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ENHANCING SUPPLY CHAIN RESILIENCE IN PROJECT PROCUREMENT THROUGH RISK MANAGEMENT STRATEGIES IN CONSTRUCTION PROJECTS

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ABSTRACT

"Uncertainty" characterizes current global business conditions. Risks associated with supply chain management for construction projects have become harder to identify and manage. As a result, project outcomes have become less predictable. This study examines methods to refine procurement of construction projects, with a focus on processes and structures to effectively integrate risk management strategies, especially within the framework of the Pakistani construction industry. Using a selection of theories focused primarily on flexibility and interaction, the study develops a framework showing how risk management strategies, especially processes focused on supply chain preparation for disaster, are integrated with the flexibility of the organization's culture and staff to achieve the success of a construction project. Data were collected from construction industry professionals working in Pakistan. Data analysis was accomplished using PLS-SEM within the confines of SmartPLS 4. Findings from the study support the integration of risk management strategies for supply chain preparation for disaster to enhance construction project outcomes. The study demonstrates the need for and benefits from the integration of supply chain and project management systems to achieve project outcomes within the desired performance constraints. The adaptability of project management systems within an organization's culture is reinforced by the study. The study demonstrates risk management processes to accomplish project outcomes and facilitates project management to high risk, remote, and unstable markets.

Keywords:

Supply Chain Resilience; Risk Management Strategies; Disaster Preparation; Supply Chain Agility; Construction Project Success; Organizational Culture; Project Procurement; PLS-SEM

INTRODUCTION

The construction industry is prone to many different types of risks. These include supply chain disruptions, changes in the economy and inflation, geopolitical risks, and the availability of building materials. Traditional manufacturing has fewer risks of this nature. This is because in traditional manufacturing, the materials, processes, and people are integrated and controlled by the organization. This is not the case with construction. Each part of a construction project is integrated and controlled by different entities. The uncontrollable nature of construction makes it very susceptible to disruptions, which can impact schedule, cost and the quality of the

end product. The nature of disruptions in construction has evolved to the extent that Shishehgarkhaneh et al. (2024) argue that construction procurement risks require innovative, sophisticated, and proactive risk management strategies. Disruptions in the world have become more prevalent. This includes the COVID-19 pandemic and the war in Ukraine. Organizations have become more interested in managing their supply chains to be flexible rather than focused on efficiency. The focus is on supply chains that can help an organization be resilient to shocks. This includes the supply chain's ability to withstand and recover from significant disruptions. Several strategies can help an organization achieve this, such as increased collaboration between organizations and supply chain partner networks.

The ability of construction supply chains to absorb, adapt to, or resist supply and demand shocks has a positive effect on the performance of construction projects. Risks and challenges that are often beyond the control of the project team and include unpredictable behavior of suppliers, insufficient and unbalanced resources, and inadequate planning to address risks lead to cost overruns, schedule delays, and performance failures. Chen et al. (2024) stressed the need to develop and incorporate various supply chain alternatives to ensure a reliable source of construction materials to support the continuity of the project. Other strategies to support the supply chain, including supplier risk management and negotiation, should also be employed. Shishehgarkhaneh et al. (2024) noted that the focus of construction supply chain risk management has been on integrating various risk management, assessment, and resilience-building strategies.

Pakistani construction industry has its own set of unique challenges, including high level of project and construction industry risks, failures, and shocks, coupled with the challenges faced by other developing economies. Construction firms have to develop a more proactive approach to identify and effectively address shocks and risks. One of the more effective approaches to address shocks and risks has been to develop a flexible and responsive supply chain. It has also been widely adopted by construction firms to improve the firm's approach to shocks, risks, and uncertain demands.

There is growing recognition for the need to integrate supply chain resilience within organization's risk management systems and processes. In the process, the objectives of businesses are better achieved. The Dynamic Capabilities theory argues that the long term competitive edge of a business is guided by the organization's ability to identify new opportunities and threats, and subsequently, change the business's organizational structure to take advantage of the opportunities and respond to the threats (Teece, 2018). Prior to the award of a construction contract, preparation for a possible disaster by a contracting entity includes the entity's assessment of the risks that may disrupt the construction of the facility. This also includes the entity's assessment of the risks that may hinder the supply of the construction materials. Maintaining the resilience of a supply chain enables attainment of flexibility and adapts to the various changes that may occur in a supply and demand environment. Because of the nature of construction work, the success of building supply chain resilience is dependent on the organization's culture. For example, the extent to which an organization's culture fosters positive relationships, openness and integration enables the organization to achieve the goal of integrating the risks that may disrupt a business and the response strategies. The response to disruptive risks, amongst others, ultimately determines the organization's ability to be resilient. While studies have investigated the management of risks and resilience in supply chains for various industries, research has ignored the interrelation of different variables such as advanced preparation for a disaster, agility of the supply chain, organizational culture and success in completion of construction projects in growing economies. Additionally, the body of knowledge has inadequate case studies to validate the theory of integration of supply chain resilience with proactive risk management strategy and project performance. This theory is tested in the framework developed in this research.

This research attempts to conceptually bridge the gap created due to inadequate case studies to validate the integration theory of supply chain resilience and other related variables with project performance. This study uses examples and case studies to explain the benefits of resilient supply chain strategies for the building construction industry. This research emphasizes the use of proactive strategies to manage the risks associated with the supply chain, flexibility and adjustability in the supply chain and organizational culture to achieve overall performance of construction projects.

