EVALUATING THE IMPACT OF CONSTRUCTION RISK FACTORS ON PROJECT PERFORMANCE IN INDIA: STRUCTURAL EQUATION MODELING

Manpreet Kaur, Research Scholar, School of Management Studies, Punjabi University
Dr. Rajwinder Singh, Assistant Professor, School of Management Studies, Punjabi University

ABSTRACT

Construction projects are extremely multifaceted and dynamic. Though, its dynamicity subjects to numerous risks that can affect project performance. Therefore, study aimed to identify the risk factors affecting project performance, and also develop the research model representing risk factors affecting project performance. Data was collected from residential, institutional and retail building construction projects between July 21, 2019, and November 17, 2019. 237 valid responses were collected via questionnaire survey from the construction professionals. Exploratory factor analysis (EFA) was employed to extract the factors of construction projects where five independent factors (risk factors) and one dependent factor (project performance) were extracted. Analysis of a Moment Structures (AMOS) software was used to analyse the relationship among five risk factors and their impact on project performance. The results of the Structural Equation Modeling (SEM) observes the significance of risk factors impacting project performance. In addition, managerial risk found to be the most dominant risk factor impacting project performance followed by design, financial, resource and construction risk factor. Despite the limitations of the study, study has contributed knowledge by providing new visions, such as how do risks differentially influence project performance in construction projects? Moreover, study provides a clear and well understanding of "which are the most critical risks in construction projects'', and ''how are they impacting on performance of construction projects''. Further, it is anticipated that the results of study would be a guidebook for all the stakeholders to prevent any possible impact of risk on their construction project performance.

Keywords: Construction Project, Risk, Performance, Structural Equation Modeling.

INTRODUCTION

Risk plays a substantial role in the construction sector that is known for being borne to risks. It has an undesirable effect in attaining project objectives. Risks could cause time and cost overruns, and quality issues. Risks in construction projects have long been a major problematic issues. Moreover, increase in time and cost in construction projects seem to be a global phenomenon, with no any decrease in the last 70 years and an average cost overrun of 28% (Flyvbjerg et al., 2002). Risk in construction projects cause financial losses and schedule delays for project stakeholders in various developing countries. In Kuwait, (Zubaidi & Otaibi, 2008) found that only 30% of construction projects were observed to be completed within the given time period. On an average, about 20-50% projects executed in Kuwait have time- overrun problems. Aibinu & Odeyinka (2006) observed that in Nigerian construction projects, performance of the construction sector in terms of time was badly effected by risk. Moreover, (Adenuga 2013) found that seven out of ten projects surveyed in Nigeria suffered from time overrun and quality defects. Further, (Larsen et al., 2015) scrutinized construction projects in Hong Kong and suggested that 15–20% time overrun in construction projects was due to various risk namely, slow decision-making, insufficient planning, and availability of labor, materials and equipment.

