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Designing a Resilient Supply Chain Model with a Focus on Financial Outcomes (Case Study: Mobarakeh Steel Company)

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Abstract

Resilience enables companies to manage supply chain disruptions and continue delivering their products and services to customers. The purpose of analyzing and managing supply chain resilience is to prevent a transition to an undesirable state, that is, a situation in which failure modes may occur. Therefore, understanding the factors influencing the establishment and enhancement of supply chain resilience is of particular importance to organizational managers. The aim of the present study is to design a resilient supply chain model with a focus on financial outcomes at Mobarakeh Steel Company. The statistical population of this research includes 280 managers and supervisors from Mobarakeh Steel Company. Data collection was conducted through interviews and questionnaires, and inferential statistics along with structural equation modeling were employed to test the hypotheses. The findings of the study revealed that the factors and components influencing supply chain resilience include transformational supply chain leadership, resource-based dynamic capability, digital tools, partner dissatisfaction, customer relationship, communication quality, supply chain flexibility, supply chain robustness, supplier relationship, information processing capability, digital marketing orientation, supply chain reciprocity, knowledge-based dynamic capability, supply chain integration, and environmental dynamism. Among these factors, transformational supply chain leadership, resource-based dynamic capability, digital tools, partner dissatisfaction, customer relationship, communication quality, supply chain flexibility, supply chain robustness, supplier relationship, and information processing capability were found to significantly influence supply chain resilience. Moreover, the results indicated that supply chain resilience has a positive and significant impact on financial performance.

Keywords: supply chain, supply chain resilience, financial performance.

1. Introduction

In today's globalized and highly volatile business environment, the ability of supply chains to withstand, adapt to, and recover from disruptions has emerged as a strategic imperative for firms seeking long-term success and competitive advantage. Supply chain resilience (SCR) refers to the capacity of a supply chain to prepare for unexpected events, respond adaptively to disruptions, and recover from them with minimal impact on operations and performance (Zhou, 2024). The significance of SCR has been amplified in recent years due to a series of global disruptions, including the COVID-19 pandemic, geopolitical tensions, natural disasters, and the increasing complexity of supply networks (McKinsey & Company, 2022). These developments have brought to the forefront the need for firms to not only optimize for efficiency but also incorporate flexibility, visibility, and responsiveness into their supply chain strategies (Qi et al., 2022).

The emergence of SCR as a key concern in supply chain management has prompted a surge in academic and industry interest in identifying the enablers and mechanisms that support resilience across supply chain tiers. Researchers have emphasized that resilient supply chains exhibit capabilities such as adaptability, agility, redundancy, and collaboration, which enable them to effectively mitigate risks and maintain performance under conditions of uncertainty (Shishodia et al., 2023; Stadtfeld & Gruchmann, 2023). Moreover, SCR is not solely a defensive mechanism but a strategic capability that contributes directly to enhanced financial performance, operational continuity, and long-term sustainability (Shen et al., 2023; Zhu & Wu, 2022).

One of the foundational elements of SCR is dynamic capabilities, which refer to a firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments (Stadtfeld & Gruchmann, 2023). These capabilities underpin the strategic flexibility of supply chains and enable organizations to sense disruptions, seize opportunities, and transform their processes accordingly (Yamin et al., 2024). Furthermore, the integration of physical, informational, and financial flows has been shown to be critical in achieving holistic resilience, especially in complex industrial sectors such as automotive and steel manufacturing (Abedini Nazari et al., 2024). In this regard, the present study seeks to design a resilient supply chain model with a specific focus on financial outcomes, using Mobarakeh Steel Company as a case study.

Digital transformation has emerged as a pivotal enabler of SCR. Technologies such as big data analytics, artificial intelligence (AI), blockchain, and the Internet of Things (IoT) enhance supply chain visibility, predictability, and responsiveness, allowing firms to make data-driven decisions in real-time (Li, 2022; Yamin et al., 2024). Digital tools have also been linked to better partner collaboration and proactive risk management, thereby reinforcing the resilience capacity of supply chains (Akbar & Aslam, 2023). In fact, digitalization acts as a catalyst for integrating fragmented supply chain activities and strengthening the connective infrastructure necessary for adaptive responses to disruptions (Meredith et al., 2023). In highly dynamic and uncertain environments, the ability to leverage digital resources can determine whether a firm merely survives or thrives.