Background of the Study

The construction industry is important to economic and infrastructure growth, but it is a risky industry due to instability and supply chain issues. Long construction projects have many procurement parties and are vulnerable to many risks. Geopolitical and economic risks can disrupt construction, and delays can increase costs. Sometimes disruptions can make it too difficult to maintain construction quality. In recent years, unexpected events have shown that project management and procurement practices are limited. Project management has focused on risk management and response. Processes and practices have shown little resilience to disruption. To be competitive, companies need resilient supply chains to absorb shocks and provide the ability to rapidly recover and re-adjust to continuously changing disruptions. The building construction industry has the capability to prepare for disasters, adjust and adapt to various risks in the supply chain, assess different types of risks, and collaborate with suppliers. Disaster preparation allows firms to proactively seek out risks to their business. Supply chain agility enables firms to quickly alter and adjust their procurement activities to fulfill demand. Dynamic Capabilities emphasize the importance of a firm's sensing, seizing, and reconfiguring capabilities to survive and thrive in the face of environmental uncertainty and competitive rivalry.

The construction industry in Pakistan has numerous challenges beyond those addressed by the literature on construction industry project failures, including economic instability, high inflation, depreciation of the local currency, excessive reliance on imported materials, and a lack of sophisticated procurement methods. Many of these challenges lead to contractors and construction firms' inability to effectively manage construction project activities and increase the likelihood of project failures. For projects to be successfully completed in Pakistan, construction firms must develop resilience to absorb and recover from risks and negative situations in their supply chain.

Research Problem

Procurement processes and risk management practices in the Pakistani construction industry create several challenges such as time and cost overruns. Cost-focused procurement practices ensure that construction firms maintain a reactive approach toward supply disruptions including inflation, supply shortages and variances in the cost of transport and other service and input costs.

Construction firms understand that they must mitigate risks in the supply chain. However, most firms do not invest in integrating systems that help plan and manage the supply chain and facilitate procurement and flexibility. Because of this, firms are unable to identify and manage risks.

Research Gap

Many studies focus on supply chain risk and resilience in manufacturing and other industries in developed countries. Research on construction supply chains in emerging countries like Pakistan is lacking. Also, most studies on supply chain management address individual problems affecting the supply chain. Research on the joint effects of the preparedness to respond to a natural disaster, the flexibility of the supply chain, and organizational culture on project performance is inadequate.

Research Objectives

The objectives of this study are

1. To examine the relationship between disaster preparation and construction project success.
2. To analyze the relationship between supply chain agility and construction project success.

3.To investigate the mediating role of supply chain resilience between disaster preparation, supply chain agility, and construction project success.
4.To examine the moderating effect of organizational culture on the relationship between proactive risk management strategies and supply chain resilience.

Research Questions

This study addresses the following research questions

RQ1: What is the impact of disaster preparation on construction project success?
RQ2: Does supply chain agility significantly influence construction project success?
RQ3: Does supply chain resilience mediate the relationship between disaster preparation and construction project success?
RQ4: Does supply chain resilience mediate the relationship between supply chain agility and construction project success?
RQ5: Does organizational culture moderate the relationship between disaster preparation, supply chain agility, and supply chain resilience?

Significance of the Study

The study extends the body of knowledge on risk management strategies in construction through resilience. It enriches academic literature by incorporating the aforementioned theories to construct resilience within organizations and firms. Most importantly, the study enriches the practices and behaviors of construction firms and project managers and offers novel insights to procurement specialists. It demonstrates that prevention, flexibility, and the adaptation of different organizational practices and cultures along the supply chain can mitigate disruption and improve the overall performance of construction projects. The authors of this study have examined various cases of buildings and civil infrastructure in Pakistan and outline areas for research on procurement systems and strategies for the construction industry in Pakistan. They provide insight for industry and government on integration of systems that focus on flexible practices to address challenges of reducing uncertainty in the construction industry of Pakistan.

LITERATURE REVIEW

Disruptions to construction project procurement and distribution have increased in recent years. Construction supply chains (concroc) are by nature complex and uncertain with supply chain tiers often represented by multiple, unconnected intermediaries. Many of the supply chain strategies employed by construction organizations are based on the principles of supply chain integration and continuous improvement. However, recent focus has been on supply chain resilience. In effect, a construction organization must have the capability to preempt, adapt and adjust to changing supply and/or demand conditions. (Ivanov and Dolgui 2021). The term supply chain resilience is described as the ability of a supply chain to absorb disruption and/or volatility and enable the restoration of service and/or supply continuity (Wieland and Durach 2021). Resilient supply chains in construction have the potential to ensure continuous improvement (cost, schedule and performance) of project outcomes.

In recent years, a great body of academic literature has focused on the strategies construction organizations should pursue to improve supply chain resilience. These strategies have centered on risk management and integration, particularly as it relates to supplier collaboration. Construction supply chain resilience was also investigated by alternative sourcing and supplier strategies, as well as integration and collaboration across the project supply and delivery tiers.

In developing countries, including Pakistan, there are many challenges in the supply chain. This is exacerbated by economic instability, limited means, and reliance on exported goods. The Pakistani construction industry, for example, is vulnerable to price and exchange rate fluctuations when importing construction materials. It is also vulnerable to supply and demand lags in the import and procurement process. Consequently, constructing resilient systems is critical for managing risks in the supply chain, as it can improve the overall

performance and help the industry overcome disruptions.

