complexity, and ambiguity. However, Figure 1 serves to clarify these relationships but also to guide empirical testing throughout the research.

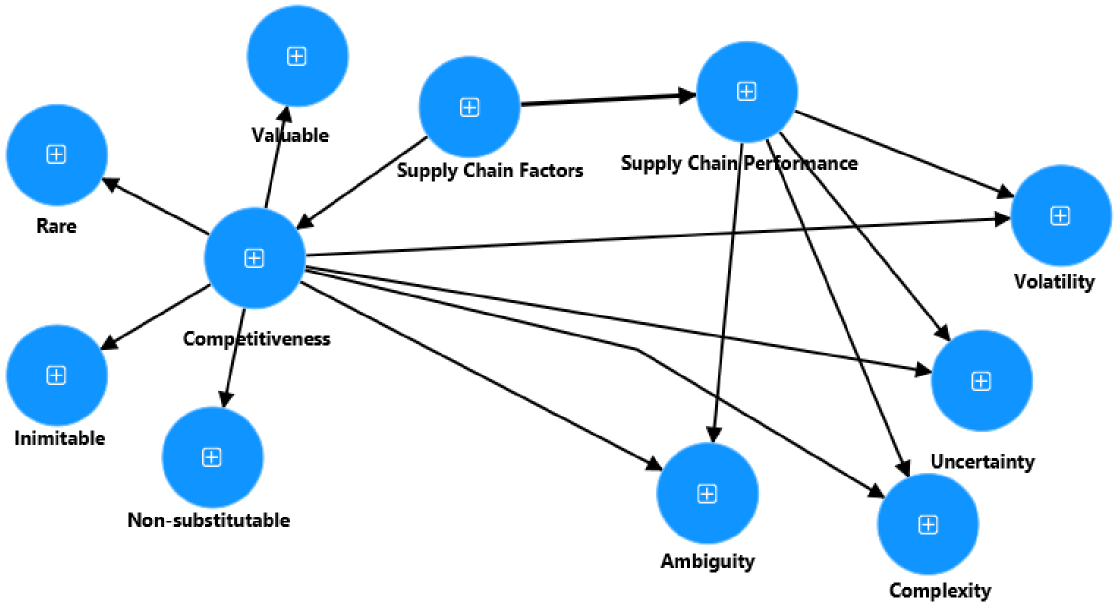

Figure 1: Research Model

The model proposes that SCM factors, such as supplier relationship management, inventory management, and demand forecasting, are critical in enhancing supply chain performance, especially within volatile and uncertain environments. According to the hypothesis H1, these factors have a direct and positive impact on VUCA supply chain performance, highlighting their significance in improving agility, resilience, and responsiveness (Wong et al., 2020). Additionally, the model suggests that supply chain flexibility acts as a mediating factor, bridging the influence of SCM factors on overall VUCA supply chain performance (Singhal et al., 2019). The hypotheses within the model further dissect this relationship by proposing that competitiveness factors significantly impact each dimension of VUCA. For volatility (H1.1.1), it is hypothesized that these factors enhance supply chain resilience against rapid market fluctuations. Regarding uncertainty (H1.1.2), the model posits that effective SCM strategies can nurture trust and collaboration, thereby diminishing the adverse impacts of unpredictable supply chain conditions (Grzybowska & Tubis, 2022). Complexity (H1.1.3) is addressed through streamlined operations facilitated by comprehensive SCM practices, while ambiguity (H1.1.4) is tackled by implementing robust risk management systems to support strategic decision-making (Sohail et al., 2022).

Methods and Procedure

The methodology of this study is meticulously designed to understand the impact of Supply Chain Management (SCM) factors on VUCA (Volatile, Uncertain, Complex, and Ambiguous) supply chain performance within the Jordanian engineering, electrical, and information technology industries sector. This sector is pivotal to Jordan's economy, contributing significantly to its exports and attracting a large portion of foreign investments. The study's focus on these industries is driven by their technological complexity, economic impact, and role in driving innovation. The population for this study includes companies within Jordan's engineering, electrical, and information technology industries sector, encompassing 391 firms with 31,725 employees. Stratified random sampling was employed to ensure a representative cross-section of the industry, considering different sizes and characteristics of companies. This technique, as endorsed by Fraenkel et al (2012), ensures diverse representation and mitigates sampling bias. Stratification was done based on specific departments—namely, Purchasing, Information Technology, Operations/Production, and Inventory—given their integral roles in supply chain management. This stratification allowed the study to capture the distinct challenges and dynamics within these sectors.

The sample size was determined using Krejcie and Morgan's formula, requiring approximately 309 respondents to ensure a 5% margin of error with 95% confidence for a population of 1,564 departments. Ultimately, 328 questionnaires were distributed, and 326 usable responses were analyzed. The sample size was deemed appropriate based on guidelines for Structural Equation Modeling (SEM), as suggested by Hair et al (2010), ensuring robust analytical outcomes and reliable generalizations. Data were collected via structured electronic questionnaires distributed among the selected firms. The questionnaire design focused on capturing data relevant to SCM practices and VUCA performance indicators. The responses were processed and converted into a CSV format for analysis. Initial data validation was performed using SPSS version 29.0, which included checks for missing values, outliers, and assessment of normality and multicollinearity. This rigorous preprocessing ensured data integrity, preparing it for advanced analysis using Smart PLS 4.