Supplier relationships and collaboration mechanisms are equally vital in enhancing SCR. Studies have underscored that resilient supply chains rely on trust-based partnerships, information sharing, and coordinated decision-making to respond effectively to disturbances (Akbar & Aslam, 2023; Ekpudu & Udofia, 2023). The role of suppliers in ensuring upstream stability and flexibility cannot be overstated, especially in industries where procurement is a major determinant of operational continuity (Mogere et al., 2023). In parallel, customer relationships serve as a key downstream factor in resilience, as they facilitate demand visibility and responsiveness, enabling firms to align production and distribution plans more effectively (Mosavian & Zeinalnejad, 2022).

Moreover, leadership plays a critical role in shaping and sustaining a resilient supply chain culture. Transformational leadership in supply chain management fosters innovation, proactive thinking, and organizational learning, all of which contribute to resilience (Shishehbori, 2023). Leaders who prioritize resilience initiatives and invest in capacity building can embed risk-awareness and adaptability into the supply chain structure (Yamin et al., 2024). This strategic orientation is particularly important when considering that supply chains must not only respond to immediate crises but also develop long-term capabilities for enduring volatility (Annals of Operations, 2023).

Another cornerstone of SCR is supply chain integration (SCI), which refers to the extent to which internal and external supply chain processes are aligned and coordinated. SCI includes both vertical integration across internal functions and horizontal integration with external partners (Shen et al., 2023). Empirical evidence indicates that higher levels of integration enhance responsiveness and reduce lead times, both of which are essential for resilient operations (Qi et al., 2022). Integration also supports the development of shared goals and collaborative risk-sharing mechanisms that are central to resilience-building (Razavian et al., 2021).

In addition to structural and technological factors, resilience is shaped by environmental dynamics and stakeholder expectations. Environmental dynamism—characterized by the frequency and unpredictability of changes in the external environment—requires supply chains to develop real-time monitoring and adaptive planning mechanisms (Kazim et al., 2023). Moreover, evolving expectations around sustainability, circularity, and ethical responsibility compel organizations to embed resilience into broader strategic objectives (Malashahi et al., 2024; Sepasi & Khodaparasti, 2022). These shifts necessitate a move from reactive approaches to resilience toward proactive and anticipatory frameworks that align with long-term value creation (Song et al., 2022).

While the theoretical foundations of SCR are well-established, there remains a need for empirical models that contextualize resilience within specific industries and examine its direct financial implications. Despite numerous conceptual frameworks, few studies have systematically linked resilience components to financial performance outcomes, especially in capital-intensive and strategic sectors such as steel manufacturing (Rachid et al., 2024). The interdependence between resilience and financial performance is crucial, as firms must justify resilience investments in terms of returns, efficiency, and risk mitigation (Zhou, 2024; Zhu & Wu, 2022). This study addresses this gap by empirically evaluating the relationship between SCR and financial performance in Mobarakeh Steel Company, the largest steel producer in the Middle East.

2. Methods and Materials

The present study was conducted with the aim of designing a resilient supply chain model with a focus on financial outcomes in Mobarakeh Steel Company. Accordingly, this research presents a novel model and is therefore categorized as exploratory research. Exploratory studies are used to understand unfamiliar phenomena and expand knowledge through theorization. Given the exploratory nature of this research, qualitative methods such as observation and interviews were used to collect the required data. Thus, the study was carried out using a qualitative approach, and in addition to the qualitative methodology, the study also included a review of previous literature to identify the factors affecting supply chain resilience. Subsequent phases of the research involved quantitative analysis. In this way, both qualitative and quantitative methods were applied concurrently, making this study a mixed-methods research project. Specifically, the exploratory mixed-methods design was employed. Among the existing strategies in mixed-methods research (mixed-methods strategy and action research strategy), the researcher chose the mixed-methods strategy, as it allows for the collection of both qualitative and quantitative data to explain, dissect, and understand a phenomenon. The combination of these two types of data provides a better understanding of the problem compared to focusing solely on one data type. The mixed-methods strategy includes explanatory, exploratory, nested, and multiphase designs. In this study, the exploratory mixed-methods design was employed. Moreover, the researcher may combine the information categories obtained from qualitative data with the quantitative data.

This research was conducted in four stages as follows:

Stage One: Extraction of Initial Indicators from Theoretical Foundations (Review of Written Sources)

In the first step, the researcher reviewed all written sources, including articles, books, and theses, to achieve theoretical sufficiency on the subject under investigation. Thus, all existing models regarding factors influencing supply chain resilience were studied, and the measurement indicators for this variable and its influencing factors were extracted.

