Strategic Insights into Supply Chain Resilience in Construction: Unveiling Influencing Factors and Dynamic Capabilities

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ABSTRACT

The research aimed to empirically assess the impact of dynamic capabilities on supply chain resilience within the construction industry in Saudi Arabia, specifically through the lens of innovation capabilities. Cross-sectional data were gathered from 320 construction industry employees in Saudi Arabia using a convenience sampling technique. A quantitative research approach was employed, with structural equation modelling (PLS-SEM) utilized to analyse the research hypotheses. The results indicated that the dimensions of dynamic capabilities have a direct, positive, and significant impact on the supply chain resilience of the Saudi Arabian construction industry. Additionally, the analysis revealed that while the relationship between most dynamic capabilities dimensions and supply chain resilience is partially mediated by innovation capabilities, the recovery ability dimension does not exhibit such mediation. The study provides theoretical contributions by highlighting the critical role of dynamic capabilities in bolstering supply chain resilience and underscores that innovation capabilities mediate this relationship, with the exception of recovery ability. Practically, construction firms in Saudi Arabia are advised to focus on developing dynamic capabilities and enhancing innovation to improve resilience and gain a competitive advantage.

Keywords: Dynamic Capabilities, Supply Chain Resilience, Construction Industry, Saudi Arabia.

INTRODUCTION

The rapid expansion of the construction industry has shifted towards modernization and enhancement (Li et al., 2023). This innovative approach plays a crucial role in supporting the industry's goals of achieving carbon peak and carbon neutrality (Abourokbah et al., 2023). Construction now often involves deconstructing buildings into prefabricated modules manufactured in controlled factory environments, which are then transported to construction sites for assembly (Du et al., 2023). Typical construction components include reinforced concrete elements, such as one-dimensional single pieces (e.g., beams and stairs) and two-dimensional panelised systems (e.g., floors, walls, and roofs) (Fagbenro et al., 2023). The resilience of the supply chain is crucial in prefabricated construction, bridging construction sites and manufacturing facilities (Han et al., 2023). For optimal project performance, a seamless supply chain is essential (Han et al., 2023). Inefficient supply chain management can lead to increased transportation costs, diminished production efficiency, and compromised project outcomes, ultimately reducing a company's competitive advantage (Yevu et al., 2023).

The supply chain process in the construction industry can be adversely affected due to the involvement of various participants with diverse demands. The interconnectivity among these participants often leads to challenges that negatively impact supply chain resilience (Yevu et al., 2023). Common issues arising from inadequate supply chain management include premature or delayed deliveries, extended construction timelines, excess inventory, repetitive handling, and increased project costs (Hua et al., 2023). Traditional risk management strategies frequently fall short in addressing unexpected disruptions within the prefabricated construction supply chain (Hua et al., 2023). As a result, supply chain resilience has become a critical tool for managing risks, demonstrating a firm's ability to survive, adapt, and thrive despite challenges (Cheng et al., 2024). Enhancing resilience is vital for effectively managing unforeseen disruptions (Cheng et al., 2024).

Improving supply chain resilience is crucial for achieving organizational competitive advantage. Among various factors contributing to this enhancement, dynamic capabilities—defined as a firm's ability to continually adapt and refine its resources in response to environmental changes—play a pivotal role (Dubey et al., 2023). These capabilities enable firms to proactively adjust to market conditions and foster resilience by focusing on resource reconfiguration (Dubey et al., 2023). Junaid et al (2023) argue that incorporating dynamic capabilities into resilience studies overcomes the limitations of static perspectives, demonstrating how these capabilities provide sustained resilience advantages. Furthermore, various scholars highlight that the impact of dynamic capabilities on supply chain resilience is amplified by innovation. Innovation represents a firm’s capacity to develop processes that enhance efficiency and adaptability (Zhou et al., 2024). In the construction sector, strong innovation capabilities enable firms to adapt to evolving market conditions and technological advancements (Abourokbah et al., 2023). By fostering continuous improvement and creative problem-solving, innovation capabilities help firms manage disruptions more effectively and optimize supply chain operations (Abourokbah et al., 2023). Integrating innovation capability into the analysis of supply chain resilience offers a deeper understanding of how dynamic capabilities influence resilience outcomes and underscores the importance of adaptive strategies for maintaining competitive advantages. Given that innovation enhances supply chain resilience, it is recommended that dynamic capabilities improve the culture of innovation, which in turn enhances resilience (Abourokbah et al., 2023). Therefore, this study employs innovation capability as a mediating factor between dynamic capabilities and supply chain resilience.

The importance of dynamic capabilities for enhancing supply chain resilience has been recognized; however, prior research often neglects these capabilities in the context of construction supply chains, predominantly addressing static factors related to vulnerability and risk resistance (Junaid et al., 2023; Pu et al., 2023; Ramos et al., 2023). Additionally, earlier studies have concentrated primarily on the impact of dynamic capabilities on performance outcomes (Baía & Ferreira, 2024; Vardarsuyu et al., 2024). Notably, the dimensions of dynamic capabilities have not been thoroughly examined within existing models (Liu et al., 2024; Pundziene et al., 2022). Conversely, dynamic capabilities have been linked to innovation (Foguesatto et al., 2024; Praditya & Purwanto, 2024). and the effects of innovation capabilities on supply chains have been explored (Belhadi et al., 2024; Zhou et al., 2024). One study investigated innovation as a mediating variable between dynamic capabilities and performance but did not consider the mediating role of innovation capabilities between dynamic capabilities and supply chain resilience. This suggests a gap in research regarding the combined effects of dynamic capabilities, innovation capabilities, and supply chain resilience. Furthermore,

existing studies have predominantly focused on contexts outside Saudi Arabia and other sectors, with limited attention given to the construction industry within Saudi Arabia (Albesher, 2014; Alhassani & Al-Somali, 2022). To address these gaps, this study focuses on the mediating effect of innovation capabilities between dynamic capabilities and supply chain resilience specifically within the construction industry of Saudi Arabia.