Smart PLS 4 was subsequently employed to evaluate the measurement and structural models, confirming convergent and discriminant validity. The analysis focused on verifying the reliability of constructs and testing the hypothesized relationships. With SEM, the study was able to explore complex variable interactions accurately, confirming the mediating role of supply chain flexibility in linking SCM factors and VUCA performance. Demographic analysis of the data reveals a comprehensive view of the sector's workforce and technological engagement. Respondents predominantly hail from the electronics industry (51.5%), followed by information technology (33.7%) and engineering (14.7%). The prevalence of Jordanian-owned companies (81.3%) reflects local dominance in these industries. Educational attainment is high among respondents, with a majority holding bachelor's degrees and substantial numbers pursuing postgraduate education, underscoring a qualified workforce. Experience distribution indicates that most employees have 5 to less than 10 years of experience (40.8%), suggesting a mature and seasoned workforce. Technological engagement is significant, with medium technology levels present in 69.6% of departments and advanced technologies like industrial robotics (28.8%) and cloud computing (19.0%) being notably utilized. These insights into digital transformation emphasize the sectors' readiness to adapt to VUCA challenges by harnessing technological advancements to enhance supply chain resilience and adaptability.

Findings

A total of 328 questionnaires were collected from respondents across the Jordanian engineering, electrical, and information technology industries. The data were downloaded as an Excel file, converted into CSV format, coded, and entered into an Excel sheet. To ensure the data's completeness and usability, checks for missing values and outliers were performed before conducting further analysis using SPSS-29 and Smart PLS-4. Moreover, the data analysis was conducted meticulously, using SPSS version 29.0 and Smart PLS 4 to guarantee reliable results. SPSS was first used to examine the dataset for missing values, outliers, normality, and multicollinearity, essential steps to ensure data quality and validity. Exploratory Factor Analysis (EFA) confirmed the reliability and suitability of the variables, and

SPSS also assessed internal consistency. Smart PLS 4 was then employed to evaluate the Measurement and Structural Models, verifying convergent and discriminant validity.

Of the 328 questionnaires, 326 usable responses were identified after addressing missing values and outliers. Rigorous validation ensured the normal distribution of core variables, with skewness and kurtosis within acceptable ranges, forming a solid foundation for Structural Equation Modeling (SEM). The absence of multicollinearity was confirmed, as all variables showed favorable Variance Inflation Factor (VIF) and Tolerance values, supporting the stability of the regression coefficients. Demographic analyses offered insights into the participants' diversity in education, experience, and technological engagement, particularly highlighting the widespread use of advanced digital tools like industrial robotics and cloud computing.

The demographic data revealed a diverse respondent pool across key industries. The majority of respondents were from the electronics sector (51.5%), followed by information technology (33.7%) and engineering (14.7%), with local ownership dominant (81.3%). Departmentally, most respondents were from IT (32.2%), followed by Operations/Production and Inventory. Educationally, 69.6% held bachelor's degrees, with 24.2% holding postgraduate qualifications, indicating a well-educated workforce. Experience varied, with 40.8% having 5 to less than 10 years of experience. Technologically, 69.6% of departments operated at medium technology levels, with advanced tools like industrial robotics (28.8%) and cloud computing (19.0%) reflecting a strong digital transformation in these sectors, providing key insights into the technological landscape of Jordanian industries.

Hypotheses Testing

In order to test the hypotheses using Smart PLS-4, it is essential to follow a two-step process as outlined by Hair et al. (2011). First, the Measurement Model must be evaluated to assess the reliability and validity of the constructs. This involves checking for convergent and discriminant validity to ensure the accuracy of the measurement instruments. Once the measurement model meets the necessary criteria, the second step involves assessing the Structural Model. This step tests the hypothesized relationships between the variables, evaluating the path coefficients, R-squared values, and the significance of the relationships. These steps are crucial to ensure the robustness of the empirical findings and validate the proposed hypotheses.

Measurement Model

The measurement model is a crucial step in assessing the validity and reliability of the constructs used in the research. It focuses on evaluating the relationships between latent variables and their respective observed indicators, ensuring that the constructs accurately reflect the theoretical concepts they represent. The measurement model assessment involves testing for internal consistency, convergent validity, and discriminant validity. Internal consistency is verified through indicators such as Cronbach's Alpha and Composite Reliability (CR), while convergent validity is confirmed through the factor loadings and the Average Variance Extracted (AVE). Discriminant validity, on the other hand, ensures that each construct is unique and distinct from others by comparing the AVE with cross-loadings. By confirming the reliability and validity of the measurement model, we ensure the robustness and accuracy of the constructs before proceeding to the structural model for hypothesis testing. However, figure (2) illustrates the relationships between competitiveness factors, supply chain factors, supply chain performance, and the various dimensions of VUCA (Volatility, Uncertainty, Complexity, and Ambiguity). It provides a visual representation of the measurement model used to assess the structural relationships among the latent variables. Each construct (represented by blue circles) is associated with specific observed variables (yellow rectangles), and the factor loadings for each relationship are indicated. Additionally, paths between constructs, along with their coefficients, are depicted, showcasing the hypothesized influence among variables.