Risk Management in Project Procurement

The procurement process of construction projects provides numerous opportunities for risk exposure. Some of these risks include selection and management of subcontractors, suppliers and consultants; and the acquisition, transport, and storage of construction materials. Risk exposure continues throughout the project, and its unmanaged presence can negatively impact the project. Anticipating risk and managing it is essential in preventing unexpected negative impacts and enhancing positive impact potentials.

There are many similarities between the concepts and practices of risk management and opportunity management. Traditionally, project management focused on managing unexpected risks. The project management approach is gradually changing to a more proactive position. The focus is on realizing anticipated opportunities and risks. The project management approach, of course, relies on managing the risks and enhancing the opportunities in a manner that best fulfills the project objectives. The same principle can be applied to the construction industry.

Supply Chain Agility and Construction Performance

Supply chain agility is a measure of the speed at which a business can adapt to changes in demand, supply disruptions, and other unplanned events. A construction company would benefit from supply chain agility in that it could adapt its procurement strategy, recognize and approach alternative suppliers, and respond to rapidly changing project conditions.

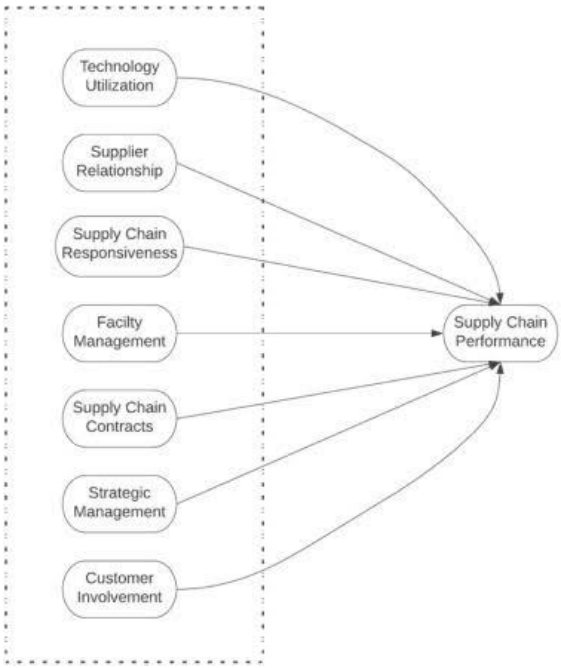


Fig 2.1 Supply Chain Agility and Construction Performance

In supply chain management, responsiveness is frequently tied to information technology, and the integration of business and supply chain partners. Agile processes and organizational cultures foster responsiveness and are best positioned to adjust to unanticipated changes.

Research over the last few years has focused more on the relationship between agility and resilience. While there is a relationship between the two concepts, the focus has been more on the former. It is understood that the adaptability and resilience of a supply chain is a key element to improving overall project performance.

Role of Organizational Culture in Supply Chain Resilience

The ability of a firm to respond to uncertainty and acquire resilient capabilities is culturally influenced. Cultural influence encourages the development of both the organization's system and personnel to foster a learning environment to recognize threats and stimulate response strategies.

In the context of construction, the ability of an organization to influence its partner firms to collaborate to manage risks along the supply chain depends on the organizational cultures of the firm and its partners. Improving cooperation among stakeholders along the supply chain and fostering a commitment to continuous improvement to reinforce the proactive strategies of supply chain resilience enhances the relationship and integration of a learning culture within the organization.

For the purpose of this study, the findings confirm that a learning culture is central in integrating resilience strategies along the supply chain.

Theoretical Foundation

The main bodies of theory underpinning this research are the Dynamic Capabilities, Absorptive Capacity and the Resource-based View of the Firm. These bodies of theory influence an organization's ability to respond to uncertainty and adapt to meet various demands in the environment.

Dynamic Capabilities Theory

Dynamic capabilities allow organizations to identify changes in the environment, take advantage of opportunities, and change or combine their resources to meet those changes. This provides the organization a competitive edge. Traditional theories on competitive advantage focus on the resources available to an organization and how best to utilize them.

For this research, the sense capability is represented by disaster preparedness, which allows an organization to recognize risks. The seize capability is represented by supply chain agility, which allows an organization to respond to risks in the supply chain. The reconfigure capability is represented by the supply chain's resilience to allow the organization to adapt to new normalcy after a supply chain shock.

Resource-Based View Theory

Resource-Based View Theory asserts that for a competitive advantage to be sustainable, it must be aspired by a fiber, rare, and inimitable resource. Superior performance by an organization is attributed to the organization's internal resources and capabilities.

When discussing construction supply chains, it is argued that the primary resources are the organizational and strategic capabilities to manage risks along the supply chain. These capabilities enable construction firms to improve the variability and performance of construction projects.

Absorptive Capacity Theory

This theory focuses on an organization's ability to learn from its environment and implement this knowledge to enhance its performance.

In the context of supply chain resilience, absorptive capacity encompasses the various strategies organizations employ to learn from past experiences, or from the experiences of stakeholders and the risk information to determine the kind of disruptions that may occur in the supply chain.

Conceptual Framework

Disaster Preparation and Supply Chain Agility are constructs in the framework developed to explain the factors that positively influence Construction Project Success. Supply Chain Resilience is posited to show how the firm proactively creates pathways to achieve project success. Further, it is posited that culture would influence the relationship between proactive behavior and the supply chain.