In Indian context, construction sector has a huge potential for growth and job creation. According to government figures, personnel's demand for construction is estimated to rise steadily from 8 percent to 9 percent, reaching about 2.5 million jobs a year. In the past two decades it has been assisting in growth of India's economy, by adding 14 percent in the gross domestic product (Doloi et al., 2012). Though, due to its speedy and continuous changes in the construction sector of India it is observed as a dynamic sector (Luu et al., 2009; Wong & Vimonsatit, 2012). However, its dynamicity subjects it to several delays and risks. Risk & uncertainty present in all areas of construction, irrespective of the complexity, size, and site characteristics of the project (Zubaidi & Otaibi, 2008; Mitikie et al., 2017; Rostami & Oduoza, 2017). Risks can cause schedule delays, cost overruns, security and quality issues. In recent years, there has been prolonged deliberation relating to risk that impacts performance of construction projects (Olawale & Sun, 2010; Wong & Vimonsatit, 2012; Amoatey et al., 2015; Sinesilassie et al., 2017). Certainly, in developed and developing countries, delay in schedule and cost overruns in construction are the major reasons for project failure (Koushki et al., 2005; Shehu et al., 2014). Additionally, ambiguous project-specific variables and multifaceted influential variables such as, project funding problem, lack of coordination and lack of experience, modifications in design and scope have been found main risk variables which have an impact on cost, time, and quality of construction project (Andi, 2006; Zubaidi & Otaibi, 2008; Chileshe & Fianko, 2012). Furthermore, abundance of efforts were made to identify, evaluate, and mitigate risks (Choudhry et al., 2014; Zailini et al., 2016; Rostami & Oduoza, 2017; Muneeswaran et al., 2018). Moreover, there have been studies on construction risk factors that have been published, which includes risk causes, have an impact on time and cost performance with the help of various techniques (Koushki et al., 2005; Chileshe & Fianko, 2012; Doloi et al., 2012; Choudhry et al., 2014; Larsen et al., 2015; Sinesilassie et al., 2017). So far, researchers have focused on time (Olawale & Sun, 2010), cost (Koushki et al., 2005; Shehu et al., 2014), quality (Tam et al., 2007; Shanmugapriya & Subramanian, 2015), and client satisfaction (Hussain et al., 2019) studying the impact of risk on the limited aspects of project risk. Furthermore, above studies have failed in exploring how the risk works jointly to have an impact on performance (time, cost, quality and client satisfaction) of construction projects, which is still hard to find. To the best of the researcher's knowledge, there is no study that has tested a comprehensive model, showing in a manner that the risk factors work together to influence performance of construction projects. So, this study is trying to fill those gaps.

Thereby the research aims to identify the key risk factors that affect project performance of construction projects. The objectives of the study are to (1) explore the risk factors faced by construction projects, and to (2) develop a structural model to evaluate the impact of the risk factors on the project performance of the construction projects. Thus, the empirical model provided by this research work would be beneficial not only for construction practitioners rather for researchers also to unveil how project performance could be impacted by risk factors of construction projects and offers an extensive methodological contribution to the prior research work.

The remainder of this paper is structured as follows. Initially we focus on reviewing previous research on the various risks and impact on project performance of construction projects of different studies which was used to establish the knowledge gap for the current work. Afterwards, we focused on research methods, the technique of factor analysis has been applied to classify factors for risk factors and structural equation Modeling has been applied to test them. Then, we present the data analysis of risk factors and impact on project performance of the proposed model. In the last part, the article ends with discussion, limitation and space for future research.

Theoretical Framework (Construction Risk and Project Performance)

Risk and project performance of construction projects in indian context

Although the importance of the construction sector in India has been increased greatly over the past five years, lack of financial support is one of the key risks in construction sector (Sawhney et al., 2011). As evident from several publications on construction sector in Indian context, projects are failing across the key performance measures namely, cost, time and quality performances due to occurrence of numerous risk. A report published by the Indian Ministry of Statistics and Programme Implementation in India (MOSPI) confirmed that out of the 951 projects which were being scrutinized, 309 projects found cost overruns and 474 projects were found schedule overrun (Kishore, 2004). Moreover, a report by Ernst & Young in February 2011, out of 559 ongoing infrastructure projects in India, 293 were delayed (Ernst & Young, 2011).

Again, report published by MOSPI on construction projects of India, it was shown that construction projects were extremely affected by cost overruns due to various risks. Out of 727 running projects,410 projects were reviewed all over India. It was observed that 235 projects were running with cost overruns (MOSPI, 2014). Another report published by (MOSPI, in August 2019), it was highlighted that of the 1,634 infrastructure projects in India, 373 projects reported cost overruns, while 552 projects saw time escalation.

Study by Jha & Iyer (2006), they examined critical factors impacting quality performance of construction projects in India and found that lack of coordination and lack of experience, insufficient site investigation, non availability of resource, construction errors and inadequate management negatively affect the quality performance of construction projects. Another research by (Doloi et al., 2012) analysed the impact of risk on project performance in Indian construction projects and used structural equation models to consider the schedule performance, and it was concluded that construction risks negatively influence the project performance. Additionally, (Muneeswaran et al., 2018) where relative importance index was employed for evaluation of risk in construction projects. They divided risk into six major categories namely client risk, financial risk, political risk, safety risk, execution risk and management risk

Risks Factors in construction projects

Risk refers to deviation of any variable that has a positive or negative impact on the project from its expected results (Schieg, 2010). According to (Perry and Hayes 1985) referred risk is the uncertain condition, and in case of the occurrence of that, the construction project objectives may be affected positively or negatively. Moreover, (Doloi et al., 2012) states that risk arises in a situation which has a negative impact on the performance of construction projects.