Stage Two: Identification of Factors Affecting Supply Chain Resilience Using the Delphi Method

The second phase of the research focused on identifying correlated groups among the variables. To identify the components of the model, the Delphi method was used. The Delphi method is a structured communication technique for academic and steel industry experts, designed to support decision-making and analysis under uncertainty with minimal error. The foundation of the Delphi method lies in the belief that experts in any scientific domain provide the most accurate forecasts of the future. Thus, unlike survey research methods, the validity of the Delphi method depends not on the number of participants but on the scientific credibility of the experts involved. Therefore, selecting knowledgeable and experienced individuals is critical, making this stage one of the most important and requiring careful attention. The number of expert panel members can range from five to twenty. In the current study, 18 academic and steel industry experts with relevant expertise participated. After identifying the experts, the factors influencing supply chain resilience, identified in previous studies, were reviewed through interviews. Some less impactful factors were excluded through several stages. Then, using structural equation modeling in the PLS software, the interview results were analyzed, and key indicators for the supply chain resilience model were extracted based on expert opinions.

Stage Three: Determining the Strength of Relationships Between Model Components and Ranking Influencing Factors Using Structural Equation Modeling

In this stage, to determine the strength of the relationships between the components and indicators of the conceptual model, data obtained from the second stage were analyzed using structural equation modeling concepts. The output led to the presentation of a model of the factors affecting supply chain resilience.

Stage Four: Determining the Impact of Supply Chain Resilience on the Company's Financial Performance

At this stage, after identifying the factors influencing supply chain resilience, a qualitative questionnaire was designed to determine the impact of supply chain resilience on the company's financial performance. Structural equation modeling was used to analyze this relationship. Additionally, regression analysis could also be applied to examine the relationship between supply chain resilience and financial performance.

The research population consisted of 850 managers and supervisors from Mobarakeh Steel Company, as well as academic and industry experts who also participated in the qualitative part of the study. The Cochran formula was used to determine the sample size. Given that the total population of the study was 850 individuals, the minimum required sample size based on the Cochran formula was 265. Ultimately, 300 questionnaires were distributed, and 280 completed questionnaires were collected. A random sampling method was used to identify the sample members. Data collection for this study was conducted through interviews and questionnaires. First, the factors affecting supply chain resilience were identified using expert interviews and the Delphi method. Then, a standardized questionnaire was designed for each factor. To measure supply chain resilience, the Abiscar (2019) questionnaire was used, and financial performance was measured using the standardized questionnaire by Azizi (2011).

For selecting experts for interviews, the snowball sampling method was employed. According to this method, the process began with an informed manager who had relevant academic qualifications and practical experience related to the subject. At the end of the interview, this individual was asked to introduce other knowledgeable and informed persons related to the research topic. To enrich the research, efforts were made to interview individuals who had personal experience with the subject and possessed high levels of expertise and experience. This process continued until theoretical data saturation was achieved, and ultimately, after interviewing 18 individuals, data collection concluded. At the beginning of each interview, the overall aim of the research was explained, and it was emphasized that the interviews would only be used for research purposes, and participant identities would not be disclosed in reports or published articles. After completing interviews with academic and industry experts, the factors influencing supply chain resilience were identified.

The reliability of the questionnaire was assessed at the start of the research process after a pilot implementation and the collection of preliminary questionnaires using the Cronbach's alpha statistical technique. The results showed that the Cronbach's alpha coefficient for all variables was above 0.7, indicating a high level of reliability and precision of the measurement instruments used in this study.

3. Findings and Results

This section first presents the descriptive statistics of the research variables. The descriptive statistics for the variables in this study are as follows:

Table 1. Means and Standard Deviations of Research Variables

Variables	Mean	Standard Deviation
Financial Performance of the Company	4.12	0.63
Supply Chain Resilience	4.09	0.64
Digital Tools	3.98	0.70
Supplier Relationship	4.02	0.71
Customer Relationship	4.12	0.64
Supply Chain Robustness	4.09	0.64
Supply Chain Flexibility	4.08	0.65
Digital Marketing Orientation	4.09	0.63
Supply Chain Reciprocity	4.08	0.65

Transformational Supply Chain Leadership	4.09	0.63
Information Processing Capability	4.14	0.61
Knowledge-Based Dynamic Capability	4.13	0.62
Resource-Based Dynamic Capability	4.09	0.64
Partner Dissatisfaction	4.08	0.63
Environmental Dynamism	4.06	0.60
Communication Quality	4.04	0.63
Supply Chain Integration	4.04	0.65

To assess validity, construct validity (convergent and discriminant) was used, and for reliability assessment of the research variables, Cronbach's alpha and composite reliability tests were applied. The results of validity and reliability tests for the research variables are presented in Table 2:

Table 2. Cronbach's Alpha, Composite Reliability, and Average Variance Extracted (AVE) of Research Variables

Construct	Cronbach's Alpha	Composite Reliability	AVE	Confirmation
Financial Performance of the Company	0.837	0.760	0.561	Confirmed
Supply Chain Resilience	0.878	0.886	0.675	Confirmed
Digital Tools	0.817	0.873	0.571	Confirmed
Supplier Relationship	0.862	0.766	0.589	Confirmed
Customer Relationship	0.807	0.769	0.582	Confirmed
Supply Chain Robustness	0.812	0.869	0.589	Confirmed
Supply Chain Flexibility	0.761	0.832	0.647	Confirmed
Digital Marketing Orientation	0.828	0.798	0.636	Confirmed
Supply Chain Reciprocity	0.862	0.842	0.589	Confirmed
Transformational Supply Chain Leadership	0.793	0.734	0.582	Confirmed
Information Processing Capability	0.825	0.763	0.542	Confirmed
Knowledge-Based Dynamic Capability	0.782	0.886	0.675	Confirmed
Resource-Based Dynamic Capability	0.814	0.819	0.636	Confirmed
Partner Dissatisfaction	0.770	0.849	0.585	Confirmed
Environmental Dynamism	0.701	0.816	0.526	Confirmed
Communication Quality	0.700	0.743	0.613	Confirmed
Supply Chain Integration	0.825	0.869	0.577	Confirmed

Based on Table 2, it was found that the Cronbach's alpha values for all constructs exceed 0.70, which is the threshold for acceptable internal consistency, indicating satisfactory reliability of the model. Furthermore, the composite reliability values for all constructs are above 0.70, confirming good model fit. Additionally, the AVE values for all constructs are above 0.50, which confirms acceptable convergent validity and indicates that the constructs are well-fitting.

Before testing the research hypotheses, the measurability of the research variables through the questionnaire items was evaluated using factor analysis. The factor loadings for the measurement model are provided in Table 3.

Table 3. Factor Loadings of Research Variables

Variable	Dimensions	Factor Loading
Supply Chain Resilience	Reengineering	0.522
	Collaboration	0.574
	Agility	0.668
	Risk Management Culture	0.776
Financial Performance	Value Management	0.739
	Risk Control	0.744
	Cost Control	0.802

As shown in Table 3, all factor loadings are above 0.30, indicating acceptable reliability of the measurement model.

To identify the components of the model, the Delphi method was employed. The Delphi technique is a structured and systematic method for facilitating group communication among academic and steel industry experts, enabling decision-making and analysis under uncertainty with minimal error. Accordingly, for using the Delphi method, experts in the research topic were first identified. After identifying the experts, the factors previously examined by researchers regarding supply chain resilience were filtered through interviews with these experts. In several stages, some less influential factors were removed. Subsequently, structural equation modeling in PLS software was used to analyze the interview results and extract the key indicators of the model of factors influencing supply chain resilience based on expert opinion. The results are presented in Table 4.

Table 4. Factors Influencing Supply Chain Resilience (First Research Question Analysis)

No.	Component	Coefficient	Rank
1	Digital Tools	0.489	3
2	Supplier Relationship	0.354	9
3	Customer Relationship	0.420	5
4	Supply Chain Robustness	0.358	8
5	Supply Chain Flexibility	0.367	7
6	Digital Marketing Orientation	0.160	11
7	Supply Chain Reciprocity	0.142	12
8	Transformational Supply Chain Leadership	0.757	1
9	Information Processing Capability	0.322	10
10	Knowledge-Based Dynamic Capability	0.127	13
11	Resource-Based Dynamic Capability	0.524	2
12	Partner Dissatisfaction	0.455	4
13	Environmental Dynamism	–0.082	15
14	Communication Quality	0.393	6
15	Supply Chain Integration	0.110	14

According to the results in Table 4, the most influential factors on supply chain resilience are, in descending order: transformational supply chain leadership (0.757), resource-based dynamic capability (0.524), digital tools (0.489), partner dissatisfaction (0.455), customer relationship (0.420), communication quality (0.393), supply chain flexibility (0.367), supply chain robustness (0.358), supplier relationship (0.354), information processing capability (0.322), digital marketing orientation (0.160), supply chain reciprocity (0.142), knowledge-based dynamic capability (0.127), supply chain integration (0.110), and environmental dynamism (–0.082).