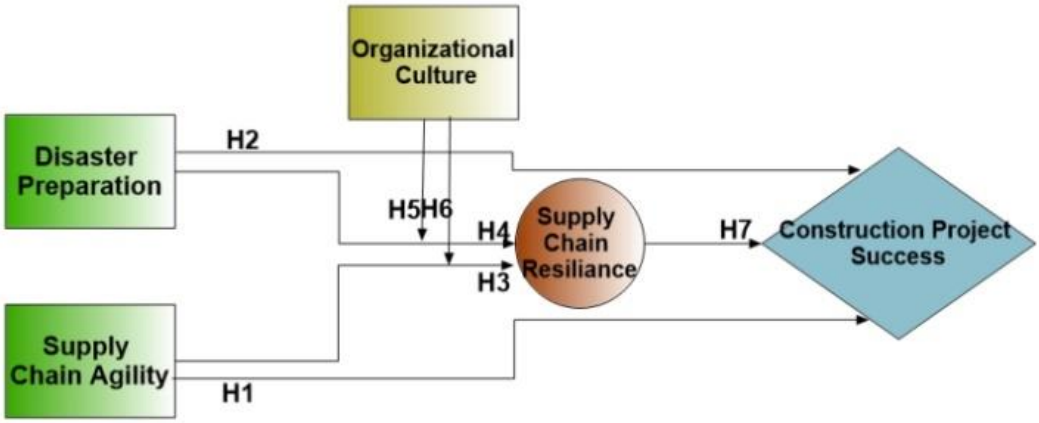


Fig 2.2 Conceptual Framework

With the framework, it is expected that the integration of proactive behaviors by the firm to better manage the construction supply chain would help enhance the success of construction projects.

RESEARCH METHODOLOGY

This study uses a quantitative research design to examine the effect of risk management strategies on supply chain resilience and its impact on the success of construction projects. A quantitative research design was adopted to test and confirm the hypotheses formulated after evaluating the effect of Disaster Preparation and Supply Chain Agility on the Success of Construction Projects, and to assess the role of Supply Chain Resilience and the effect of Organizational Culture.

The design adopted for this study was a survey from which data were collected from construction specialists at a given point in time. This design was useful for confirming the theories and hypotheses of the study regarding the relationships that exist in the construction industry.

Research Approach

The study employed a hypothesis-testing approach. The approach involves formulating hypotheses using empirical evidence from the literature and/or other sources. This approach is generally acceptable to the members of the target population because it is based on theories relating to Dynamic Capability, Resource based View, and Absorptive Capacity.

The main objective of this study was to examine the relationships that exist among Disaster Preparation, Supply Chain Agility, Supply Chain Resilience, Organizational Culture, and the Success of Construction Projects. This was accomplished by administering a survey to the construction specialist population. The survey data were analyzed to accept or reject the hypotheses formulated to evaluate the relationships.

Population and Sample

This study is concerned with project procurement and management personnel in the Pakistani construction industry. This includes, but is not limited to, contractors, consultants, and buyers.

As formal participants in the Pakistani construction industry are concerned, this study is interested in personnel of Pakistan Engineers Council (PEC) recognized construction organizations. A sample of 300 was chosen from this population for empirical study. Other constructions professionals were not accessible for participation in the study due to sampling constraints.

The sample permits evaluation of the proposed research-model.

Data Collection Procedure

Data were collected by means of a pre-designed questionnaire sent to professional personnel working in the construction industry of Pakistan. Questions were based on previously published and validated questionnaires and measurement scales, and were modified to be

contextually relevant to the procedure and practices of the Pakistan construction industry, especially, procurement.



Fig 3.2 Flow chart of methodology

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Prior to the completion of the questionnaires, respondents were given a brief description of the research to provide them an opportunity to understand the scope of the research.

The focus of the current study was to evaluate the constructs of supply chain and project management in the context of disaster management. This included the assessment of organizational culture, the role and contributions of the personnel, and the key success indicators of project management.

Measurement Instrument

The main tool of data collection was a questionnaire that contained factors that represent the dimensions of the constructs of interest in the study. Respondents were required to indicate their views on each of the factors using a Likert type scale.

The independent variables were Disaster Preparation and Supply Chain Agility. Supply Chain Resilience was assessed as a meditating variable. Organizational Culture was assessed as a moderating variable. The dependent variable was Construction Project Success.

The constructs represented by the survey items include (a) risk forecasting, (b) contingency planning, (c) supply chain collaboration, (d) organizational recovery, (e) flexibility, (f) efficiency, (g) timeliness, and (h) quality.

Data Analysis Technique

The statistical techniques included descriptive and inferential analyses. SmartPLS 4 software was utilized to conduct the analysis, as it supports the definition and testing of multiple mediating and moderating variables. The advanced feature of the software supports the estimation of path models.

The analysis was comprised of a measurement model assessment and a structural model assessment.

Reliability and Validity Analysis

The analysis of reliability and validity was performed to examine the level of confidence in the measurement tool. The analysis of reliability was performed using various methods including Cronbach's Alpha and Composite Reliability.

For validity, the researcher evaluated the factor loadings. Further, average variance extracted (AVE) was assessed to evaluate convergent validity. To analyze discriminant validity, researcher evaluated if the variances of the different constructs of the research model were greater than the correlations of the respective elements of the model.

Ethical Considerations

The researcher adhered to all ethical practices during the research. The research was fully voluntary, and participants were free to withdraw at any time. Respondents were not identified, and their responses were kept confidential. The researcher adhered to all ethical practices during the research. All research practices were in accordance to the ethical practices of research and academic integrity.