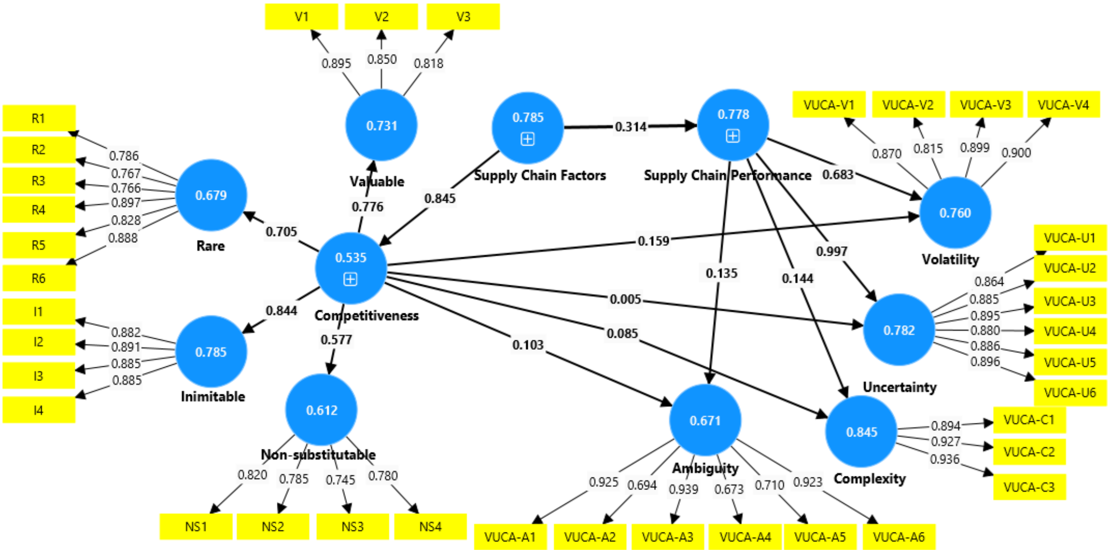

Figure 2: Measurement Model

The figure (2) above demonstrates the structural and measurement models used to assess the relationships between competitiveness factors and VUCA supply chain performance. The model indicates that constructs such as "Competitiveness" are measured by dimensions like "Rare," "Inimitable," "Non-substitutable," and "Valuable," each with factor loadings above the threshold of 0.70. Moreover, the paths from "Supply Chain Factors" to "Supply Chain Performance" and from "Supply Chain Performance" to the VUCA dimensions show significant coefficients, reflecting strong relationships between these variables. The model provides evidence of the importance of these competitiveness factors in enhancing supply chain performance in VUCA environments.

As stated by Hair et al (2011), several steps are involved in assessing the measurement model. To confirm internal consistency reliability, Cronbach's Alpha and Composite Reliability (CR) should exceed 0.70. In the figure, each factor loading must also be above 0.70, indicating the strength of the relationship between observed and latent variables. Convergent Validity is assessed using the Average Variance Extracted (AVE), which must be greater than 0.50, suggesting that each construct explains a substantial portion of the variance in its indicators. However, convergent validity is achieved when the AVE exceeds 0.50. Before this, factor loadings should be above 0.70, and both Cronbach's Alpha and Composite Reliability (CR) must exceed 0.70 to confirm internal consistency. Table (1) below demonstrates that all constructs meet these criteria, with factor loadings, Cronbach's Alpha values, and CRs surpassing the 0.70 threshold. The AVE for all constructs exceeds 0.50, confirming that convergent validity has been achieved.

Table (1)
Convergent validity of the model

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Ambiguity	0.911	0.968	0.923	0.671
Competitiveness	0.856	0.862	0.889	0.535
Complexity	0.910	0.955	0.942	0.845
Inimitable	0.909	0.912	0.936	0.785
Non-substitutable	0.790	0.797	0.863	0.612
Rare	0.905	0.919	0.927	0.679
Supply Chain Factors	0.909	0.912	0.936	0.785
Supply Chain Performance	0.905	0.905	0.933	0.778
Uncertainty	0.944	0.944	0.956	0.782
Valuable	0.818	0.833	0.891	0.731
Volatility	0.895	0.912	0.927	0.760

Table (1) indicate that Cronbach's Alpha is a widely recognized measure of internal consistency, ensuring that the items used to measure each construct are closely related. In the table, all constructs report Cronbach's Alpha values above the recommended threshold of 0.70, indicating strong internal consistency. Particularly, constructs such as Uncertainty (0.944), Complexity (0.910), and Supply Chain Performance (0.905) show excellent reliability. These values suggest that the items associated with these constructs are measuring a consistent latent concept. However, while the Non-substitutable construct has a relatively lower Cronbach's Alpha (0.790), it still meets the acceptable threshold, though its proximity to the lower limit suggests that further refinement of its measurement items could improve internal consistency.

The Composite Reliability (rho_a and rho_c) values further confirm the reliability of the constructs. For all constructs, rho_c values are well above the threshold of 0.70, with particularly high values for constructs like Uncertainty (0.956) and Complexity (0.942). These high values indicate strong construct reliability and suggest that the indicators consistently represent their corresponding latent variables. Constructs such as Non-substitutable (0.863) and Competitiveness (0.889) show slightly lower values compared to others, but still meet the accepted standards for reliability.