This study addresses both practical and theoretical gaps in the context of the Saudi Arabian construction industry. From a theoretical perspective, the study offers significant findings on the impact of dynamic capabilities, highlighting their direct and indirect effects and emphasizing the critical role of innovation capabilities within this relationship. Previous research has often overlooked the dynamic interplay between these elements, focusing primarily on static factors or the direct impact of innovation on performance. By incorporating innovation capabilities as a mediating variable, this study provides a comprehensive perspective that bridges gaps in existing models and underscores the importance of dynamic capabilities in enhancing resilience. From a practical perspective, the study's findings offer valuable insights for construction companies in Saudi Arabia. It suggests that increasing innovation within their supply chains can significantly enhance their resilience against disruptions. This approach not only improves supply chain resilience but also aligns with the need for adaptive strategies in a rapidly evolving industry. Consequently, companies will be better equipped to address supply chain challenges, thereby gaining a competitive edge in the region where empirical findings remain robust. The study is structured into four additional chapters. The first chapter, the literature review, discusses both theoretical and empirical studies relevant to the research. The second chapter, research methodology, outlines the research design and sampling techniques employed in the study. The third chapter presents the data analysis and interpretation of the results. The final chapter discusses the findings and addresses the research limitations.

LITERATURE REVIEW

Dynamic capabilities refer to a firm's ability to build and reconfigure various internal and external resources to adapt to rapidly changing environmental conditions. These capabilities enable organizations to respond to new opportunities and threats by evolving their resource base and operational routines. The extant literature discusses various dynamic capabilities. One such capability is the ability to participate in the supply chain, which is considered integral to resilience, enhancing a firm's capacity to sustain operations during disruptions (Ramos et al., 2023). Participation involves efficiently sharing information and collaborating throughout the supply chain. The more participants actively engage in supply chain processes, the greater the collective ability to respond to and manage disruptions (Dubey et al., 2023). Effective participation fosters a more integrated and agile supply chain, crucial for resilience as it allows for quicker adjustments and improved problem-solving capabilities (Dubey et al., 2023). Ramos et al (2023) demonstrated that companies with high levels of supplier integration exhibited better resilience during disruptions. Similarly, Liu et al (2024) found that firms with collaborative relationships with their supply chain partners were more successful in managing supply chain disruptions. Furthermore, it is suggested that participation increases supply chain resilience by enhancing information flow (Ramos et al., 2023)

Another dimension of dynamic capabilities is response capability, which entails the capacity to react efficiently to disruptions. This capability is a subset of organizational agility, enabling firms to adjust their capabilities to align with operational needs (Liu et al., 2024). A responsive

supply chain can rapidly reconfigure its resources and processes to address emerging challenges, thus maintaining operational continuity and competitive advantage (Kähkönen et al., 2023). This capability is integral to managing disruptions and sustaining supply chain performance. Junaid et al (2023) found that companies with high response capabilities were better equipped to handle supply chain disruptions and recover more swiftly. Uddin et al (2023) highlighted that firms with robust response strategies experienced less operational disruption and faster recovery. Additionally, further studies have demonstrated the importance of responsive practices in enhancing a firm's ability to manage challenges efficiently and effectively, thereby increasing competitive advantage.

Another dimension of dynamic capabilities is adaptability, which refers to the ability to adjust to challenging environmental conditions (Dubey et al., 2023). Adaptability helps companies modify their operations and structures in response to changes, contributing to long-term resilience by enabling firms to stay competitive and recover from disruptions through continuous evolution of practices and processes. Juan & Li (2023) found that companies with high adaptive capability were more successful in managing supply chain disruptions and maintaining performance. Junaid et al (2023) also noted that adaptive supply chains could better anticipate and react to disruptions, enhancing resilience. Dubey et al (2023) demonstrated the positive impact of adaptability on supply chain resilience and suggested future studies should explore this relationship alongside other dynamic capabilities to further enhance resilience. Another critical dimension is recovery capability, which focuses on the capacity to restore normal business operations after disruptions (Junaid et al., 2023). Recovery involves the processes and strategies organizations use to regain previous performance levels and operational stability (Ponomarov, 2012). Theoretically, recovery is integral to overall supply chain resilience, as firms with strong recovery mechanisms can better absorb shocks and minimize long-term impacts. Juan & Li (2023) highlighted that firms with robust recovery capabilities experienced less operational downtime, thus supporting company growth.