RESULTS AND FINDINGS

This section presents the results of the data analysis. The data analysis was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS 4. The results are reported in two parts: outcomes of the assessment of the measurement model and outcomes of the assessment of the structural model. The measurement model assesses constructs of the model and the relationships among these constructs. The structural model, on the other hand, assesses the relationships among Disaster Preparation, Supply Chain Agility and Supply Chain Resilience, as well as Organizational Culture and the Success of the Construction Project under study.

Respondents' Demographic Profile

The demographic information of respondents was analyzed to reveal the professional and other information about the participants of the study. The respondents were employees working in construction projects in Pakistan. These employees included project managers, procurement officials and other consultants and contractors.

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Table 4.1: Respondents' Demographic Profile

Demographic Variable	Category	Frequency	Percentage (%)
Gender	Male	252	84.0
	Female	48	16.0
Total		**300**	**100**
Education	Bachelor Degree	118	39.3
	Master Degree	156	52.0
	PhD	26	8.7
Total		**300**	**100**
Experience	1–5 Years	74	24.7
	6–10 Years	112	37.3
	Above 10 Years	114	38.0
Total		**300**	**100**
Position	Project Manager	96	32.0
	Procurement Manager	72	24.0
	Consultant	66	22.0
	Contractor	66	22.0
Total		**300**	**100**

The information evaluated included professional training, work experience and work position. The analyzed information helped identify constructs and elements of the research model and determine the suitability of the respondents to evaluate the model.

The information collected from a sample of professionals working in the various segments of the construction industry was useful in developing a broad base of professional insights to validate the research model.

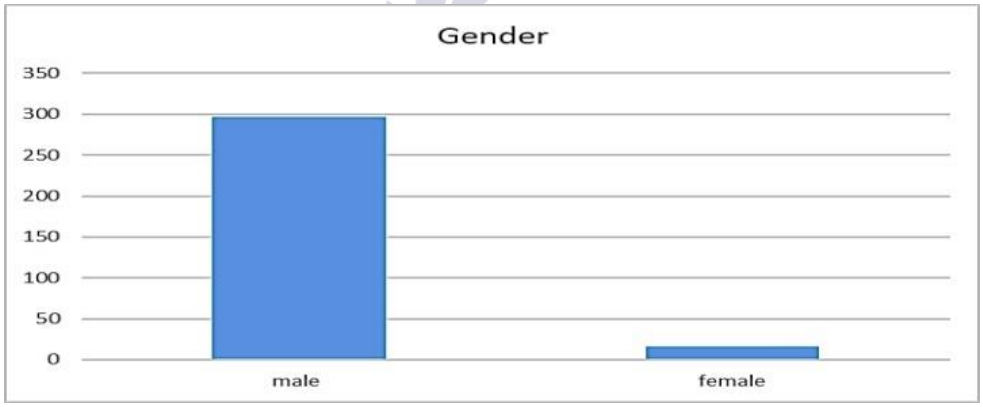
Assessment of the Measurement Model

The measurement model assessed the degree to which the elements of the constructs of the model were measured. The assessment also helped evaluate the degree to which the elements of the constructs of the model were correlated. The assessment also evaluated the degree of association of elements of different constructs of the model.

Table 4.2: Descriptive Statistics of Constructs

Construct	Mean	Standard Deviation	Minimum	Maximum
Disaster Preparation (DP)	4.12	0.61	1	5
Supply Chain Agility (SCA)	4.05	0.64	1	5
Supply Chain Resilience (SCRES)	4.18	0.58	1	5
Organizational Culture (OC)	4.09	0.62	1	5
Construction Project Success (PS)	4.21	0.55	1	5

Measurement Model The components of the measurement model were Disaster Preparation, Supply Chain Agility, Supply Chain Resilience, Organizational Culture and Construction Project Success. The model tested to confirm if the representation of the constructs by the respective measurement items was clear. The model further tested the connection and relationship of the constructs to each other.



Resource; compiled by author based on questionnaire

Reliability Analysis

The analysis of the internal consistency of the measurement model was conducted. It involved evaluation of the relationship among the items that make up a construct.

The results of the analysis indicated that the measurement items were reliable and could be further analyzed. Further, the results indicated that the questionnaire items were stable, thereby assuring measurement of the research variables of interest. It was, therefore, established that the constructs of Disaster Preparation, Supply Chain Agility and Supply Chain Resilience, as well as Organizational Culture and Construction Project Success were analyzed and modeled in the measurement model.

Convergent Validity

This level of validity was assessed by evaluating the amount of variance shared by the measurement items of a construct as well as by reviewing factor loadings.

The results showed that measurement items of the various constructs loaded on their respective factors and that the measurement

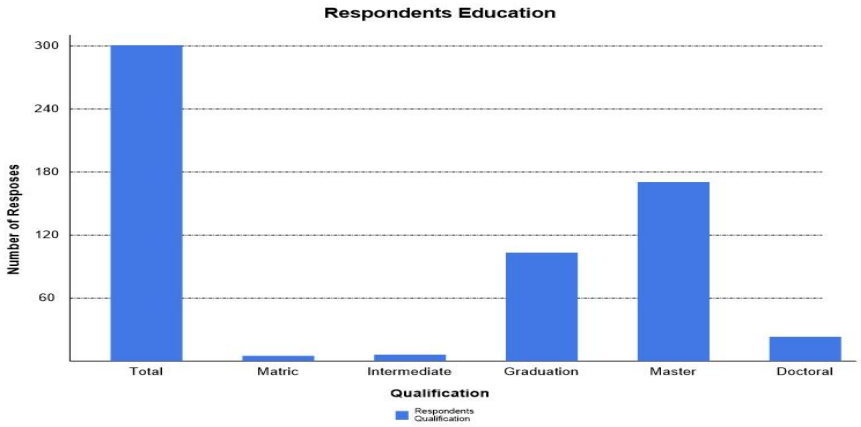
model captured the intended research constructs.

