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The Effects of Organisational Culture and Lean Practices on Engineering Projects in China Related to Risk Management: The Mediating Function of Project Outcomes

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ABSTRACT

Examining how project performance mediates the relationship between lean methodology, organisational culture, and risk management knowledge in engineering projects in China is the main objective of this article. In order to tackle the growing complexity and unpredictability of engineering project settings, this study utilises quantitative data analysis in conjunction with qualitative case studies to provide a comprehensive picture of the interplay between operational tactics and risk awareness. Quantitative data was gathered by sending structured questionnaires to the quality assurance personnel, project managers, and engineers of several Chinese engineering businesses. Companies with a strong culture that values teamwork, open dialogue, and individual accountability are seeing an increase in risk awareness and a corresponding decrease in strategies. Project performance acts as a moderator between risk management knowledge, lean practices, organisational culture, and lean practices, which highlights the significance of project performance in translating organisational values and practices into successful knowledge application. Time and money saved, as well as the quality of the final product, are three metrics that could be used to assess a project's success. The qualitative data gathered from semi-structured interviews provided a more complete picture of the ways in which engineering teams apply lean principles and cultural norms to real projects, and it also served to balance the quantitative findings. Engineering businesses may improve their risk management capabilities in the long run by fostering a supportive culture and striving for operational excellence, according to this comprehensive research. The findings should guide Chinese project managers, policymakers, and business tycoons in their quest to strengthen the country's engineering sector's project management practices.

Keywords: lean practices, organisational culture, project performance, risk management knowledge, Chinese engineering projects.

1. INTRODUCTION

In rapidly developing nations such as China, the ability to effectively manage risk has emerged as a vital component of contemporary engineering project management. China's engineering projects may face several risks, including financial, technical, operational, and environmental uncertainty, due to their magnitude, resource intensity, and time sensitivity. Therefore, to ensure continuous project success and organisational sustainability, it is vital to comprehend the factors that enhance project teams' proficiency in risk management. Lean methodologies have developed into an effective instrument for project management, focussing on enhancing efficiency, minimising waste, and fostering a development mindset, as shown by the Toyota Production System. Lean principles not only streamline operations and minimise redundancy but also enhance an organization's capacity to manage risk effectively. Organisational culture strongly influences employee behaviour, communication, and the management of risks and issues inside the organisation. A robust, transparent, and collaborative culture would greatly enhance the capacity to identify threats, disseminate information about them, and collaboratively address emerging challenges. Little is known about the interplay between lean methodologies and organisational culture in influencing the comprehension of risk management in engineering projects in China. The performance of a project, including time, cost, quality, and stakeholder satisfaction, introduces an additional layer of complexity that need research intervention. One operational strategy is project performance; hence, cultural values may be converted into a tangible risk management tool. This study conducted comprehensive research on these connections by integrating qualitative insights from in-depth interviews with quantitative data from surveys using a mixed-methods approach. This methodology aims to

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comprehensively understand the impact of project success on the interplay of lean strategies, organisational culture, and risk management expertise. This study's findings have practical implications for engineering firms, governmental bodies, and project managers within China's developing infrastructure and construction sectors, aiming to enhance project performance and establish robust, data-driven risk management frameworks (Tahir et al., 2019)

2. BACKGROUND OF THE STUDY

Company culture, proficient communication management, and a well-defined project scope are three determinants that may significantly influence the success or failure of a construction project. This study aims to elucidate how project management competencies influence this connection. This study aims to elucidate how the competencies of a project manager affect the connection, with the next paragraphs presenting these principles from a theoretical standpoint. China's recent leadership in extensive engineering and infrastructure projects entails hazards related to finance, operations, environmental impact, and organisational frameworks. Currently, no project can be deemed complete without the prior implementation of a robust risk management plan. Organisational policies, attitudes, and performance results are crucial; nonetheless, the technology aspects of risk management are essential. Increasingly, engineering projects are using lean concepts. Ultimately, these concepts enhance responsiveness and productivity by prioritising efficiency, minimising waste, and fostering continuous improvement. The corporate culture of an organisation, influenced by its values, practices, and leadership style, is equally crucial in defining the viewpoints and responses of risk teams. Despite the recognised significance of these impacts, there is less understanding of how Lean methodologies and culture influence the perception of risk management. Chen discovered that stakeholders' risk awareness and response are influenced by project performance (Chen et al., 2023).