Further states that in terms of the number of risks in projects and their impact on project performance, the risks of construction projects are significantly higher.

Project risk, their effect on performance of project relates to construction projects usually acknowledged by various researchers and practitioners. Studies on the topic of construction risks and project performance presented there in order to place the study in a proper perspective. Zou et al. (2007) studied various risk factors and divided them into six categories: clients, designers, contractors, subcontractors, government, and external issues. Among them the main risk variables were: poor estimation of time and cost, social and technological problems, site related problems, and improper techniques led to rework have been identified as the construction risks. Additionally, (Luu et al., 2009) developed key risk variables related to performance of construction projects. Revealed that planning and scheduling, price fluctuations, modification in work due to mistakes, not delivering materials on time and inefficiency in managing the site were the major risk. Furthermore, (Chileshe & Fianko, 2012) in their work on risk factors impacting construction projects found that, risk factors common to construction projects include; construction errors and inadequate management, poorly managing site related work and supervision, project funding problem, and design changes. Moreover, (Rostami & Oduoza, 2017) studied the key risk factors in Italian construction projects. It was concluded that the most important risks were delay in payment by stakeholders, modifications in design, and nonprofessional construction workers. In addition, (Wu et al., 2017) developed number of risk factors in construction projects. They pointed out that owner interference, lack of contractor experience, financing and payment, labour productivity, slow decision-making, and insufficient planning were important risk factors.

Although the variables of risk related to construction projects were extensively debated here, results of these studies were basically found with the help of review of literature and might be based on subjective evidence along with this, it lacks the strong statistical robustness in a empirical way. Even though, in a research work by (Aje et al., 2009) reported that poor planned work, poor design quality and late approval of design, inadequate schedule, insufficient site investigation, non availability of resource, subcontractors' payments, late modification of design, and ignorance of safety were risks in construction projects. However, the study failed to investigate the hidden inter-relationships existing among risk variables.

Project Performance

Project performance is an objective measure of project targets involved: completing projects on time, within budget, in standardized quality, and satisfying clients (Choudhry et al., 2014). Regarding project performance, (Zou et al., 2007) used data collected from Chinese construction projects to study the impact of construction risks on project performance indicators, such as cost and schedule delays. Their findings indicate that performance of construction projects in terms of schedule and cost overrun, quality, and client satisfaction was influenced by construction risk. Furthermore, (Choudhry et al., 2014) pointed out that financial risk was an important risk factor affecting cost and schedule performance of construction projects. Found that unavailability of funds, ineffective planning, poor site management, handling project inadequately, lack of experience, and late payments for the work at site, had an affect on schedule of the project and resulted in both time and cost overrun. Larsen et al. (2015) analysed the risk factors that had the greatest impact on time, cost and quality of construction projects. It turned out that the most influential factors were unsettled or lack of project funding, errors or omissions in consultant material, and errors and omissions in construction work. They concluded that project schedule, budget, and quality level were affected significantly in different ways.

Though, subjective judgement of relative impact of risk variables on performance of construction projects is clearly appeared in above literature, objective assessment of joint impact of various construction risk factors on performance of construction projects has not been found in the literature. Also, above studies fail to evaluate the impact of risks on performance of construction projects i.e., time, cost, quality, and client satisfaction.

As a result of reviewing all of the above literature, it is clear that, in various studies, the importance was given to identify key risks on the basis of observation of different professionals in construction projects, whereas most of them were academicians which were based on subjective evidence. Though, dependency of one on another variable and its effect on project performance has not been quantified yet. So, study is yet to be conducted to identify the relation among the risk factors and develop a model for evaluating its quantitative impact on performance of construction projects. Hence, this paper aims to identify those risks of construction projects and to quantify the impact to visualize the relationship between risk and performance of construction projects.