This section examines the structural equation model (SEM) of the study. First, the model's overall fit is evaluated, followed by an assessment of the model in terms of significance values (to test the hypotheses), and finally the model is presented in terms of path coefficients and R-squared values.

The model fit index in PLS software is assessed using the Goodness-of-Fit (GoF) index. This index allows the researcher to assess the overall model fit after evaluating the measurement and structural components. The values of 0.01, 0.25, and 0.36 are considered weak, moderate, and strong thresholds for GoF, respectively. Based on the calculations, the GoF value for this research model was determined to be 0.264. Since this value exceeds 0.25, the model fit is considered acceptable.

The results showed that at a 95% confidence level, significance values must exceed 1.96 to confirm the strength and significance of the effects of each factor on supply chain resilience.

Table 5. Second Research Question Analysis

Component → Supply Chain Resilience	Coefficient	t-Statistic	p-Value
Digital Tools	0.489	3.320	0.000
Supplier Relationship	0.354	3.464	0.000
Customer Relationship	0.420	4.709	0.000
Supply Chain Robustness	0.358	4.218	0.000
Supply Chain Flexibility	0.367	4.502	0.000
Digital Marketing Orientation	0.160	1.383	0.167
Supply Chain Reciprocity	0.142	1.041	0.298
Transformational Supply Chain Leadership	0.757	5.470	0.000
Information Processing Capability	0.322	3.079	0.000
Knowledge-Based Dynamic Capability	0.127	1.100	0.272
Resource-Based Dynamic Capability	0.524	5.114	0.000
Partner Dissatisfaction	0.455	3.466	0.000
Environmental Dynamism	–0.082	0.534	0.594
Communication Quality	0.393	3.663	0.000
Supply Chain Integration	0.110	1.217	0.224

Table 5 presents the effect sizes, significance levels, and t-statistics for the relationships examined in the second research question. As shown, the factors that significantly influence supply chain resilience—forming the final resilience model—

include: transformational supply chain leadership, resource-based dynamic capability, digital tools, partner dissatisfaction, customer relationship, communication quality, supply chain flexibility, supply chain robustness, supplier relationship, and information processing capability.

The following table shows the effect size, significance level, and t-statistic for the impact of supply chain resilience on financial performance.

Table 6. Research Hypothesis

Relationship	Coefficient	t-Statistic	p-Value
Supply Chain Resilience → Financial Performance	0.502	2.003	0.046

At the 95% confidence level, considering that the p-value is less than 0.05 ($p \leq 0.05$), it can be concluded that supply chain resilience has a statistically significant effect on financial performance, assuming other factors remain constant. Additionally, since the effect coefficient is positive, it is concluded that supply chain resilience positively influences financial performance.

4. Discussion and Conclusion

The findings of this study aimed at designing a resilient supply chain model with a focus on financial outcomes at Mobarakeh Steel Company revealed several critical insights. Using structural equation modeling and the Delphi method, the research identified fifteen primary components influencing supply chain resilience. Among these, ten components demonstrated statistically significant effects: transformational supply chain leadership, resource-based dynamic capability, digital tools, partner dissatisfaction, customer relationship, communication quality, supply chain flexibility, supply chain robustness, supplier relationship, and information processing capability. Moreover, the results confirmed that supply chain resilience has a statistically significant and positive impact on financial performance.

Transformational leadership emerged as the most influential factor, indicating the essential role that visionary and proactive leadership plays in navigating uncertainties. This finding aligns with the literature emphasizing leadership's role in embedding resilience within organizational culture and motivating adaptive strategies across the supply chain network (Shishehbori, 2023; Yamin et al., 2024). Transformational leaders cultivate a forward-looking approach, promoting innovation, flexibility, and rapid response, all of which are indispensable for coping with disruptions (Münch & Hartmann, 2022). In high-risk sectors such as steel manufacturing, leadership that champions resilience can significantly enhance the organization's ability to withstand and recover from disruptions.

Resource-based dynamic capabilities were the second most influential factor. These capabilities enable firms to reconfigure resources and processes in real-time to maintain performance amid volatility. This result supports the conclusions of Stadtfeld and Gruchmann (2023), who highlighted dynamic capabilities as a core enabler of resilient supply chains, especially in turbulent markets (Stadtfeld & Gruchmann, 2023). The ability to adapt sourcing, production, and logistics operations swiftly is central to mitigating risks and achieving continuity (Zhou, 2024). It also validates findings by Li (2022), who emphasized the role of big data and digital competencies in enhancing dynamic capability and strategic responsiveness (Li, 2022).