The operational methodologies and cultural dynamics both influence the project's performance. Employing integrated management strategies in difficult project contexts may enhance risk resilience and performance. This study aims to elucidate China's engineering objectives using this technique. In 1990, the word "lean" was first used to describe the Toyota model, which had long been the focal point of the "transference" idea. This thesis posits that non-Japanese firms might get a competitive edge by emulating the conceptual frameworks of Japanese organisations, since management faces analogous challenges across all industries, including manufacturing. Lean management is a theoretical framework and methodology that facilitates waste reduction, process optimisation, and the promotion of continuous improvement across the business. All personnel comprehend the significance of a lean culture in optimising the continuous advancement of internal processes to their fullest effectiveness. The lean approach fosters cooperation across departments and hierarchical levels among workers to minimise internal waste and provide the optimal product to customers (Hong et al., 2019).

3. PURPOSE OF THE RESEARCH

The purpose of this study is to investigate how lean techniques affect people's knowledge of risk management in engineering projects in China and how project performance acts a mediating role in this respect. This study focusses on the knowledge of risk-related processes and practices of project teams to find the ways in which lean methodologies—including value-driven processes, continuous improvement, and waste minimization—help to reach this aim. This paper investigates how lean approaches affect knowledge of risk management in order to clarify how operational strategies grow into strategic awareness and informed decision-making. Furthermore investigated in the paper is whether project performance is a main way lean techniques influence risk awareness. Lean concepts are meant to be included into Chinese engineering industry project management systems to increase project performance and risk awareness. It will achieve this applying a mixed-methods strategy.

4. LITERATURE REVIEW

Stakeholders in engineering projects are expected to have a better understanding of risk management as the project's complexity increases. This is particularly the case with rapidly developing economies like China's. Risk management is a mental and emotional process that is influenced by communication, company culture, and operational processes, according to the Project Management Institute. Corporate culture is another potential component that might affect risk management (Khinvasara et al., 2023). However, due to uneven stakeholder participation and contradictory techniques, many project teams fail to properly identify and manage risks. In order to understand how corporate

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culture and employee adaptability affect the manufacturing industry in Syria, I looked at several enterprises in the country. Study results classify company cultures into four broad types (McMaster et al., 2020).

Elements like as teamwork, participation, employee autonomy, and idea exchange form the bedrock of every group's culture. The capacity to multitask and adjust to changing circumstances is a must-have skill for success in today's environment, whether at business or in your personal life. The engineering and construction industries have made great strides in implementing lean principles originally intended for the manufacturing sector to improve efficiency, cut down on waste, and streamline processes. Lu the industrial sector was the original target of the development of lean concepts (Lu et al., 2024).

5. RESEARCH QUESTIONS

5.1 How do lean practices influence risk management understanding in Chinese engineering projects, and what role does project performance play in this relationship?

5.2 In engineering projects in China, how may lean approaches affect the comprehension of risk management?

6. RESEARCH METHODOLOGY

6.1 Research Methodology: As part of their cross-sectional inquiry, the researchers monitored the participants for four months to compile their data. Implementing the cross-sectional design required fast and cost-effective data collection at a particular point in time. The study was conducted by a wide variety of groups in China. Due to time constraints and limited resources, the researcher opted for a quantitative approach. The survey was administered to all respondents using a random selection method. After that, 500 samples were collected using Rao Soft to estimate a sample size. A researcher would read the survey questions aloud to those who are unable to read or write, and then they would record their exact responses on the survey form. This method would be useful for people who are confined to wheelchairs or who are unable to read and write. As people waited to fill out their questionnaires, the researcher would brief them about the study and answer any questions they may have. On rare occasions, we require that you complete and return our surveys all at once.

6.2 Sampling: To collect information for the study, survey methods were used. The sample size was found to be 600 using Rao-soft software. Out of 775 questionnaires, 662 were returned, and 13 were rejected because they were not filled out completely. The study included a total of 649 questionnaires, with 257 women and 392 men participating.