Table (1) reveal that, while there is room for improvement in the measurement of certain constructs, overall the model demonstrates strong reliability. In terms of AVE, which assesses convergent validity, all constructs exceed the minimum threshold of 0.50, confirming that the constructs explain a significant amount of the variance in their indicators. Constructs like Complexity (0.845), Uncertainty (0.782), and Volatility (0.760) stand out with particularly high AVE values, indicating that these constructs capture a large portion of variance relative to error, and thus have high convergent validity. On the other hand, Competitiveness has the lowest AVE value (0.535), indicating that although the construct meets the basic criteria for convergent validity, it captures less variance compared to other constructs. This lower AVE suggests that there may be some room for improving the measurement model by revising or adding items to better capture the concept of Competitiveness.

Structural Model

In statistical analysis, the evaluation of hypotheses relies on several key indicators that provide critical insights into the relationships between variables. Among the most commonly used indicators are the original sample estimates (O), t-statistics (T), and p-values (P). Each of these plays a distinct role in determining the strength, significance, and direction of the hypothesized relationships. For instance, the original sample estimates (O) reflect the magnitude and direction of the relationship between variables, helping researchers understand whether the link between constructs is positive or negative. Meanwhile, the t-statistics (T) serve as a measure of the statistical significance of the relationships, with higher t-statistics indicating stronger evidence that the observed relationships are not due to random chance.

p-values (P), on the other hand, offer critical information about the probability that the results observed in the data occurred by random chance. Lower p-values (typically below 0.05) suggest that the relationships between variables are statistically significant and provide strong support for the proposed hypotheses. Together, these indicators enable researchers to draw robust conclusions based on the statistical data, offering valuable insights into the correlations and causal relationships between the variables under investigation. While the specific values of these indicators are often displayed in tables and figures—such as Table 2 and Figure 3—their true importance lies in how they contribute to the broader process of hypothesis testing and inference. By interpreting these values, researchers can assess whether their hypotheses are supported by the data, leading to well-informed conclusions about the nature and strength of the relationships between variables. The integration of these statistical measures into the analysis process ensures that findings are grounded in empirical evidence, providing a rigorous foundation for subsequent theoretical or practical applications. Thus, the use of O, T, and P values is integral to making data-driven inferences that contribute to the body of knowledge in a meaningful and scientifically sound manner.

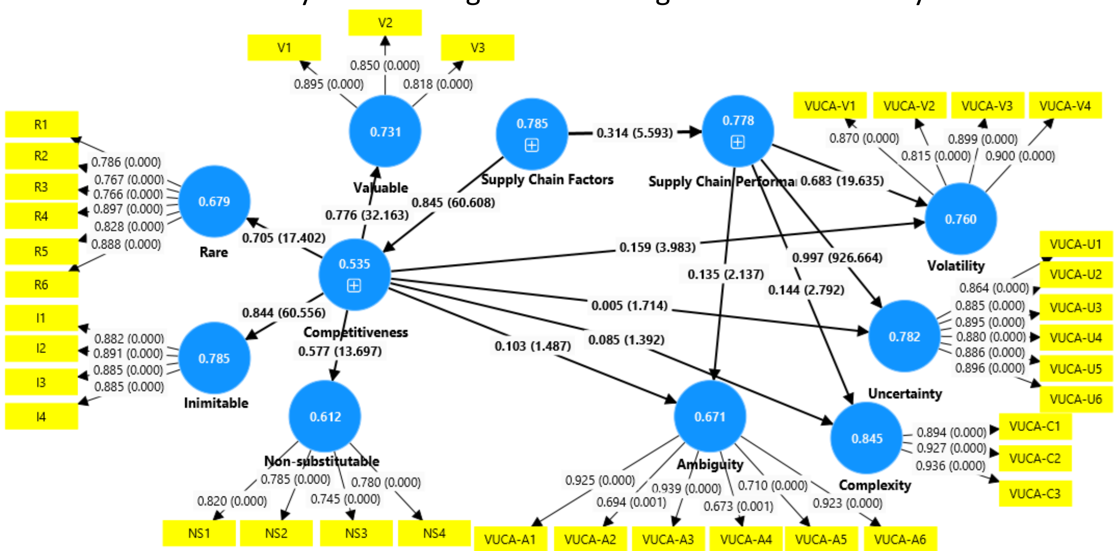

Figure 3: Hypothesis Testing Results

The figure (3) presents the structural model, illustrating the relationships between constructs such as Competitiveness, Supply Chain Factors, Supply Chain Performance, and the four VUCA dimensions (Volatility, Uncertainty, Complexity, and Ambiguity). Each blue circle represents a latent variable, while the yellow rectangles show the indicators that measure these constructs. The paths between the constructs, marked with black arrows, show the hypothesized relationships, along with the path coefficients and significance levels (in parentheses). The R^2 values for the endogenous constructs (shown inside the blue circles) represent the variance explained by the independent variables. In the model, Competitiveness is shown as a central construct, influencing both Supply Chain Factors and Supply Chain Performance, with path coefficients of 0.577 and 0.314, respectively, both statistically significant. Supply Chain Factors also have a strong, direct effect on Supply Chain Performance (path coefficient = 0.683), indicating a significant and robust relationship. This highlights that Competitiveness and Supply Chain Factors are crucial drivers of Supply Chain Performance.