The third-ranked factor, digital tools, reflects the growing importance of digitalization in modern supply chain resilience strategies. Digital platforms, analytics, and real-time monitoring tools enable firms to detect, assess, and respond to disruptions more effectively. This is in line with Akbar and Aslam (2023), who argued that digitalization enhances the speed and accuracy of decision-making processes and strengthens coordination among supply chain actors (Akbar & Aslam, 2023). The integration of digital tools improves visibility, facilitates scenario analysis, and optimizes inventory and capacity planning, all of which contribute to resilience (Meredith et al., 2023).

Partner dissatisfaction was also found to significantly influence supply chain resilience. This negative relationship suggests that strained relationships with partners can compromise coordination, reduce trust, and increase vulnerability to disruptions. This aligns with studies that underscore the importance of collaboration and mutual satisfaction among supply chain partners as foundational to resilience (Akbar & Aslam, 2023; Ekpudu & Udofia, 2023). Weak partnerships can lead to misalignment of goals and inadequate information sharing, thereby reducing the system's ability to adapt under stress (Kazim et al., 2023).

Customer relationship quality was another significant predictor. Responsive and communicative relationships with customers not only ensure accurate demand forecasting but also build loyalty and reduce the bullwhip effect during crises (Mogere et al., 2023). Customer-centric strategies that emphasize trust and transparency can buffer demand-side shocks and support agile production and distribution responses (Mosavian & Zeinalnejad, 2022).

Communication quality, likewise, plays a central role in shaping resilience. Efficient, timely, and open communication across the supply chain supports situational awareness and swift coordination in crisis scenarios. This finding corroborates Shen et al. (2023), who showed that communication quality significantly contributes to supply chain integration and resilience by reducing ambiguity and enabling joint problem-solving (Shen et al., 2023).

Supply chain flexibility and robustness also proved to be critical. Flexibility allows organizations to adapt operations in response to unforeseen changes, while robustness enables them to absorb shocks without substantial performance degradation. These results echo those of Shishodia et al. (2023) and Song et al. (2022), who reported that flexible and robust systems can reallocate resources and reconfigure workflows rapidly to maintain service levels (Shishodia et al., 2023; Song et al., 2022). In high-asset industries such as steel production, the interplay between robustness and flexibility determines whether disruptions cause minor setbacks or catastrophic failures.

The significance of supplier relationship management supports the growing consensus that upstream collaboration is vital to resilience. Reliable and strategic partnerships with suppliers ensure continuity of raw material supply and rapid recovery capabilities (Akbar & Aslam, 2023; Albalushi et al., 2023). This reinforces the findings of Rahimi et al. (2022), who identified strategic supplier engagement as a top resilience strategy in Iranian industrial firms (Rahimi & et al., 2022). Transparent supplier relationships also facilitate dual sourcing, capacity buffering, and contingency planning.

Information processing capability emerged as the final significant factor. This highlights the need for supply chains to efficiently interpret and act on complex data to anticipate and respond to risks. As noted by Qi et al. (2022), superior information processing enables better demand sensing, resource allocation, and coordination, all of which bolster resilience (Qi et al., 2022). The finding is further validated by Abedini Nazari et al. (2024), who stressed the integration of informational flows as a key pillar of resilience in the automotive industry (Abedini Nazari et al., 2024).

Interestingly, five components—digital marketing orientation, supply chain reciprocity, knowledge-based dynamic capability, supply chain integration, and environmental dynamism—did not show statistically significant effects in the final model. While these factors have been noted in the literature, their influence in the steel industry context may be limited. For example, digital marketing orientation might be more relevant to consumer-facing supply chains, whereas in B2B-heavy industries like steel, it plays a lesser role in operational resilience (Parsamehr & Iraji Rad, 2021). Likewise, environmental dynamism may be a contextual factor that affects other industries more directly than vertically integrated and heavily regulated sectors such as steel manufacturing.

Finally, the positive and significant relationship between supply chain resilience and financial performance confirms the strategic value of resilience investments. This finding supports prior research showing that resilient supply chains outperform their counterparts in cost efficiency, service levels, and risk-adjusted returns (Rachid et al., 2024; Zhu & Wu, 2022). Firms with resilient capabilities are better equipped to avoid costly disruptions, recover faster, and sustain customer satisfaction, all of which contribute to improved profitability (Annals of Operations, 2023). Razavian et al. (2021) similarly noted that resilient strategies reduce operational risk and enhance financial stability in capital-intensive industries (Razavian et al., 2021).