6.3 Data and measurement: Questionnaires served as the main means of data collection for the investigation. There were two sections to the survey: (A) General demographic information and (B) Online and non-online channel factor replies on a 5-point Likert scale. The majority of the secondary data was culled from online databases and other secondary sources.

6.4 Statistical Software: MS-Excel and SPSS 25 will be used for Statistical analysis.

6.5 Statistical tools: Descriptive analysis was used to comprehend the fundamental characteristics of the data. Validity will be assessed by factor analysis.

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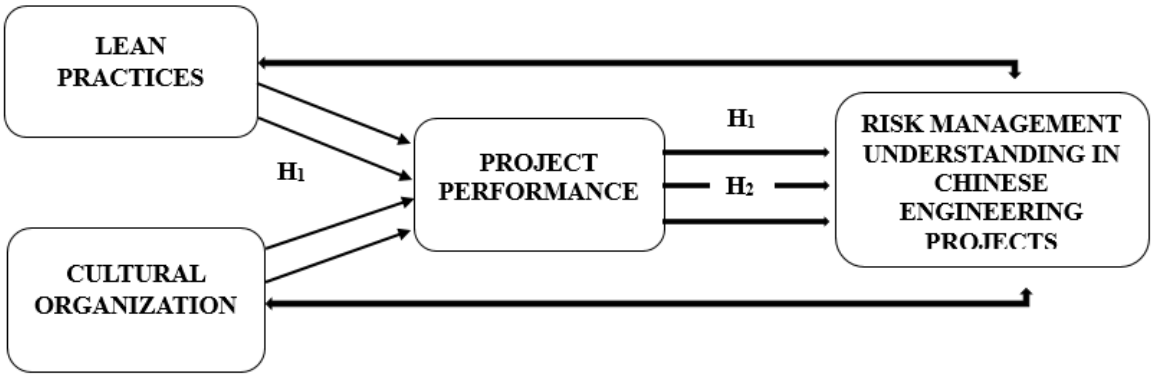
7. CONCEPTUAL FRAMEWORK



8. RESULT

Factor Analysis

One common usage of Factor Analysis (FA) is to check the underlying component structure of a group of measurement items. There is a belief that factors that are not immediately apparent impact the scores of the observable variables. A strategy that relies on models is the accuracy analysis (FA) method. Building causal pathways that link observable events, hidden causes, and measurement errors is the main focus of this work.

One way to determine whether data is suitable for factor analysis is to use the Kaiser-Meyer-Olkin (KMO) Method. We check whether the sample is enough for the whole model and for each individual variable. The statistics provide a numerical representation of the potential shared variance across several variables. Factor analysis works better with data that has smaller percentages.

The output of KMO is an integer between 0 and 1. A sufficient sample size is defined as a KMO value between 0.8 and 1.

In the event that the KMO falls below 0.6, indicating insufficient sampling, corrective measures must be implemented. Make an informed decision; 0.5 is used by certain writers for this purpose, hence the range is 0.5 to 0.6.

The high partial correlations relative to the overall correlations are indicated by a KMO near to 0. To reiterate, significant correlations significantly impede component analysis.
According to Kaiser, the following are the acceptable limits:
Declining from 0.050 to 0.059.
• Below-average by 0.60 to 0.69
Middle school typical range: range: 0.70-0.79.
With a quality point score ranging from 0.80 to 0.89.
Everything from 0.90 to 1.00 is really mind-blowing.

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Table: KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.955
Bartlett's Test of Sphericity	Approx. Chi-Square	3252.968
	df	190
	Sig.	.000

To further validate the overall relevance of the correlation matrices, Bartlett's Test of Sphericity was used. It is OK to use 0.955 for Kaiser-Meyer-Olkin sampling. Using Bartlett's sphericity test, the researchers found a p-value of 0.00. The results of Bartlett's sphericity test were significant, proving that the correlation matrix was not a correlation matrix.