Conceptual Model and Hypothesis Development

The present research is intended to develop a project performance model to determine impact of construction risk on project performance. The impact of each factor was hypothesized and studied (shown in figure 1). Each hypothesis is discussed below.

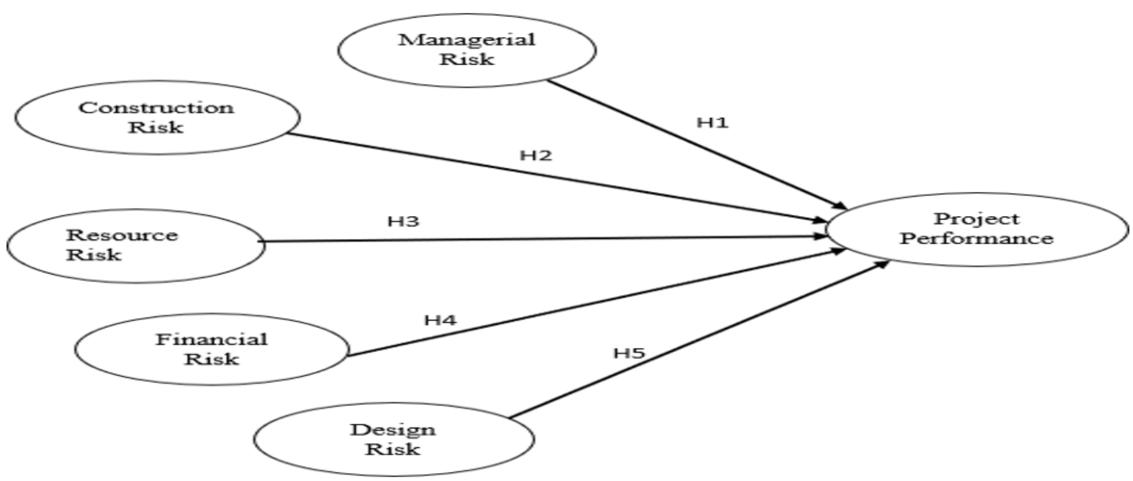

FIGURE 1
HYPOTHETICAL MODEL OF RISK FACTORS INFLUENCING CONSTRUCTION PROJECT PERFORMANCE

Managerial Risk and Project Performance

Managing construction projects is handling resources properly for attaining better performance in a specified project (Sawhney et al., 2011). Further, (Sambasivan & Soon, 2007) studied the risk namely, poor planning, inefficiency in managing site, and insufficient experience in project handling that affect project completion and cause time overrun. Similarly, researchers (Zubaidi & Otaibi, 2008; Nagaraju et al., 2012) states that planning and scheduling issues where construction project plans were not in sufficient detail & regularly updated, and lack of coordination among project teams were also perceived as an important source of construction risk. Another study by Aje et al. (2009) found that inadequate project planning & scheduling and poor site management and supervision, incapable project managers, who had deficient in necessary skills for monitoring and controlling project performance were found to be the major managerial risk and becoming more serious. In view of the above reasons, the following hypothesis is proposed:

H1: Managerial risk has positive and significant impact on project performance.

Construction Risk and Project Performance

Construction risks are the complications that sponsors, and prime contractors may face in completion of the project (Wong & Vimonsatit, 2012). Also, (Hwang et al., 2013) states that construction risk includes the failure to deliver construction funds on time, lack of project or weak feasibility studies, inability to execute and deliver the project within specified time, gap between the implementation and the specification due to misinterpretation of drawings, and unavailability of values at site (such as, water, electricity, telephone, etc.). Moreover, (Chandra, 2015; Hussain et al., 2019) states that construction related risk may have an impact on the project performance. Therefore we hypothesize.

H2: Construction risk has positive and significant impact on project performance.