The VUCA dimensions (Volatility, Uncertainty, Complexity, and Ambiguity) are influenced by Supply Chain Performance with varying degrees of significance. For instance, Volatility shows a strong path coefficient of 0.997, suggesting a near-perfect relationship with Supply Chain Performance. Uncertainty and Ambiguity show moderate relationships, with coefficients of 0.144 and 0.135, respectively. While these relationships are statistically significant, the relatively lower coefficients imply that these dimensions are less influenced by Supply Chain Performance compared to Volatility. The model also depicts the relationships between Competitiveness and the individual dimensions of VUCA. However, some paths, such as those leading to Complexity and Uncertainty, have non-significant path coefficients (e.g., 0.103 and 0.085), indicating weaker relationships and suggesting that these aspects of Competitiveness do not strongly influence the VUCA dimensions.

Table 2
Path Testing Results

Hypothesis	**Original Sample (O)**	**T Statistics**	**P Values**	**Result**
H1: Supply Chain Factors -> VUCA Supply Chain Performance	0.314	5.593	0.000	Supported
H1.1: Competitiveness Factors -> VUCA Supply Chain Performance	0.577	13.697	0.000	Supported
H1.1.1: Competitiveness Factors -> Volatility	0.159	3.983	0.000	Supported
H1.1.2: Competitiveness Factors -> Uncertainty	0.005	1.714	0.087	Not Supported
H1.1.3: Competitiveness Factors -> Complexity	0.085	1.392	0.164	Not Supported
H1.1.4: Competitiveness Factors -> Ambiguity	0.103	1.487	0.137	Not Supported

Based on Table 2, starting with H1, the hypothesis that Supply Chain Factors positively and significantly affect VUCA Supply Chain Performance is strongly supported by the data. The path coefficient of 0.314, combined with a highly significant t-statistic (5.593) and a p-value of 0.000, confirms that supply chain factors have a clear and substantial impact on supply chain performance in VUCA environments. This finding aligns with the theoretical expectation that well-managed supply chains, characterized by agility, flexibility, and efficiency, are better equipped to navigate the volatility, uncertainty, complexity, and ambiguity that define modern business environments. The strong statistical support for this hypothesis underscores the critical role of supply chain management in enhancing organizational resilience and adaptability. Similarly, H1.1, which posits that Competitiveness Factors have a positive and significant effect on VUCA Supply Chain Performance, is also supported by the data. With a path coefficient of 0.577, a t-statistic of 13.697, and a p-value of 0.000, this relationship is not only statistically significant but also indicates a strong effect size. This suggests that competitiveness—encompassing elements such as innovation, resource capabilities, and strategic positioning—significantly enhances the ability of firms to perform well in VUCA conditions. The results highlight that firms which cultivate their competitive advantages are better equipped to deal with the disruptions and challenges inherent in volatile and uncertain markets. However, when examining the individual components of VUCA, the results present a more nuanced picture. H1.1.1, which examines the impact of Competitiveness Factors on Volatility, is supported by a significant path coefficient of 0.159, a t-statistic of 3.983, and a p-value of 0.000. This finding confirms that firms with stronger competitiveness are more adept at handling volatility in their supply chains. In volatile environments, where rapid changes in demand, supply, or market conditions are frequent, competitiveness enables firms to remain flexible and responsive, thereby ensuring better performance.

On the other hand, the hypotheses related to Uncertainty, Complexity, and Ambiguity—H1.1.2, H1.1.3, and H1.1.4, respectively—are not supported by the data. The path coefficients for these relationships are small (ranging from 0.005 to 0.103), and the t-statistics do not reach the critical value for significance, with p-values above the conventional threshold of 0.05. Specifically, the p-values for Uncertainty (0.087), Complexity (0.164), and Ambiguity (0.137) indicate that Competitiveness Factors do not significantly influence these aspects of VUCA supply chain performance. These results suggest that while competitiveness is essential for managing volatility, it may not be as effective in addressing the challenges posed by uncertainty, complexity, and ambiguity within the supply chain. This lack of significant impact on Uncertainty, Complexity, and Ambiguity raises important considerations. It may imply that other factors beyond competitiveness are necessary to manage these dimensions of VUCA. For example, managing uncertainty might require more robust forecasting methods or risk management strategies, while complexity may call for greater supply chain integration or collaboration with partners. Ambiguity, in turn, might necessitate clearer communication channels and decision-making frameworks. Therefore, while competitiveness is a critical component of supply chain performance, these findings highlight the need for additional strategies to effectively address the full spectrum of VUCA challenges.

Discussion

This study provides strong evidence for the positive effects of Supply Chain Factors and Competitiveness Factors on overall VUCA Supply Chain Performance, particularly in managing volatility. The findings, however, reveal weaker or unsupported relationships between Competitiveness Factors and other dimensions of VUCA—uncertainty, complexity, and ambiguity—suggesting that firms may need to adopt more targeted approaches to address these specific challenges. This highlights the multifaceted nature of VUCA environments and underscores the necessity of comprehensive, multidimensional strategies that go beyond competitiveness alone to ensure resilient and effective supply chain performance.