TEST FOR HYPOTHESIS

- ❖ **INDEPENDENT VARIABLE**
- **Lean practices**

The goal of implementing lean processes is to maximise value in an organization's operations by systematically reducing or eliminating waste. Lean refers to a way of doing things that aims to gradually improve the efficiency and quality of operations. A key factor propelling progress was the Toyota Production System. Lean methods in engineering and construction seek to make the most of available resources, simplify processes, get rid of things that don't provide value, and guarantee on-time project completion. Value stream mapping, just-in-time manufacturing, and employee participation in issue solving are the pillars upon which the lean methodology rests. The frequency of reactive risk management may be reduced while productivity can be increased via the use of measures that promote openness, collaboration, and flexibility. In addition to reducing the possibility of budget and schedule overruns, lean methodology, when used correctly, may improve team communication and ease proactive decision-making. Theoretically, lean principles should facilitate the development of robust systems that actively deal with uncertainty while still meeting performance benchmarks over the long haul (Lyu et al., 2020).

- ❖ **MEDIATING VARIABLE**
- **Project performance**

A project's performance is defined as how well it meets its objectives in terms of time, money, scope, and quality. One way to find out whether a project was successful in meeting its stakeholders' expectations and goals is to look at how well it performed. Due to the enormous infrastructure needs and rapid economic growth in China, project performance is of the utmost importance for the operational success of engineering systems. In traditional performance reviews, the "iron triangle" of staying under budget, meeting deadlines, and delivering a high-quality product is used. Team performance, resource utilisation, innovation, safety, environmental compliance, and stakeholder satisfaction are all components of modern assessments. Executing a project to completion demonstrates careful planning, flexible leadership, and sound judgement. Lean methodology, company culture, and risk management are determinants of project success. Stakeholder anger may impact quality, cost overruns, and delays if

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performance is inadequate. The engineering and construction industries should use performance evaluations of projects as they provide useful information for growth, planning, and success (Zhou et al., 2024).

❖ **DEPENDENT VARIABLE**

- **Risk management understanding in Chinese engineering projects**

In order to successfully complete engineering projects, one has to have a basic understanding of risk management, which involves being aware of potential dangers, determining their severity, developing plans to mitigate them, and monitoring their progress. Due to China's stringent regulatory systems, complex stakeholder networks, and plenty of engineering projects involving large-scale infrastructure, understanding risk management is essential to a project's success. It addresses the competence of project teams to actively manage risks, such as design flaws, cost overruns, delays, and compliance issues. To acquire such knowledge, organisations may benefit from training, experience, readily available data on dangers, and organisational learning. Engineering projects in China have been influenced by rapid urbanisation and projects driven by policies. These factors have an impact on risk management knowledge and several other domains. Team members may use this data to adapt to new project environments, meet regulatory standards, and deal with local challenges. Additionally, it encourages a knowledge-based approach to better collaboration, resilience, and reduced project risk (Ullah, 2021).

- **Relationship between lean practices and Risk management understanding in Chinese engineering projects through project performance**

Project performance is rather important as a mediator in the link between lean techniques and risk management knowledge in engineering projects in China. Lean ideas including always improving, standardising processes, and waste cutting help to boost operational efficiency and teamwork. These developments seem in better cost control, on-time delivery, high-quality outputs, and stakeholder satisfaction, so improving the project success. The capacity of teams to identify, evaluate, and handle risks develops in line with the success of their projects. To help one better understand risk management, high-performance projects sometimes include more documentation, better communication structures, and more proactive decision-making processes. Lean ideas essentially provide the route for improved project performance, so enabling teams to better control risks. This mediated relationship highlights the need of applying lean methods to raise the company's capacity for risk management and so improve results (Zhang et al., 2021),

On the basis of the above discussion, the researcher formulated the following hypothesis, which was analyse the relationship between lean practices and Risk management understanding in Chinese engineering projects through project performance.

"H_{01}: There is no significant relationship between lean practices and Risk management understanding in Chinese engineering projects through project performance."

"H_1: There is a significant relationship between lean practices and Risk management understanding in Chinese engineering projects through project performance."

Table 2: H_1 ANOVA TEST

ANOVA					
Sum					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	75114.754	115	3576.893	360.390	.000
Within Groups	774.156	533	9.925		
Total	75888.910	648			

In this study, the result is significant. The value of F is 360.390, which reaches significance with a *p*-value of .000 (which is less than the .05 alpha level). This means the ***"H_1: There is a significant relationship between Lean***

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Practices and Risk Management Understanding in Chinese Engineering Projects through Project Performance." is accepted and the null hypothesis is rejected.