Resource Risk and Project Performance

Nagaraju et al. (2012) defines the resources that are used to carry out the whole project properly, namely, labour, material and equipment. Material resources comprise shortages and changes in material, late delivery, and damage of material. Labour force involves scarcity of labour, and inadequate skills. Furthermore, equipment related are: failure and lack of equipment. In addition, (Habibi & Kermanshachi, 2018) found that the schedule performance was severely affected by resource risk. Moreover, (Zubaidi & Otaibi, 2008) pointed out that the availability of labor, materials and equipment and the decline in labour productivity due to extreme weather conditions were the main risks in construction projects seamlessly related to project performance. This leads to the following hypothesis.

H3: Resource risk has positive and significant impact on project performance.

Financial Risk and Project Performance

Financial aspects of projects include financial necessities and making payments on time. Wu et al. (2017) found that the problem of project financing was the key risk which had an impact on project cost. Another study by (Anton et al., 2011) indicated that price escalation of material, and delay in payments by stakeholders can lead to the cost overrun of construction projects. Furthermore, (Zailani et al., 2016) reported that financial risks were the foremost cause of risk in construction projects that generate affect on performance of construction projects. Consequently, on the basis of the results of these issues. We propose the following hypotheses:

H4: Financial risk has positive and significant impact on project performance.

Design Risk and Project Performance

Maintaining high design performance standards during a project is often hard, deviations in design or specifications occur that create construction related problems. Andi (2006) reported that defective design was the most serious and common risk followed by incorrect and insufficient design information, inconsistent information among design documents, and unrealistic design (constructability issue). In addition to this, (Wu et al., 2017) found that risk related to design such as inadequate site information resulting in improper design had an affect on project performance.

H5: Design risk has positive and significant impact on project performance.

RESEARCH METHODS

Measures

Measures are established on the basis of existing questionnaires developed by researchers. Literature review was done including theoretical and empirical literature in the construction project risk areas. The items used to identify risks were based on the questionnaires developed by (Zubaidi & Otaibi, 2008; Chileshe & Fianko, 2012; Amoatey et al., 2015). Additionally, items from (Chileshe & Fianko, 2012; Choudhry et al., 2014; Larsen et al., 2015) were also adapted to measure project performance. The content of items was revised for the purpose of the development of a questionnaire. So, a total of 28 items were added to the questionnaire. Afterwards, structured interviews were conducted with two academicians, three researchers with research knowledge and with three project experts in the construction sector which facilitated in generation of items of risks in construction projects and evaluated the items in formal preliminary tests. Recommendations were used to modify the items in questionnaire. 28 items incudes five items for managerial risk, four items for design risk, four items for financial risk, five items for resource risk, six items for construction risk and four items for project performance. The finalized items are given in Table 1.

Table 1
MEASURES OF ITEMS

Risk Factors	Measures	Sources of Measured Items
Design Risk	DR01: Frequent Change in design	Sambasivan & Soon (2007), Zailini et al. (2016), and Rostami & Oduoza, (2017)
	DR02: Inadequate study and insufficient data before design	Larsen et al. (2015), Rostami & Oduoza (2017), and Muneeswaran et al. (2018)
	DR03: Mistakes and Errors in design	Andi (2006), Zou et al. (2007), and Muneeswaran et al. (2018)
	DR04: Late in reviewing and Approving design by authorities	Andi (2006), Sambasivan & Soon (2007), and Muneeswaran et al. (2018)
Financial Risk	FR01: Project funding problem	Anton et al. (2011), Rostami & Oduoza, (2017), and Muneeswaran et al. (2018)
	FR02: Price escalation of raw Materials	Enshassi et al. (2009), and Anton et al. (2011)
	FR03: Increase in cost of resources such aslabour, materials and machinery	Enshassi et al. (2009), and Anton et al. (2011)
	FR04: Delay in payments by	Chileshe & Fianko (2012), and Wu et al.