The results strongly support the hypothesis (H1.1) that Competitiveness Factors have a positive and significant effect on VUCA Supply Chain Performance in the Jordanian engineering, electrical, and information technology sectors. A path coefficient of 0.577 and a highly significant t-statistic of 13.697 substantiate this relationship. These findings align with previous studies emphasizing that competitiveness enhances supply chain performance, especially under volatile and uncertain conditions. Wong et al (2020), argue that firms with strong competitive advantages, such as innovation and strategic positioning, are better equipped to handle disruptions in their supply chains. Similarly, Singhal et al (2019), note that competitiveness, including robust supplier relationships and effective resource management, boosts supply chain agility, which is crucial in navigating VUCA environments. However, some researchers suggest that competitiveness alone may not be sufficient for optimizing supply chain performance, particularly in complex environments. Rana et al (2020), contend that competitiveness should be complemented by other strategic elements, such as digital integration and risk management, to maximize its benefits in ambiguous and uncertain conditions. This view nuances the findings, indicating that while competitiveness is a critical driver of supply chain success, it must be paired with other capabilities to fully address the diverse challenges posed by VUCA environments.

The results for H1.1.1 strongly support the hypothesis that Competitiveness Factors positively and significantly impact Volatility in supply chain performance. With a path coefficient of 0.159 and a t-statistic of 3.983, the findings suggest that firms with higher competitiveness are better equipped to manage volatility. These results resonate with Hofmann et al (2014), who assert that competitive firms tend to be more flexible and adaptive, enabling them to respond quickly to market fluctuations and supply chain disruptions. The ability to mitigate volatility is critical for maintaining supply chain continuity in unpredictable environments. While these findings are consistent with much of the existing literature, some scholars advocate for a more cautious interpretation. Sarkis et al (2020), suggest that although competitiveness is vital for managing volatility, it must be supplemented with advanced forecasting capabilities and real-time data analytics to fully anticipate and respond to market shifts. This perspective extends the current study's argument, emphasizing that competitiveness is necessary but may require integration with other capabilities, such as data-driven decision-making, to optimize its effectiveness in managing volatility.

The hypothesis (H1.1.2) that Competitiveness Factors would have a positive and significant effect on Uncertainty in supply chain performance was not supported by the data. The path coefficient of 0.005 and an insignificant t-statistic of 1.714 indicate that competitiveness factors do not significantly influence uncertainty in the supply chain. This result contradicts some studies, such as those by Ababneh et al (2024), which found that competitive firms perform better in uncertain environments by leveraging their internal resources and networks to mitigate risks. However, the current findings suggest that competitiveness, while important, may not be sufficient on its own to manage uncertainty effectively. This interpretation is consistent with the arguments made by Mohanta et al (2020), who claim that managing uncertainty requires not just competitiveness but also robust risk management systems and flexible supply chain strategies. In environments characterized by high unpredictability, competitiveness may need to be augmented by better scenario planning, enhanced information flow, and strategic partnerships to effectively reduce uncertainty. Thus, the results highlight the need for a broader, more comprehensive approach to uncertainty management within supply chains.

The hypothesis (H1.1.3) that Competitiveness Factors would have a positive and significant effect on Complexity in supply chain performance was also not supported. A path coefficient of 0.085 and an insignificant t-statistic of 1.392 suggest that competitiveness factors do not significantly affect the management of complexity within supply chains. This finding contrasts with previous research by Shubailat et al (2024), which suggested that competitive firms, due to their ability to innovate and streamline processes, are better equipped to handle complex supply chains. The lack of significant findings in the current study may indicate that complexity is influenced by factors beyond competitiveness, such as supply chain integration, technology adoption, and external collaboration. Grzybowska and Tubis (2022), argue that reducing complexity requires a holistic approach, including digital transformation and the development of collaborative ecosystems, which go beyond the scope of competitiveness alone. Therefore, while competitiveness remains an important factor, it may not be decisive in managing complexity in supply chains, necessitating other strategic interventions.

The hypothesis (H1.1.4) that Competitiveness Factors would have a positive and significant effect on Ambiguity in supply chain performance was similarly unsupported. The path coefficient of 0.103 and a t-statistic of 1.487 indicate that this relationship is not statistically significant. This finding contrasts with Carroll's (2015), suggestion that competitive firms, through their strategic foresight and decision-making processes, are better able to navigate ambiguous environments. The lack of support for this hypothesis suggests that managing ambiguity, characterized by unclear or incomplete information, requires more than just competitiveness. As Sohail et al (2022), argue, effectively managing ambiguity in supply chains necessitates clearer communication channels, better risk management systems, and structured frameworks for dealing with uncertainty in decision-making. While competitiveness may provide strategic advantages, it appears insufficient for managing ambiguity without additional decision-support mechanisms.