- **Relationship between project performance and risk management understanding in Chinese engineering projects**

The degree of knowledge of risk management among Chinese engineering project teams is much correlated with the success of such projects. High project performance that is, meeting deadlines, staying under budget, preserving quality, and thus pleasing stakeholders usually results from good organisational structures, excellent communication, and proactive management techniques. Accurate understanding and management of risks depend on these fundamental characteristics. Projects that run successfully usually result from teams having access to open systems, up-to-date data, and cooperative settings allowing them to recognise and address issues before they become more serious. Good project management makes feedback accessible that will help to improve risk awareness and readiness by means of ongoing education. On the other hand, poor project performance might point to inadequate processes that restrict the team's capacity to react suitably and hide risk visibility. Thus, improved project performance strengthens the team's ability to grasp, evaluate, and reduce risks all through the project lifetime, thus improving the results (Kim et al., 2021).

On the basis of the above discussion, the researcher formulated the following hypothesis, which was analyse the relationship between project performance and risk management understanding in Chinese engineering projects.

"H_{02}: There is no significant relationship between project performance and risk management understanding in Chinese engineering projects."

"H_2: There is a significant relationship between project performance and risk management understanding in Chinese engineering projects."

Table 3: H_2ANOVA TEST

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	75207.347	135	4700.459	572.417	.000
Within Groups	681.563	513	8.212		
Total	75888.910	648			

In this study, the result is significant. The value of F is 572.417, which reaches significance with a *p*-value of .000 (which is less than the .05 alpha level). This means the ***"H_2: There is a significant relationship between Project Performance and Risk Management Understanding in Chinese Engineering Projects."*** is accepted and the null hypothesis is rejected.

9. DISCUSSION

Project performance and risk management knowledge in Chinese engineering projects are allegedly significantly impacted by lean methodologies. Waste reduction, continuous development, and process standardisation are three examples of how lean methodologies may aid engineering teams in identifying, assessing, and mitigating risks. A more organised and transparent workplace is one result of these strategies, which also enhance communication and foster a sense of shared risk awareness. Enhanced project performance is another benefit of using lean approaches. These include increased productivity, less delays, improved quality assurance, and cost management. In particular, the results show that project performance acts as a mediator; hence, lean methodologies have an indirect effect on risk management knowledge via improved project execution. By acting as a go-between, lean methods not only boost performance, but also provide a framework for a more holistic comprehension of risks and more deliberate decision-making. In the context of engineering projects in China, where rapid growth, high complexity, and regulatory restraints are the norm, these suggestions shine. They stress the significance of aligning operational strategies with project performance objectives in order to construct robust and risk-aware project configurations. Research like this

adds to what is already known about the potential benefits of lean methodologies as a tool for improving engineering performance and raising awareness of potential risks. Aside from lean training, it stresses the requirement of performance monitoring systems that can combine operational practices with strategic risk management, which is something that Chinese engineering organisations should invest in. These findings provide a framework for businesses aiming to improve their operational excellence and, by extension, their risk capacity and project outputs, and they demonstrate the revolutionary potential of lean thinking in engineering project management.

10. CONCLUSION

This study demonstrates that engineering projects in China may greatly benefit from lean methodologies in terms of both understanding of risk management and project performance. Projects may achieve operational success and simultaneously cultivate a risk-sensitive culture with the help of lean methodologies, which enable continuous development, waste reduction, and efficiency increase. In order to strengthen the connection between lean methodologies and risk management expertise, the research highlight the mediating role of project performance. Successful initiatives often take a more proactive and self-aware stance when it comes to risk. In light of China's rapidly evolving and technologically sophisticated engineering landscape, these findings provide strong evidence that lean methodologies must be integrated into project management frameworks. Engineering companies and project managers may use this study's findings to create better, more knowledge-based solutions for managing projects. To increase this study's global significance, future research could explore other mediating elements and broaden their scope to include several domains or industries.

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