	stakeholders	(2017)
Resource Risk	RR01: Defective or non-conforming materials/equipment	Andi (2006), Sambasivan & Soon (2007) Chileshe & Fianko (2012), and Zalini et al. (2016)
	RR02: Shortage/Scarcity of material/equipment	Aibinu & Odeyinka (2006), Chileshe & Fianko (2012), and Mitikie et al. (2017)
	RR03: Equipment/material failure	Nagaraju et al. (2012) and Mitikie et al. (2017)
	RR04: Insufficient skilled labor in the area of project	Sambasivan & Soon (2007), and Nagaraju et al. (2012)
	RR05: Changes in Material Specification and type	Nagaraju et al. (2012), and Wu et al. (2017)
Managerial Risk	MR01: Poor site management and supervision	Sambasivan & Soon (2007), Enshassi et al. (2009), and Doloi et al. (2012)
	MR02: Ineffective planning and scheduling	Sambasivan & Soon (2007), Zubaidi & Otaibi (2008), Aje et al. (2009), and Mitikie et al. (2017)
	MR03: Lack of coordination among team members	Chileshe & Fianko (2012), Shehu et al. (2014), and Rostami & Oduoza (2017)
	MR04: Inadequate experience and project management skills of the project stakeholders	Chileshe & Fianko (2012), Shehu et al. (2014) and Zailini et al. (2016)
	MR05: Changes in management ways and new management	Iyer & Jha (2005), and Muneeswaran et al. (2018)
Construction Risk	CR01: Construction errors lead to rework	Zubaidi and Otaibi (2008), Choudhry et al. (2014), and Chandra (2015)
	CR02: Delays in decisions making / interruptions causing a cost increase project	Chandra (2015), and Hussain et al. (2019)
	CR03: Unreasonably tight project schedule	Choudhry et al. (2014), Chandra (2015), and Rostami & Oduoza (2017)
	CR04: Unsuitable construction methods construction/change in construction method	Iyer and Jha (2005), Chileshe and Fianko (2012), and Chandra (2015)
	CR05: Unexpected site conditions	Luu et at. (2009), and Chandra (2015)
	CR06: Improper site utilities at project	Luu et al. (2009), and Sawhney et al. (2011)
Project Performance	PP01: Cost	Iyer & Jha (2005), Shehu et al. (2014), and Abusafiya & Suliman (2017)
	PP02: Time	Sawhney et al. (2011), Wong & Vimonsatit (2012), Hwang et al. (2013), and Sinesilassie et al. (2017)
	PP03: Quality	Jha & Lyer (2006), Tam et al. (2007), Adenuga (2013), Larsen et al. (2015), and Hussain et al. (2019)
	PP04: Client Satisfaction	Choudhry et al. (2014) Larsen et al. (2015), and Hussain et al. (2019)

Note: Items were modified based on this reference.

Questionnaire Design

The questionnaire consists of two sections. Section first involved statements about the respondent's profile. Section second comprised 24 items of risk variables and 4 project performance variables. Likert scale (five-point) was employed, (where 1 = strongly disagree and 5= strongly agree) to answer each item. This five-point scale has been extensively used in the measuring risk and performance of construction projects (Mohamed, 2003; Doloi et al., 2012; Ozorhon et al., 2011; Arditi & Wang, 2012; Ikediashi et al., 2013). Respondents were then asked to rate the extent of occurrence of the risk and impact on performance of construction projects.

Sampling and Questionnaire Dissemination

A pilot study was conducted prior to the final survey, to test the items of questionnaire, its comprehensibility and reliability. Pilot study's main purpose is to verify the comprehensiveness of the items in the questionnaire and check the significance of the hypothetical risk factors that affect project performance, whether they are valid and relevant to the Indian construction projects. Twelve construction experts participated to make sure that respondents could understand items in the questionnaire. These professionals have extensive academic knowledge and experience in the field of construction project management in India. Experts were asked to check the relevance of the items, and answer them to give their contributions. Experts suggested much and made some improvements. Their feedback helped to correct errors and make improvements. Based on feedback, we restructure and reform the content of the questionnaire. After pilot-testing, the questionnaire was modified as needed before it was finally distributed.