Conclusion

The results of this study provide a mixed perspective on the role of Competitiveness Factors in enhancing VUCA Supply Chain Performance. While the findings strongly support the positive impact of competitiveness on managing Volatility, they offer limited evidence for its role in managing Uncertainty, Complexity, and Ambiguity. These results are consistent with some aspects of the existing literature, but they also highlight the limitations of competitiveness in addressing all dimensions of VUCA challenges. The study suggests that while competitiveness is a necessary component for success, it is not sufficient by itself to navigate VUCA environments. A more holistic approach, including the integration of risk management, digital strategies, and collaborative frameworks, is essential to effectively manage the complexities and uncertainties of modern supply chains. This reinforces the need for multidimensional strategies that can complement competitiveness to ensure supply chain resilience and sustainability in the face of VUCA challenges. This study provides valuable insights into the role of supply chain factors specifically competitiveness, sustainability, and resilience in enhancing VUCA supply chain performance within the Jordanian engineering, electrical, and information technology industries. The findings confirm that these factors positively and significantly impact supply chain performance in environments characterized by volatility, uncertainty, complexity, and ambiguity. In particular, competitiveness plays a pivotal role in managing volatility, allowing firms to remain agile and responsive in the face of rapid market changes. However, competitiveness alone is insufficient to fully address the broader spectrum of VUCA challenges, including uncertainty, complexity, and ambiguity. This necessitates the adoption of additional strategies. Sustainability and resilience emerge as equally important factors, contributing to enhanced transparency, traceability, and operational efficiency, while also supporting the supply chain's adaptability in unpredictable conditions. Sustainable practices, such as blockchain technology, further mitigate risks by improving trust and collaboration, which are critical for reducing uncertainty and complexity. Resilience, on the other hand, ensures that supply chains remain flexible and robust against disruptions, offering a critical buffer against volatility and ambiguity. The study highlights the need for a comprehensive, multidimensional approach to supply chain management, where competitiveness is integrated with sustainability and resilience to navigate the complex challenges posed by VUCA environments. Organizations that adopt such an integrated approach are better equipped to ensure continuity, stability, and long-term success in highly dynamic and unpredictable market conditions. Thus, this research underscores the importance of developing holistic supply chain strategies that leverage the strengths of competitiveness, sustainability, and resilience. These strategies are essential for enhancing supply chain performance, mitigating risks, and achieving organizational sustainability in the increasingly volatile and complex global economy. By building on the findings of this study, future research can further explore how these factors can be tailored to different industry contexts and how emerging technologies can support the effective management of VUCA challenges.

References

Ababneh, A. M., Jarah, B. A. F., Al-Kharabsheh, A., Al-Zaqeba, M. A. A., Basheti, I. (2024). The role of human resources management in the development of total quality management in the public and private sectors in Jordan. Humanities and Social Sciences Letters, 12(2), pp. 319–330

Agrawal, A., Gans, J., & Goldfarb, A. (2018). *Prediction machines: the simple economics of artificial intelligence*. Harvard Business Press.

Al Obaidy, A. L. A., Ping, T. A., Ganesan, Y., & Alzaqeba, M. A. A. (2024). Defining Inheritance Risk Management as A New Concept Towards Sustainability of Family Businesses. *The Journal of Muamalat and Islamic Finance Research*, 139-161.

Al Rousan, S. R. (2024). Green Human Resource Management Towards Digital Transformation in Municipalities in Irbid Governorate. International Journal of Digital Accounting and Fintech Sustainability, 1 (1), 2-12. https://tanmeah.com/wp-content/uploads/2024/08/PAPER-3-TBP.pdf

Aloqaily, A. N., & Al-Zaqeba, M. A. A. (2024, April). The Impact of Green Human Resource Management Practices on Engagement of Employee and Organizational Creativity Towards the Green Environment. In *International Conference on Business and Technology* (pp. 265-276). Cham: Springer Nature Switzerland.

Al-Taani, A. H. M., Al-Zaqeba, M. A. A., Maabreh, H. M. A., & Jarah, B. A. F. (2024). Exploring the impact of digital accounting and digital zakat on improving business sustainability in the Middle East and Malaysia. *International Journal of Advanced and Applied Sciences*, *11*(1), 56-67.

Al-Zaqeba, M. A. A., & Basheti, I. A. 2024a. Evaluating the effects of customs policy on supply chain performance. Afr.J.Bio.Sc.6(13)(2024).3386-3403. https://doi.org/10.48047/AFJBS.6.13.2024. 3386-3403

Al-Zaqeba, M. A. A., & Basheti, I. A. (2024). Measurement Problems in Interest-Free Financial Instruments. *Pakistan Journal of Life and Social Sciences*. https://doi.org/10.57239/PJLSS-2024-22.1.00410

Al-Zaqeba, M. A. A., Alshehadeh, A. R., Al-Khawaja, H. A., Basheti, I. A., & Lootah, R. E. S. A. (2024D). The role of inheritance risk management in family enterprises to achieve family businesses sustainability in the middle east. *Humanities and Social Sciences Letters*, *12*(3), 639-658.

Al-Zaqeba, M., Ineizeh, N., Jarah, B., Hamour, H. M. J. A., & Zeyad, Z. (2022). Intelligent matching: Supply chain factors and financial accounting technology. *Uncertain Supply chain factors*, *10*(4), 1405-1412.