Another dimension of dynamic capability is the ability to learn, which involves leveraging past experiences to enhance future operations and bolster supply chain resilience (Dubey et al., 2023). This capability facilitates organizations in identifying and implementing improvements based on previous disruptions (Kähkönen et al., 2023). Learning organizations can adapt their practices, refine strategies, and avoid repeating past mistakes, thereby enhancing their resilience to future disruptions (Roh et al., 2022). Empirical research by Yu et al. (2019) also found a positive and significant impact of learning ability on supply chain resilience. They suggested that future studies could explore the relationship between learning capability and other dimensions of dynamic capabilities to further enhance supply chain resilience.

Environmental scanning involves systematically monitoring and analysing external factors that may impact supply chain resilience. YahiaMarzouk & Jin (2023b) emphasized that environmental scanning is crucial for identifying risks and opportunities, thereby enhancing resilience. By staying informed about external changes, firms can proactively adjust strategies and operations to mitigate risks and seize opportunities (YahiaMarzouk & Jin, 2022b). Effective environmental scanning improves risk management and strategic planning, making firms better prepared for external disruptions (YahiaMarzouk & Jin, 2022, 2023). Additionally, employee engagement plays a significant role in enhancing supply chain resilience. Engaged employees contribute to better collaboration and problem-solving, which are critical for resilience (Gu et al., 2023; Monternel et al., 2023). Higher engagement levels are associated with improved coordination and adaptability during disruptions, positively impacting supply

chain resilience (Gu et al., 2023; Monternel et al., 2023). These findings underscore the importance of dynamic capabilities in boosting supply chain resilience. Therefore, the study has formulated the following research hypotheses,

H1: *ABT has significant influence to SCR.*
H2: *ABR has significant influence to SCR.*
H3: *ATA has significant influence to SCR.*
H4: *ATOR has significant influence to SCR.*
H5: *ABTR has significant influence to SCR.*
H6: *ES has significant influence to SCR.*
H7: *OE has significant influence to SCR.*

Mediating Effect of Innovation Capability

The preceding discussion highlights the relationship between dynamic capabilities and supply chain resilience. Several studies have underscored the importance of examining the mediating effects in this relationship (Herburger et al., 2024; Stadtfeld & Gruchmann, 2024). Gu et al (2023) argued that active participation fosters information exchange and collaborative innovation, thereby enhancing resilience. Salam & Bajaba (2023) emphasized that promoting an innovation culture through stakeholder participation can strengthen supply chain resilience. Similarly, Abourokbah et al (2023) found that increased stakeholder engagement led to enhanced innovation capabilities, which, in turn, improved supply chain resilience. Piprani et al (2023) also demonstrated that firms with strong participative practices and high innovation capabilities exhibited greater resilience. Conversely, the ability to respond effectively also fosters organizational innovation (Sullivan & Wamba, 2024), which can enhance supply chain resilience (Belhadi et al., 2024). Responsive organizations are better positioned to leverage their innovation capabilities to address disruptions (Praditya & Purwanto, 2024). Effective response mechanisms enable firms to rapidly develop and implement innovative solutions, thereby improving resilience (Praditya & Purwanto, 2024). Ismail (2024) noted that firms with strong response capabilities, which also boost innovation, are better equipped to handle disruptions. Furthermore, Wang et al (2024) found a positive and significant impact of dynamic capabilities on innovation capabilities, suggesting that both dynamic and innovation capabilities should be examined in relation to supply chain factors.

Adaptability within dynamic capabilities plays a crucial role in enhancing innovation (Zhou, 2024). Nguyen et al (2024) suggested that the ability to adapt allows firms to reconfigure their operations and strategies in response to environmental changes, thereby facilitating the development and implementation of innovative solutions. This, in turn, can enhance supply chain resilience (Belhadi et al., 2024). Iftikhar et al (2024) demonstrated that firms with strong adaptability and innovation capabilities are better equipped to respond to supply chain disruptions. Hu et al (2024) further found that adaptability improves resilience through enhanced innovation, as firms with flexible operations manage challenges more effectively. Recovery capabilities also play a significant role in fostering an innovation culture Zhou et al (2024), which can improve supply chain resilience. Recovery processes that incorporate innovative approaches to problem-solving and process improvements can enhance overall resilience (Zhao et al., 2024). Effective recovery not only restores normal operations but also integrates innovative practices to prevent future disruptions (Zhao et al., 2024). Wen & Wen(2024) identified a partial mediating effect of innovation capabilities between dynamic capabilities and the global value chain, suggesting that further research is needed in other

contexts and with different endogenous variables. Additionally, studies on innovation capabilities have demonstrated significant mediating effects of environmental scanning, recommending further exploration of these relationships to understand variations in findings. Consequently, this study focuses on examining the mediating effect of innovation capabilities between dynamic capabilities and supply chain resilience. In this context, the study has proposed the following research hypotheses,

H8: *ATP has significant influence to SCR via mediating effect of IC.*
H9: *ATR has significant influence to SCR via mediating effect of IC.*
H10: *ATA has significant influence to SCR via mediating effect of SCR.*
H11: *ATOR has significant influence to SCR via mediating effect of IC.*
H12: *ABTR has significant influence to SCR via mediating effect of IC.*
H13: *ES has significant influence to SCR via mediating effect of IC.*
H14: *OE has significant influence to SCR via mediating effect of IC.*

Based on the literature review, the proposed research framework is illustrated in Figure 1.