Discriminant Validity

The focus here is on confirming that different constructs are indeed different. The Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio were applied to assess discriminant validity.

Generally, the findings indicated that the various constructs of the model are indicators of different constructs of the research model.

The analysis of the measurement model indicated that the constructs showed adequate discriminant validity and therefore, the constructs are legitimate for assessment of the research structural model.



Structural Model Assessment

The focus of this analysis is on relationships that exist between the research variables. Path coefficients and R squared are among the indicators of relationships assessed in this analysis.

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Table 4.3: Reliability Analysis

Construct	Cronbach's Alpha	Composite Reliability	Result
Disaster Preparation	0.861	0.902	Reliable
Supply Chain Agility	0.874	0.913	Reliable
Supply Chain Resilience	0.889	0.921	Reliable
Organizational Culture	0.846	0.891	Reliable
Project Success	0.903	0.931	Reliable

The findings revealed that the research model captured and explained the construct of Construction Project Success. The research findings supported the role of Disaster Preparation and Supply Chain Agility in the context of Construction Project Success.

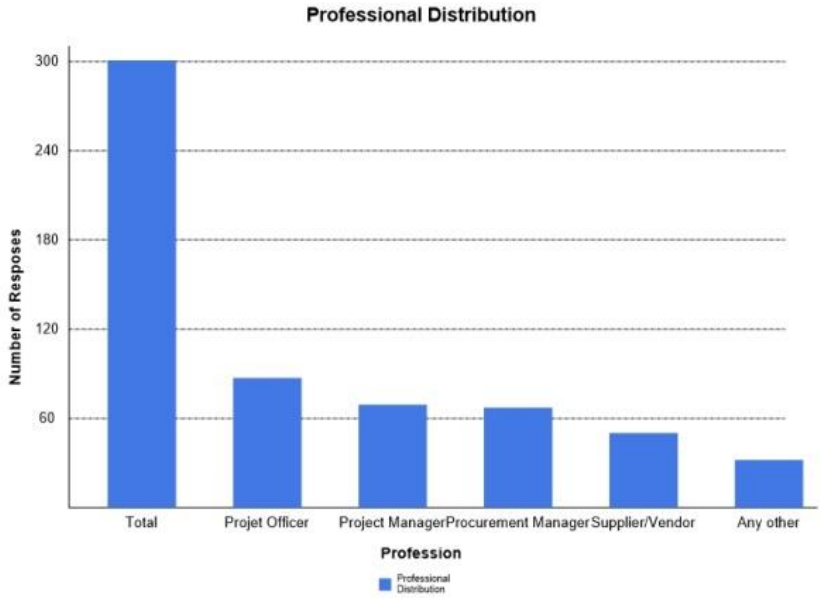
The results confirmed the hypothesized relationships for the study variables. The impact of Disaster Preparation was positive and significant for Construction Project Success. Therefore, the formation of and planning for contingencies by the project team is presumed to enhance project outcome.

Table 4.4: Convergent Validity

Construct	Loading Range	Average Variance Extracted (AVE)	Result
Disaster Preparation	0.721–0.861	0.648	Accepted
Supply Chain Agility	0.735–0.884	0.671	Accepted
Supply Chain Resilience	0.756–0.891	0.695	Accepted
Organizational Culture	0.704–0.852	0.633	Accepted

Project Success	0.771–0.912	0.724	Accepted

Likewise, the positive influence of Supply Chain Agility on Construction Project Success denoted that project success is impacted by the supply side of the project including the project team's procurement and supply processing, logistics and delivery capabilities and coordination.



Further, project success is impacted by the project team's supply chain resilience and flexibility.

Mediation of Supply Chain Resilience

The analysis focused on whether Supply Chain Resilience would represent the relationship between Disaster Preparation and Project Supply Chain Agility, and Construction Project Success.

Table 4.5: Discriminant Validity (HTMT Ratio)

Construct	DP	SCA	SCRES	OC	PS
Disaster Preparation	-				
Supply Chain Agility	0.612	-			
Supply Chain Resilience	0.684	0.721	-		
Organizational Culture	0.551	0.638	0.694	-	
Project Success	0.703	0.746	0.782	0.665	-

The results showed that Supply Chain Resilience represents, and therefore mediates, the relationships between the aforementioned constructs.

The results showed that the use of resilient supply chains built strategic risk management capacities, and helped in achieving the desired goals of construction projects. With the help of flexibilities, organizations affected by disruptions can take less time to come back to their original states and continue with their activities.

Table 4.6: Fornell-Larcker Criterion

Construct	DP	SCA	SCRES	OC	PS
Disaster Preparation	0.805				

Supply Chain Agility	0.534	0.819			
Supply Chain Resilience	0.612	0.658	0.834		
Organizational Culture	0.471	0.552	0.627	0.796	
Project Success	0.632	0.681	0.724	0.581	0.851

Moderation Analysis of Organizational Culture

Table 4.7: Structural Model Assessment (R^2)

Endogenous Construct	R^2 Value	Interpretation
Supply Chain Resilience	0.624	Moderate
Construction Project Success	0.697	Substantial

The effects of Organizational Culture on the relationship between the proactive capacities of the workforce and Supply Chain Resilience were analyzed using a moderation approach.