Despite the valuable findings, this study is not without limitations. First, the research is based on a single case study—Mobarakeh Steel Company—which limits the generalizability of the results to other sectors or contexts. While the steel industry offers a rich context for studying resilience due to its complexity and exposure to global risks, the results may differ in service-based or technology-driven supply chains. Second, the cross-sectional nature of the study restricts the ability to infer long-term causal relationships. Resilience is a dynamic construct that evolves over time, and longitudinal data could offer deeper insights. Third, reliance on self-reported data through surveys and interviews may introduce bias, as respondents might overstate their organization's resilience capabilities or performance levels.

Future research should explore the applicability of this model across multiple industries, especially in service-oriented, agricultural, or high-tech supply chains, where the nature of resilience enablers may vary. A comparative study across sectors could enrich the understanding of context-specific resilience mechanisms. Additionally, employing longitudinal designs would allow researchers to observe how resilience strategies are developed and refined over time, particularly in response to recurrent disruptions. Another promising direction is to integrate sustainability metrics and investigate the intersection between resilience and environmental/social performance. Lastly, future studies could incorporate simulation-based modeling to evaluate how different resilience configurations respond to specific disruption scenarios.

For practitioners, the findings of this study offer actionable insights. Supply chain managers should prioritize developing transformational leadership capabilities and dynamic resource management strategies to build resilience. Investment in digital tools that support real-time visibility and decision-making is essential, as is fostering strong relationships with both suppliers and customers. Emphasizing communication quality across all supply chain tiers can improve coordination during crises. Importantly, resilience-building should not be seen as a reactive cost but as a strategic investment with long-term financial returns. Managers should assess their organization's current resilience maturity and embed resilience thinking into daily operations, strategic planning, and performance evaluation frameworks.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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References

Abedini Nazari, N., Adab, H., & Chahardoli, A. (2024). Designing a Model for the Integration of Physical, Informational, and Financial Processes in the Supply Chain to Achieve Resilience in the Automotive Industry. *Dynamic Management and Business Analysis*, *3*(1), 192-204. https://doi.org/10.61838/dmbaj.3.1.11

Akbar, B., & Aslam, H. (2023). Reinforcing resilience on the supply side: the role of supplier capabilities. *Business Process Management Journal*, *29*(7), 1938-1957. https://doi.org/10.1108/bpmj-01-2023-0032

Albalushi, J., Mishra, R., & Abebe, M. (2023). Supply Chain Resilience Meets Quality Management. *International Journal of Professional Business Review*, *8*(12), 4165. https://doi.org/10.26668/businessreview/2023.v8i12.4165

Annals of Operations, R. (2023). Supply chain disruptions and resilience: A major review and future research agenda. *Annals of Operations Research*. https://link.springer.com/article/10.1007/s10479-023-04728-9

Ekpudu, J., & Udofia, E. (2023). Collaborative Approach to Flexibility, Visibility and Velocity in Supply Chains. *Modern Management Review*, 1-10. https://doi.org/10.7862/rz.2023.mmr.02

Kazim, M., Qureshi, I. M., Asghar, M. A., Hassan, A. F., & Ashfaq, S. R. (2023). Insights on Resilience and Flexibility During COVID-19 Pandemic: A Study on Wheat Supply Chains in Pakistan. *Research Journal for Societal Issues*, *5*(2), 137. https://doi.org/10.56976/rjsi.v5i2.137

Li, N. (2022). Research on Supply Chain Resilience and Core Competency: Considering Big Data Analytics. *Scientific and Social Research*, *4*(2), 30-38. https://doi.org/10.26689/ssr.v4i2.3630

Malashahi, H., Fakhrzad, M. B., Hosseini Nasab, H., & Khademi Zare, H. (2024). Inter-chain competition based on sustainability and resilience indicators in supply chain network design. *Supply chain management*, *26*(82), 77-93.

McKinsey, & Company. (2022). *Supply chain disruption and resilience*. https://www.mckinsey.com/business-functions/operations/our-insights/supply-chain-disruption-and-resilience

Meredith, E., Papakostas, N., & Hargaden, V. (2023). Impact of Inventory Management Policies on Supply Chain Resilience at RiRiShun Logistics. *Proceedings of the 2023 International Conference on Logistics and Supply Chain Management*. https://www.scitepress.org/Papers/2023/121468/121468.pdf

Mogere, K. M., Kwendo, E. S., & Fozia, N. (2023). Supply Chain Resilience and Service Delivery of Public Health Care Facilities in Western Region Kenya. *African Journal of Empirical Research*, *4*(1), 18. https://doi.org/10.51867/ajernet4.1.18