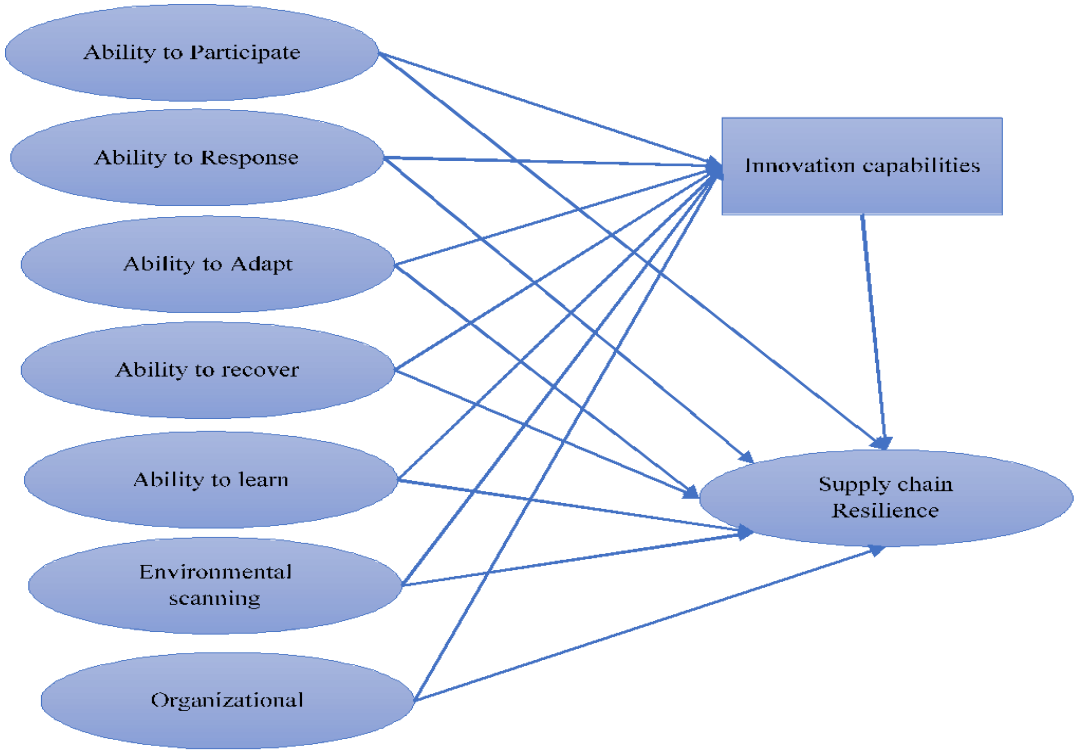

Figure 1: Research Framework

DESIGN AND RESEARCH METHODOLOGY

The study employed a quantitative research approach, utilizing data collected via a self-administered questionnaire. This survey instrument, which has been extensively used in the construction industry, aligns with the cross-sectional research design appropriate for this study. The questionnaire was adapted from existing literature where it had previously been employed. Dynamic capabilities were assessed through seven dimensions: ability to participate, ability to respond, ability to adapt, ability to recover, ability to learn, environmental scanning, and employee engagement. Specifically, the ability to participate was measured with nine

questions, ability to respond with eight questions, ability to adapt with six questions, ability to recover with seven questions, and ability to learn with six questions, all adapted from (Liu et al., 2024). Environmental scanning was assessed with six questions, and employee engagement with five questions, based on (Pundziene et al., 2022). Innovation capabilities were measured using five items from Iddris (2016), and supply chain resilience was evaluated with five items from (Ponomarov, 2012). The study utilized a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

The survey instrument was distributed among employees in the construction industry in Saudi Arabia using a convenience sampling technique, which is justified by its practicality for reaching a large number of participants within a specific sector (Taherdoost, 2016). A total of 400 questionnaires were distributed based on participants' accessibility and ease of contact, aiming for a representative sample. Of these, 320 were completed and returned, resulting in a response rate of 80%. This high response rate enhances data reliability, providing a robust basis for analysis and reflecting the perspectives of a significant portion of the target population (Kelley et al., 2003). The collected data were analysed using SPSS and Smart PLS software, with inferential analysis conducted through Partial Least Squares (PLS) Structural Equation Modelling (SEM).

Construct Reliability and Validity

The measurement model was evaluated using two key types of validity: convergent and discriminant validity. Convergent validity assesses whether the instrument accurately measures the construct of interest. High convergent validity indicates that the instrument reliably captures the intended construct. In convergent validity, factor loadings reflect the correlation between observed variables and their underlying latent factors. High factor loadings (generally above 0.7) suggest a strong relationship between observed variables and the latent construct, demonstrating that the items are effective indicators of the construct (Cheah et al., 2018). Cronbach's Alpha, which measures internal consistency, should exceed 0.7 to be deemed acceptable, with values above 0.8 preferred for greater precision (Hair Jr et al., 2020). Composite Reliability (CR) evaluates the construct's reliability by examining the weighted sum of factor loadings, with a CR value above 0.7 considered satisfactory, indicating consistent measurement across items (Hair Jr et al., 2020). Finally, Average Variance Extracted (AVE) assesses the proportion of variance in the construct explained by the measurement model, with values above 0.5 deemed acceptable for convergent validity (Ab Hamid et al., 2017). These results are detailed in Table 1.