Table 4.8: Hypothesis Testing

Hypothesis	Relationship	Beta (β)	T-value	P-value	Decision
H1	DP → PS	0.286	5.214	0.000	Supported
H2	SCA → PS	0.341	6.108	0.000	Supported
H3	DP → SCRES → PS	0.172	3.876	0.000	Supported
H4	SCA → SCRES → PS	0.194	4.215	0.000	Supported
H5	DP × OC → SCRES	0.138	2.965	0.003	Supported
H6	SCA × OC → SCRES	0.156	3.241	0.001	Supported

The results of the moderation analysis showed that Organizational Culture plays a significant role in influencing and strengthening an organization's ability to convert pre-existing preparation and adaptability into resilience.

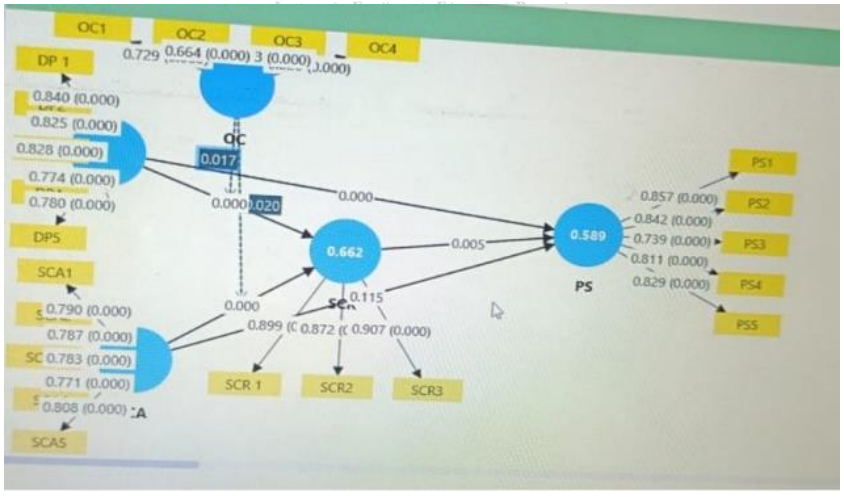


Table 4.9: Mediation Analysis of Supply Chain Resilience

Relationship	Direct Effect	Indirect Effect	Mediation Type
DP → SCRES → PS	0.286	0.172	Partial Mediation
SCA → SCRES → PS	0.341	0.194	Partial Mediation

The analysis of case companies showed that, in the absence of a collaborative and learning culture, it is difficult to ensure Resilience. Therefore, to make up for the deficiencies

caused by the lack of an effective supply chain resilience management system, an organization needs a learning and collaborative culture.

Improving construction project outcomes through effective integration of strategic risk management and resilient supply chains, supported by a learning culture.

DISCUSSION

Our research examined the integration of risk management strategies to identify the factors improving the resilience of the supply chain and the success of construction projects. Results from this research showed that the integration of risk management strategies such as the preparation for potential disasters and the flexibility of the supply chain improved the success of construction projects.

According to the results, the presence of a preparation process for potential disasters in an organization is an indicator that the organization can proactively manage disruptions, and therefore improve project performance. The inclusion of prevention processes, planning and evaluation of risk, and early warning systems allow organizations to identify threats that can jeopardize the project. Sensor processes are of strategic importance to gain knowledge of changes in the environment and to adapt proactively (Teece, 2018). The research results supported the importance of a flexible supply chain for the construction industry and proved that an organization could enhance the flexibility of its supply chain, improve project performance and provide service continuity in the face of project disruptions. Agile supply chain management aids in the procurement of construction materials, and enhances construction project performance and service continuity (Dubey et al., 2021).

The study also confirm the mediation effect of Supply Chain Resilience between Proactive strategies and success of construction project. The results of the study confirms that Disaster Preparation and Supply Chain Agility do not have any direct effect on the success of construction project. However, for the project success, it is essential that the construction firms have a resilient supply chain. The study verifies the theory that supply chain resilience plays a key role in absorbing supply chain disruptions and restores the supply chain operations to normal state. Like other supply chain systems, in case of disruptions, supply chain system can adapt to new conditions. It is also important that the construction firm has a culture that facilitates and embraces the transformation to an organization that is proactive and responsive to changes.

From the results of the study, resilient supply chain integrated with proactive strategies of construction firms would help achieve the desired success in the construction industry. The results also shows that to improve their performance and achieve competitive edge, construction firms in high-uncertainty environments, should move from focus on reactive strategies to resilience focused supply chain management systems.

Theoretical Implications

This research has several theoretical implications for construction management and risk and supply chain practices. First, it enriches Dynamic Capabilities Theory by considering Disaster Preparation and Supply Chain Agility as capabilities that facilitate an organization's response to situational uncertainty and flexibility. This research supports the notion that to successfully compete and remain sustained in the market, a firm must identify and promptly respond to opportunities and threats.

Second, from the perspective of the Resource-Based View, this research supports that a resilient supply chain enables a firm to gain and sustain a competitive advantage. This research supports that the integration and balance of a firm's adjustable risk and opportunity processes improve firm's performance and form a competitive supply chain.