Al-Zaqeba, M., Jarah, B., Ineizeh, N., Almatarneh, Z., & Jarrah, M. (2022). The effect of management accounting and blockchain technology characteristics on supply chains efficiency. *Uncertain Supply chain factors*, *10*(3), 973-982.

Alzubi, E., & Akkerman, R. (2022). Sustainable Supply chain factors practices in developing countries: An empirical study of Jordanian manufacturing companies. *Cleaner production letters*, *2*, 100005.

Centobelli, P., Cerchione, R., Oropallo, E., El-Garaihy, W. H., Farag, T., & Al Shehri, K. H. (2022). Towards a sustainable development assessment framework to bridge supply chain factors and technologies. *Sustainable Development*, *30*(4), 647-663.

Hair J. F., J., Sarstedt, M., Hopkins, L., & G. Kuppelwieser, V. (2014). Partial least squares structural equation modeling (PLS-SEM). *European Business Review*, *26*(2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128.

Hair Jr, J. F., Sarstedt, M., Ringle, C. M., and Gudergan, S. P. (2017). Advanced issues in partial least squares structural equation modeling. *SAGE Publications*.

Jarah, B. A. F., Alghadi, M. Y., Al-Zaqeba, M. A. A., Mugableh, M. I., & Zaqaibeh, B. (2024). The influence of financial technology on profitability in Jordanian commercial banks. *Humanities and Social Sciences Letters*, *12*(2), 176-188.

Jebril, I., Al-Zaqeba, M., Al-Khawaja, H., Obaidy, A., & Marashdah, O. (2024). Enhancing estate governance using blockchain technology through risk management in estate governance of business sustainability. *International Journal of Data and Network Science*, *8*(3), 1649-1658.

Lootah, R. E. A. (2024). The Impact of Blockchain Technology on Financial Reporting Practices in UAE. International Journal of Digital Accounting and Fintech Sustainability, 1 (1), 2-12. https://tanmeah.com/wp-content/uploads/2024/07/PAPER-1-TBP-1.pdf

Maabreh, H. M. A. (2024). The Role of Financial Technology (Fintech) in Promoting Financial Inclusion A Literature Review. International Journal of Digital Accounting and Fintech Sustainability, 1 (1), 2-12. https://tanmeah.com/wp-content/uploads/2024/08/PAPER-2-TBP.pdf

Mohanta, B., Nanda, P., & Patnaik, S. (2020). Management of VUCA (Volatility, Uncertainty, Complexity and Ambiguity) Using machine learning techniques in industry 4.0 paradigm. New Paradigm of Industry 4.0: Internet of Things, Big Data & Cyber Physical Systems, 1-24.

Razzak, A., Ahmad, M. A., Awad, G., & Mohammad, N. (2024). The effect of digital zakat and accounting on corporate sustainability through financial transparency. *Asian Economic and Financial Review*, *14*(3), 228-249.

Sempiga, O., & Van Liedekerke, L. (2023). Investing in Sustainable Development Goals: Opportunities for private and public institutions to solve wicked problems that characterize a VUCA world. In Investment strategies: new advances and challenges/Prelipcean, G.[edit.] (pp. 1-21).

Shambach, S. A. (2014). Strategic leadership primer. Army War Coll Carlisle Barracks Pa.

Shams, R., Vrontis, D., Belyaeva, Z., Ferraris, A., & Czinkota, M. R. (2021). Strategic agility in international business: A conceptual framework for "agile" multinationals. Journal of International Management, 27(1), 100737.

Shashi, M. (2022). *Digital Strategies to improve the performance of pharmaceutical supply chains* (Doctoral dissertation, Walden University).

Shaw, E., Walpole, S., McLean, M., Alvarez-Nieto, C., Barna, S., Bazin, K., ... & Woollard, R. (2021). AMEE Consensus Statement: Planetary health and education for sustainable healthcare. Medical teacher, 43(3), 272-286.

Shboul, T., Hazaimeh, Z. K., Ajlouni, B. A. M. (2024). The moderating role of digital leadership between digital transformation and performance of vocational education teachers in public schools. International Journal of Digital Accounting and Fintech Sustainability, 1 (1), 2-12. https://tanmeah.com/wp-content/uploads/2024/08/PAPER-4-TBP.pdf

Shubailat, O. M., Al-Zaqeba, M. A. A., Madi, A., & Hamid, S. A. (2024C, April). The Effect of Customs Strategies on Environmental and Sustainable Responsibility of Jordanian Supply Chain Management. In *International Conference on Business and Technology* (pp. 309-322). Cham: Springer Nature Switzerland.

Shubailat, O., Al-Zaqeba, M., Madi, A., & Alheet, A. (2024). Analyzing the improvement of estate governance and management in Jordan using blockchain. *International Journal of Data and Network Science*, *8*(2), 1059-1072.

Shujaat Mubarik, M., Ahmed Khan, S., Kusi-Sarpong, S., & Mubarik, M. (2023). Supply chain sustainability in VUCA: role of BCT-driven SC mapping and 'Visiceability'. International Journal of Logistics Research and Applications, 1-19.

Sohail, A. R., Ramish, A., Ali, Q., & Rehman, K. U. (2022). Supply chain resilience in VUCA world: towards a holistic approach of quality assurance and risk management. International Journal of Management Research and Emerging Sciences, 12(1).