Table 1: Convergent Validity

Variable	VIF	Alpha	CR	AVE
ATP	1.31	0.851	0.871	0.632
ATR	1.783	0.841	0.862	0.713
ATA	1.32	0.864	0.883	0.752
AT0R	1.421	0.836	0.851	0.642
ABTR	1.722	0.822	0.843	0.582
ES	1.872	0.844	0.862	0.723
OE	1.861	0.851	0.873	0.742
IC	1.781	0.816	0.832	0.572
SCR	1.341	0.845	0.863	0.781

Demographic Profile

Table 2 presents the demographic characteristics of the participants. Out of the 400 distributed questionnaires, 320 valid responses were collected. Among these respondents, 68.75% were male and 31.25% female, reflecting the male-dominated nature of Saudi Arabian society. The majority of respondents were aged between 35 and 54 years, with the largest groups in the 45 to 54 age range (28.13%) and the 35 to 44 range (25.00%), indicating a workforce with considerable industry experience. Educationally, 43.75% held an undergraduate degree, while 31.25% had a Master's degree, suggesting a highly educated demographic. Experience-wise, 21.88% of respondents had 15 to 20 years in the industry, indicating significant expertise. Additionally, 68.75% of the respondents were non-managerial, highlighting a predominance of operational staff over managerial roles (31.25%). The detailed demographic results are shown in Table 2.

Table 2: Demographic Profile

Respondents Characteristics	Distribution in Percentage
Gender	
Female	31.25
Male	68.75
Age	
Below 25	1.25
25-34	9.38
35- 44	25.00
45-54	28.13
55-64	21.88
65-74	11.25
Above 75	3.13
Education	
Above school	6.25
Under graduation	43.75
Masters	31.25
Others	18.75
Working Years	
Less than 5 years	5.00
5 to 10 years	9.38
10 to 15 years	15.63
15 to 20 years	21.8
20 to 25 years	18.75
25 to 30 years	15.63
More than 30 years	13.75
Designation	
Managerial	31.25
Non-Managerial	68.75

Note: ATP-Ability to Participate, ATR-Ability to Respond, ATA-Ability to Adapt, AT0R-Ability to Recover, ABTR-Ability to Learn. ES-Environmental Scanning, OE-Organizational Engagement, IC-Innovation Capabilities, SCR-Supply Chain Resilience.

In addition to assessing convergent validity, the next step involves evaluating discriminant validity. Discriminant validity determines whether a construct is distinct from other constructs. This can be assessed using three criteria: Fornell-Larcker criterion, cross-loadings, and the Heterotrait-Monotrait Ratio (HTMT). The Fornell-Larcker criterion involves comparing the square root of the Average Variance Extracted (AVE) for each construct with the correlations between constructs. For a construct to exhibit discriminant validity, the square root of its AVE must be greater than its correlations with other constructs (Fornell & Larcker, 1981). Another method is to examine cross-loadings, ensuring that items load more strongly on their intended construct than on other constructs. This confirms that the items are measuring the specific construct they are designed to assess (Henseler et al., 2015). The HTMT ratio provides a stringent test for discriminant validity, where HTMT values below 0.85 indicate that the construct has discriminant validity (Henseler et al., 2015). Additionally, multicollinearity was assessed using Variance Inflation Factor (VIF) values, which were all below 5, indicating no significant correlation issues among constructs (Hair Jr et al., 2020). These results are detailed in Tables 3 and 4.

Table 3: Forneall and Larcker

Construct	ATP	ATR	ATA	ATOR	ABTR	ES	OE	IC	SCR
ATP	0.794								
ATR	0.452	0.844							
ATA	0.513	0.491	0.867						
AT0R	0.246	0.433	0.441	0.801					
ABTR	0.343	0.242	0.413	0.423	0.762				
ES	0.148	0.347	0.462	0.431	0.421	0.850			
OE	0.347	0.446	0.283	0.423	0.431	0.451	0.861		
IC	0.244	0.243	0.345	0.431	0.390	0.442	0.421	0.756	
SCR	0.562	0.178	0.241	0.234	0.523	0.290	0.341	0.452	0.883

Table 4: HTMT

	ATP	ATR	ATA	ATOR	ABTR	ES	OE	IC	SCR
ATP									
ATR	0.241								
ATA	0.182	0.127							
AT0R	0.356	0.124	0.121						
ABTR	0.157	0.235	0.233	0.132					
ES	0.155	0.126	0.122	0.125	0.452				
OE	0.253	0.281	0.235	0.434	0.552	0.531			
IC	0.143	0.123	0.341	0.672	0.451	0.672	0.361		
SCR	0.162	0.231	0.267	0.562	0.672	0.452	0.231	0.345	

Empirical Findings

The next step involves testing the study hypotheses using a bootstrap resampling technique with 5,000 iterations. The results from the PLS-SEM analysis reveal that all dimensions of dynamic capabilities have a positive and significant impact on supply chain resilience within the Saudi Arabian construction industry, thereby supporting Hypotheses 1 through 7. Regarding indirect effects, the analysis indicates that the relationship between dynamic capabilities and supply chain resilience is partially mediated by dynamic capabilities, except

for the dimension of recovery, which does not show a significant mediation effect. This outcome supports Hypotheses 8 through 14, excluding Hypothesis 11, where the mediation effect of innovation capabilities is not observed. This lack of significance may be due to potential overlap with other hypotheses. Additionally, the Q^2 value exceeds 0, indicating that the constructs meet the requirement for predictive relevance (Hair Jr et al., 2020). The detailed results are provided in Table 5.