Third, this research, from the perspective of the Absorptive Capacity, supports that for an organization to be fully prepared to act on opportunities and threats, it must integrate risk processes and adopt a culture of flexibility.

This research integrates the aforementioned theoretical constructs to explain the concept of Project Success and enrich existing knowledge on the integration of disaster preparation, supply chain resilience and agility in the

context of construction in developing economies.

Impact on Construction Industry

The findings of this research report practical insights for construction firms, managers, procurement specialists, and government officials. Construction firm managers ought to discourage the use of reactive risk management strategies and promote the use of proactive strategies which include being prepared for, and anticipating, disruptions and variations.

From the results presented, construction firm managers ought to encourage the development and use of policies and strategies for advance warning and impact reduction for disruptions. While the primary focus of such strategies ought to be the management of project variability and disruptions, spillover benefits in managing supply chain disruptions is anticipated.

The use of flexible and integrated procurement and supply chain management systems and strategies which are supplemented by use of advanced digital procurement and supply chain management systems, and other sourcing and procurement strategies, ought to be encouraged for project and supply chain disruption management.

Flexible and integrated procurement and supply chain management processes which are supplemented with advanced digital procurement systems enable organizations to respond to changes in the supply and demand of project requirements and other market variability.

This research gives insights into the enhancement of organizational cultures that nurture workforce collaboration, creativity and intellectual flexibility. Construction companies must instill an environment of free and frank discussion among project teams, suppliers and clients, to name a few. This creates a culture of mental model alignment, and enables participants to share their experiences in relation to risks and challenges, and devise remedial strategies to mitigate disruptions.

The authors recommend construction industry associations and government agencies empower the construction industry to enable systems, processes and strategies to gain competitive advantage in the industry. Further, procurement systems and processes should encourage construction companies to develop systems and processes to manage risks, and enable them to be competitive.

The findings of the research suggest that the construction industry would benefit from integration of a range of systems and processes that include strategic planning and direction (i.e. goal setting) and flexibility (i.e. supply chain) to enhance resilience, to better manage and respond to the uncertainties of project execution and perform better.

CONCLUSION AND RECOMMENDATIONS

This study investigated how risk management strategies affect the resilience of supply chains and the success of construction projects. A research-based framework was created and validated to assess the impact of Preparation for Disaster Events and the Agility of the Supply Chain on Success of Construction Projects. Effects of Preparation for Disaster Events and Supply Chain Agility on construction project success were discussed with respect to Supply Chain Resilience and integration of other elements of the firm's system.

The findings demonstrate that incorporating Preparation for Disaster Events in risk management strategies improves construction project performance. Construction firms are able to identify risks and disruptions in the project before they occur and implement preventive measures through different levels of coordination. Agility in Supply Chain Management improves construction firm's responsiveness in project procurement and supply processes.

From the findings, the integration of Preparation for Disruption and Supply Chain Agility improves construction project success. However, there is a limit to what construction firms can do if they do not have the ability to adapt and integrate supply chain systems.

The study demonstrates that construction firms achieve improvement in project success through risk management strategies, and integration of a culture of collaborations within the firm.

The study presents an integrated model showing how different elements of a construction organization (i.e. proactive risk management practices, organization's supply chain, and other organizational elements) influence the performance of construction projects. The model can be useful to the construction management fraternity in understanding factors that influence project performance. The construction industry of Pakistan is characterized by different kinds of uncertainties, disruptions and bottlenecks in the supply and procurement chains. For long-term project success, construction firms operating in Pakistan need to develop strategies to navigate through the challenges posed by varying uncertainties.

Recommendations

Based on the results of this study, suggestions are provided to construction businesses, project managers, and other people working in the construction industry.

1. Construction businesses need to move from a focus on reactive to proactive management of risks by among other things developing and implementing formal systems to manage disasters.
2. Construction businesses need to improve flexibility of their supply chains by, for example, improving communications and developing partnerships with several suppliers.
3. Construction businesses need to invest in information and communication technologies in order to improve supply chain management.
4. Construction businesses need to develop and maintain a resilient and positive organization culture.

Explain Recommendations

Resilience practices should be incorporated in education and training programs, and in procurement processes by relevant authorities and institutions in the construction sector. Risk management should be mainstreamed in the construction sector through the establishment of appropriate policies, systems, and mechanisms.

Limitations of the Study

While this research provides insights on the construction industry, especially in Pakistan, there are limitations. For example, the results are context-specific and may not be applicable to other nations due to differences in their economies and legal environments.

The study used a cross-sectional research design and, therefore, may not represent the Resilience potential of construction industry organizations and the Projects they undertake. Longitudinal studies may be better suited to address such limitations.

The use of questionnaires for data collection may have introduced response bias. In addition, the study did not take into consideration other contextual variables affecting the construction industry, such as Leadership, Governance, and Finance.

Research designs based on resilience in risk management strategies may be studied over the long term, using various construction projects. This may support the case for the effectiveness of risk management strategies over the long term.

Also, other variables (e.g. digital, sustainability) may be integrated in future studies to extend the current resilience framework.

Finally, other research methodologies, especially qualitative, to test resilience frameworks in the construction industry may be explored. Some of these methodologies may include case studies and/or in-depth interviews.

Other variables, including the use of emerging technologies and recent advances in other industries may be integrated in resilience frameworks in the construction industry.

Risks in the supply chain may also be explored using recent and advanced technologies in combination with resilience frameworks.

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