Mosavian, S. G., & Zeinalnejad, M. (2022). Designing a Reverse Supply Chain in the Fast Fashion Industry for Customer Relationship Management Using Data Mining and Mathematical Modeling. *Industrial Management Studies*, *15*(76), 35-57. https://www.noormags.ir/view/fa/articlepage/1975052

Münch, C., & Hartmann, E. (2022). Transforming resilience in the context of a pandemic: results from a cross-industry case study exploring supply chain viability. *International Journal of Production Research*, *61*(6), 2544-2562. https://doi.org/10.1080/00207543.2022.2029610

Parsamehr, F., & Iraji Rad, A. (2021). The Impact of Closed-Loop Strategic Orientation on Performance by Explaining the Mediating Role of Green Supply Chain Management in Iran Khodro Company. *Strategic Management in Industrial Systems (Formerly Industrial Management)*, *16*(55), 34-49. https://doi.org/10.30495/imj.2021.681570

Qi, Y., Wang, X., Zhang, M., & Wang, Q. (2022). Developing supply chain resilience through integration: An empirical study on an e-commerce platform. *Journal of Operations Management*. https://doi.org/10.1002/joom.1226

Rachid, B., Roland, D., Sebastien, D., & Ivana, R. (2024). Risk Management Approach for Lean, Agile, Resilient and Green Supply Chain. *World Academy of Science, Engineering and Technology, International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, *11*(4), 742-750. https://publications.waset.org/10006688/risk-management-approach-for-lean-agile-resilient-and-green-supply-chain

Rahimi, A., & et al. (2022). Identifying Resilience Strategies in the Supply Chain of Industrial Companies. *Industrial Management Studies*, *15*(76), 1-15. https://www.noormags.ir/view/fa/articlepage/1975054

Razavian, E., Tabriz, A. A., Zandieh, M., & Hamidizadeh, M. (2021). An integrated material-financial risk-averse resilient supply chain model with a real-world application. *Computers & Industrial Engineering*, *161*, 107629. https://doi.org/10.1016/j.cie.2021.107629

Sepasi, M., & Khodaparasti, R. (2022). Investigating the Impact of Green Design on Environmental Performance Considering the Mediating Role of External Green Supply Chain Management Practices and the Moderating Role of the Institutional Environment (Case Study: Food Industry Companies in Urmia). *Supply chain management*, *15*(76), 23-34. https://www.noormags.ir/view/fa/articlepage/1975053

Shen, X., Xu, Q., Liu, Q., & Leibercht, M. (2023). The relationship between supply chain resilience, supply chain integration, and supply chain performance: A MASEM analysis. *Journal of Intelligent & Fuzzy Systems*, *45*, 3361-3377. https://doi.org/10.3233/jifs-220649

Shishehbori, A. (2023). Presenting a Resilient Supply Chain Management and Its Impact on Sustainable Supply Chain Performance Using Data-Based Method. *Studies of Management and Sustainable Development*, *3*(1), 49-70. https://civilica.com/doc/2057881

Shishodia, A., Sharma, R., Rajesh, R., & Munim, Z. H. (2023). Supply chain resilience: A review, conceptual framework and future research. *The International Journal of Logistics Management*, *34*(4), 879-908. https://doi.org/10.1108/IJLM-03-2021-0169

Song, M., Ma, X., Zhao, X., & Zhang, L. (2022). How to enhance supply chain resilience: a logistics approach. *The International Journal of Logistics Management*. https://doi.org/10.1108/ijlm-04-2021-0211

Stadtfeld, G. M., & Gruchmann, T. (2023). Dynamic capabilities for supply chain resilience: a meta-review. *The International Journal of Logistics Management*. https://doi.org/10.1108/ijlm-09-2022-0373

Yamin, B. M., Almuteri, S. D., Bogari, K. J., & Ashi, A. K. (2024). The Influence of Strategic Human Resource Management and Artificial Intelligence in Determining Supply Chain Agility and Supply Chain Resilience. *Sustainability*, *16*(7), 2688. https://doi.org/10.3390/su16072688

Zhou, Y. (2024). Examining Supply Chain Resilience in the Automotive Industry: A Case Study. *Frontiers in Management Science*, *3*(4), 36-38. https://doi.org/10.56397/fms.2024.08.04

Zhu, X., & Wu, Y. J. (2022). How Does Supply Chain Resilience Affect Supply Chain Performance? *Sustainability*, *14*(21), 14626. https://doi.org/10.3390/su142114626