Table 5: Empirical Findings

Hypothesis	Coefficient	Standard Deviation	T-Statistic	R Square
Direct Effects				
ABP → SCR	0.451	0.081	5.561	
ATR → SCR	0.523	0.092	5.561	
ATA → SCR	0.421	0.123	3.423	
ATOR → SCR	0.481	0.113	4.251	
ABTR→ SCR	0.434	0.122	3.552	
ES → SCR	0.381	0.091	4.186	
OE→ SCR	0.431	0.134	3.216	**0.213 Mediating Variable**
Mediating Effects (Innovation Capability)				
ABP → SCR	0.323	0.072	4.481	
ATR → SCR	0.351	0.083	4.228	
ATA → SCR	0.253	0.093	2.723	
ATOR → SCR	0.132	0.122	1.081	
ABTR→ SCR	0.281	0.123	2.284	
ES → SCR	0.321	0.082	3.910	
OE→ SCR	0.292	0.091	3.208	**0.714 Dependent Variable**

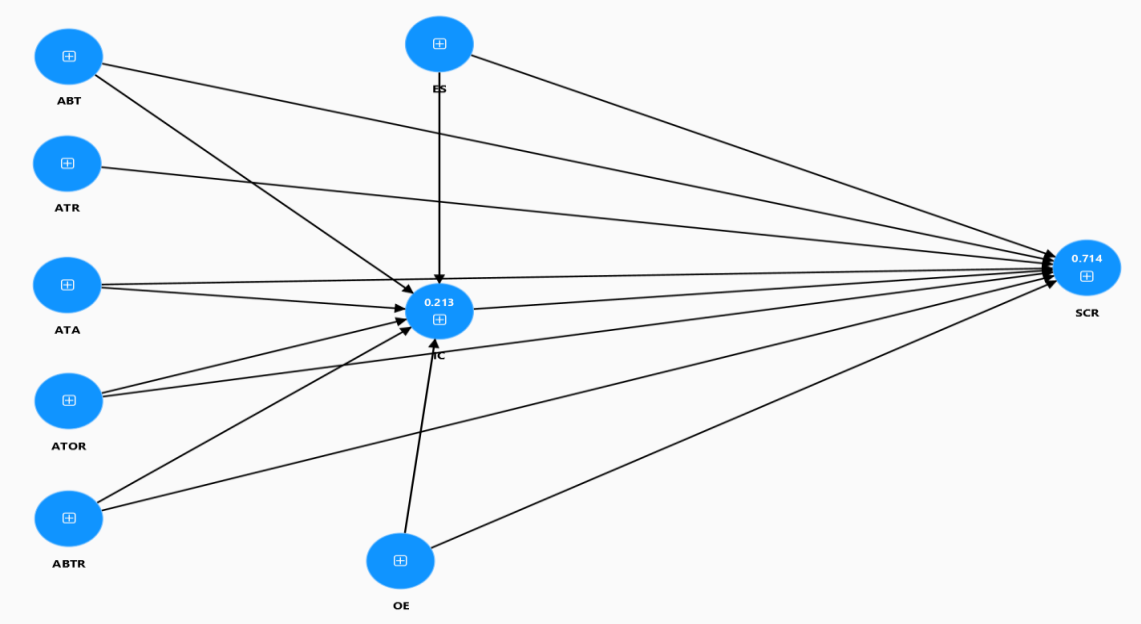

Figure 2: R-Square

DISCUSSION OF FINDINGS

The research aimed to assess the impact of dynamic capabilities on supply chain resilience through the lens of innovation capabilities within the Saudi Arabian construction industry. The results from PLS-SEM indicate that the ability to participate significantly and positively influences supply chain resilience in Saudi Arabian construction firms. This underscores the importance of stakeholder involvement in the industry, aligning with findings from Chih et al (2022) and Liu et al (2024), who observed that increased stakeholder engagement enhances risk management and project outcomes. In the context of Saudi Arabia, where large-scale infrastructure projects are prevalent, fostering stakeholder participation is crucial for ensuring efficient operations and adaptability to disruptions. Additionally, the study reveals that a strong ability to respond also has a significant positive impact on supply chain resilience. This highlights the necessity for adaptive strategies within the construction industry to gain a competitive advantage. Consistent with Chih et al (2022) and Liu et al (2024), these findings suggest that responsive supply chains are better equipped to handle delays and unforeseen issues, which is essential given the dynamic nature of the Saudi construction sector. Consequently, construction firms in Saudi Arabia should prioritize developing responsive capabilities to enhance supply chain resilience and contribute to economic growth.

The findings further indicate that adaptability positively and significantly impacts supply chain resilience within the pharmaceutical industry in Saudi Arabia. This result aligns with the studies conducted by Liu et al (2024) and Qi et al (2023), highlighting the importance of adaptability for enhancing supply chain resilience in Saudi Arabia's pharmaceutical sector. The significant impact of adaptability underscores the need for flexibility to address evolving project requirements and environmental conditions, consistent with the observations of (Liu & Liu, 2023). Additionally, the study demonstrates that the ability to recover also has a positive and significant effect on supply chain resilience. This finding is supported by Qi et al (2023), who emphasize that effective recovery processes are critical for maintaining project continuity and mitigating adverse impacts. The significant positive effect of recovery mechanisms underscores their importance for the Saudi construction industry, as robust recovery strategies can minimize downtime and financial losses during disruptions.

The ability to learn significantly influences supply chain resilience, underscoring the value of continuous improvement within Saudi Arabia's construction industry. Learning from past experiences enhances resilience by enabling firms to refine practices and anticipate potential issues more effectively, as highlighted by Qi et al (2023) and Ye & Lau (2022). These findings suggest that Saudi construction companies should prioritize learning to bolster their supply chain resilience and support economic development. Additionally, environmental scanning significantly and positively impacts supply chain resilience in the pharmaceutical industry in Saudi Arabia. This result emphasizes the importance of monitoring external factors, such as regulatory changes and market conditions, which can be volatile. Effective environmental scanning allows firms to anticipate and manage potential disruptions, aligning with the conclusions of Liu & Liu (2023) and Ye & Lau (2022), who assert that proactive scanning enhances strategic planning and risk management. Moreover, employee organizational engagement has a significant effect on supply chain resilience in Saudi Arabia's pharmaceutical sector. Engaged employees contribute to innovative solutions and effective problem-solving, reflecting the findings of (Liu et al., 2024). This suggests that high levels of employee engagement can improve operational efficiency and resilience in construction projects, thereby enhancing competitive advantage.

The mediating effect analysis reveals that the relationship between the ability to participate and supply chain resilience is partially mediated by innovation capability within the Saudi Arabian construction industry. This finding underscores the importance of stakeholder involvement in driving innovation, which, in turn, enhances supply chain resilience. As the construction industry increasingly emphasizes technological advancements, innovation plays a crucial role in leveraging stakeholder contributions to develop effective resilience strategies. This aligns with the studies of Taleb et al (2023), who argue that an innovation-driven environment, facilitated by active stakeholder participation, strengthens supply chain resilience. Additionally, the results indicate that innovation capability partially mediates the relationship between the ability to respond and supply chain resilience in Saudi Arabian construction companies. This suggests that a strong focus on customer response, coupled with an innovative culture, significantly enhances supply chain resilience. This finding is consistent with Taleb et al (2023), who observed that innovation capability serves as a significant mediator between organizational resources and business performance. The ability to respond, as a resource, contributes to supply chain resilience by enhancing innovation capabilities, thereby improving response effectiveness and resilience in construction projects. Furthermore, the analysis shows that innovation capability mediates the relationship between adaptability and resilience. Firms that integrate innovation into their adaptive strategies are better prepared to handle disruptions. In the context of Saudi Arabia's transforming construction industry, incorporating innovative practices into adaptability strategies is essential.

The further analysis of indirect mediating effects reveals that innovation capability does not significantly mediate the relationship between the ability to recover and supply chain resilience. This suggests that while recovery capability directly affects resilience, innovation may not substantially enhance this relationship within the current context. One possible explanation is that recovery strategies in Saudi Arabia's construction sector are already well-established, limiting the additional impact of innovation on these strategies. This result indicates the need for a reassessment of how innovation is integrated into recovery processes in the construction industry. Conversely, the results demonstrate that innovation capability partially mediates the relationship between the ability to learn and supply chain resilience in Saudi Arabia. This suggests that learning processes are more effective when combined with innovative practices. In the Saudi construction industry, applying lessons learned through innovative approaches strengthens resilience. This finding is consistent with the work of Cepeda & Arias-Pérez (2019) and Zehir et al (2015), who argue that innovation enables organizations to effectively apply learned knowledge to enhance resilience. Additionally, the mediating effect analysis shows that innovation capability also partially mediates the relationship between organizational commitment and supply chain resilience in Saudi Arabian construction companies. This finding highlights the role of employee engagement in fostering a culture of innovation, which in turn enhances resilience. It underscores the importance for construction firms in Saudi Arabia to cultivate an environment of engagement and innovation to boost resilience. This result is supported by Y. Zhang (2022), who emphasizes that engaged employees contribute to a more innovative and resilient construction environment. Overall, these findings illustrate that innovation capabilities play a significant role in mediating various relationships impacting supply chain resilience. They enrich the existing literature by highlighting the complex interplay between innovation and resilience, suggesting new avenues for future research.

CONCLUSION

The research aimed to examine the impact of dynamic capabilities on supply chain resilience

within the Saudi Arabian construction industry, with a particular focus on the role of innovation capabilities. Data were collected from 320 employees in the sector. The results obtained through PLS-SEM revealed that all dynamic capabilities have a direct, positive, and significant impact on supply chain resilience in the Saudi construction industry, thus supporting hypotheses 1 through 7. Furthermore, the study found that the relationship between dynamic capabilities and supply chain resilience is partially mediated by innovation capabilities, with the exception of the ability to recover. The mediating effect of innovation capabilities was not observed in the relationship between recovery ability and supply chain resilience. Theoretical contributions of this study highlight the pivotal role of dynamic capabilities in enhancing supply chain resilience and underscore the significance of innovation capabilities in mediating this relationship, with the notable exception of recovery ability. Practically, the findings suggest that construction firms in Saudi Arabia should prioritize the development of dynamic capabilities and foster innovation to bolster their resilience and gain a competitive advantage.

Implications

From a theoretical perspective, this study offers significant contributions by elucidating the direct and indirect effects of dynamic capabilities, with a particular emphasis on the critical role of innovation capabilities. Prior research has frequently neglected the dynamic interplay between these elements, often concentrating on static factors or the direct impact of innovation on performance. By incorporating innovation capabilities as a mediating variable, this study provides a more comprehensive view that addresses gaps in existing models and underscores the importance of dynamic capabilities in bolstering resilience. However, the non-significant mediating effect of innovation on recovery capability suggests that recovery strategies might require further refinement. This study also provides valuable insights for researchers in Saudi Arabia, suggesting potential avenues for investigating supply chain resilience in other sectors. Theoretical implications aside, the study offers several practical recommendations. For instance, construction firms are encouraged to prioritize stakeholder involvement to foster a collaborative environment conducive to innovation, thereby enhancing resilience. Additionally, firms should develop adaptive strategies that incorporate new technologies and innovative practices to improve their responsiveness to disruptions. It is also essential for organizations to invest in recovery strategies that are robust on their own, rather than relying solely on innovation. Emphasizing continuous learning and environmental scanning, while integrating these processes with innovative approaches, can further enhance resilience, thereby increasing competitive advantage and contributing to economic growth.

Limitations and Future Directions

The study presents several limitations that could be addressed in future research. Firstly, the cross-sectional design of the study captures data at a single point in time, which constrains the ability to infer causality or observe changes over time. Future research could overcome this limitation by employing longitudinal research designs, which would allow for tracking changes and provide a more comprehensive understanding of the evolving dynamics within the industry. Secondly, while this study utilized innovation capabilities as a mediating variable, other potential mediators could also influence the relationship between dynamic capabilities and supply chain resilience. Future research might explore additional mediating variables to enhance the predictive relevance and robustness of the findings. Lastly, the study's reliance on a quantitative research approach limits the depth of understanding that can be achieved from qualitative insights. Qualitative data, such as personal experiences and contextual factors, could

offer valuable perspectives that complement quantitative findings. Future research could benefit from adopting a mixed-methods approach, which would enable triangulation of data and provide a richer, more nuanced view of the factors affecting supply chain resilience.

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APPENDIX

Research Questionnaire

1-Strongly Disagree, 2=Disagree, 3=Neutral, 4-Agree, 5-Stronlgy Agree

Environmental Scanning

1. On a regular basis, assesses local and international market trends.
2. On a regular basis, follows technology development trends.
3. On a regular basis, appraises competitors and their products/services.
4. On a regular basis, assesses customers' experiences and emerging Needs.
5. Spares enough time for observing and evaluating the business Environment.
6. Takes early notice of forthcoming environmental changes.

Organizational Employee Engagement

1. On a regular basis, submit innovative product/service ideas.
2. Are encouraged to take calculated risks while implementing innovative ideas.
3. Invest their own time to work on innovation projects or services.
4. Mostly are initiators of innovation projects.
5. Take part in the commercialization of innovative products/services.

Ability to Anticipate

1. Information is shared between firms.
2. Firms collect business intelligence information in a timely.
3. A perfect information system for information exchange is established between firms.
4. Firms have a real-time flow of information throughout the supply chain.
5. Firms take risk management as an important topic in staff training.
6. Firms understand the risks in the supply chain.
7. Risk awareness is prevalent in firms.
8. Firms have complete risk early warning strategies.
9. Firms have comprehensive strategies to avoid risk events.

Ability to Respond

1. Firms can respond quickly to changing markets.
2. Firms are sensitive to opportunities and threats in the business environment.
3. Firms have cooperative planning and decision-making practices with supply chain others.
4. Firms cooperate deeply to predict future changes.
5. Firms share value resources with others.
6. Firms train staff, shape risk sensitive culture and cohesion team.
7. Firms combines staff with different knowledge backgrounds to solve common problem.
8. Firms carry out crisis management for experienced staff

Ability to Adapt

1. Firms can choose multiple vendors.
2. Firms have different transportation routes and transportation methods.
3. Firms have buffer stock.
4. Firms can flexibly arrange production plans according to different order.
5. Firms can make timely adjustments to order changes.
6. Firms can meet the sudden needs of customers and change the delivery schedule in a timely.

Ability to Recover

1. Firms have good capital or capital appreciation capabilities.
2. Firms have different products, which are involved in different industries.
3. Firms have provisions to cope with risks.
4. Firms have invested different insurances.
5. Firms can accurately identify emergencies and formulate emergency plans for various.
6. In the face of emergencies, firms can quickly make decisions and implement corresponding
7. Firms have an emergency plan post-event evaluation system

Innovation Capabilities

1. Use of enterprise resource planning or supply chain planning software for managing/coordinating global supply chain activities
2. Your business unit encourages employees to" think outside of the box"
3. We systematically compare our customer offerings with those of other Firms
4. The management team acts as coaches and facilitators in support of training.
5. We provide time and resources for employees to generate, share/exchange and experiment with innovative ideas/solutions

Supply Chain Resilience

1. Our supply chain is able to adequately respond to unexpected disruptions by quickly restoring its product flow
2. Our supply chain can quickly return to its original state after being disrupted
3. Our supply chain can move to a new more desirable state after being disrupted
4. Our supply chain is well prepared to deal with financial outcomes of supply chain disruptions
5. Our supply chain has the ability to maintain a desired level of connectedness among its members at the time of disruption