Respondents were taken from a list of registered construction projects in India, which we got from the ministries, regulatory bodies of India i.e., Real Estate Regulatory Authority (RERA). The key target respondents for the survey were project managers, junior engineers, architects, and designers in construction projects. The final questionnaire was distributed via online mode using the platform i.e., Google Forms and personally administered to construction experts including a cover message which shows the purpose of the research, making sure they were kept secret. The questionnaire was sent to 450 respondents. Data was collected from July 21, 2019, to November 17, 2019. Finally, in 5 months, 259 questionnaires came back. 22 responses excluded due to worthless or inadequate details. 237 valid responses taken to the data analysis, which gave a response rate of 52.7%. Moreover, response rate of 52.7%, that is adequate as per (Flynn et al. 1990), as he states that a minimum response rate of 50% can be taken as adequate. Response frequency of these questionnaires in this area of research differs, for instance, Aibinu & Odeyinka (2006), 51%, Kaliba et al. (2009), 43%; and in Olawale and Sun (2010) 44%. So, in present study, a response rate of 52.7% is good enough to make further analysis of collected data and to get more accurate results.

Table 2
SUMMARY OF RESPONSES AND RESPONDENTS' PROFILES

Sr. No.	Features	Parameters	Frequency	Percentage
1.	Type of Project Involved	ential/Housing Buildings	133	56.11%
		Institutional	37	15.61%
		Retail buildings	67	28.27%
		Total	237	100.00
2.	Education Qualification	Diploma in Civil	17	7.17%
		Graduate/B.tech	35	14.76%
		Post Graduate/M.tech	176	74.26%
		Others /Phd	9	3.79%

		Total	237	100.00
3.	Designation Respondents/Professional	Project Manager	93	39.24%
		Junior Engineer	68	28.69%
		Designer	20	8.43%
		Architect	56	23.62%
		Total	237	100.00
4.	Working Experience	1-5Years	44	18.56%
		6-10 Years	56	23.62%
		11-15 Years	78	32.91%
		15 above	59	24.89%
		Total	237	100.00

The summary of respondent's profile obtained is given in Table 2. From the 237 responses, 75% of respondents had experience of 15 years in project management. Additionally, 74.26%, had a degree in civil engineering, and maximum were project managers in their respective area. It implies that respondents had sufficient knowledge with experience to comprehend the questionnaire to respond accordingly. Thus, the collected data is supposed to be adequate to get accurate results.

Data Analysis

This part summarizes detailed results from analyses performed on data, SPSS version 20 software and Analysis of Moment Structure (AMOS) software was utilized. Initially we performed EFA for identification of the risk factors and project performance. Afterward, to generate confidence in the measurement model, confirmatory factor analysis (CFA) is employed. Doloi et al. (2012) states that measurement models determine postulated relation of variables to their factors. Subsequently, validity of the factors in the measurement model was assured by determining convergent validity and discriminant validity. Lastly, SEM was employed to approve the hypothesized impact of the risk factors on the project performance.

Exploratory Factor Analysis

We performed exploratory factor analysis (EFA) that is used for examining the relationship among the factors, shows the correlation among variables and also helps in data reduction. We extract the factors by using the principal component matrix, where rotation methods are present in SPSS. Fellows & Liu (2008) states that varimax is used as this method is popular and widely used in rotation for results of the principal components. As a result, the procedure aimed at rotating variables (factors) to get the variation of the squared variable (factor) loadings to allow easiest interpretation of loadings which is based on the significance of the loadings (Hair et al., 2010). Loading below 0.60 (standards set for significance) taken as the weak indicators of the factors. Thus, not taken in the components. Hence, five items which fail to meet the required factor loading have been omitted. All item loadings were found to be above 0.60; except for MR4 (0.56), CR2 (0.52), CR4 (0.48) DR1 (0.44) and RR3 (0.56), and all these items were deleted due to eigenvalue less than one and Cronbach alpha of individual statements less than 0.60 as suggested by (Hair et al., 2010). The Kaiser-Meyer-Olkin (KMO) is calculated to measure the sampling adequacy which indicates that the sample size is big enough for conducting research or not. The value of KMO should be more than 0.5 and values between 0.5 and 0.7 are considered as mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great values and above 0.9 are superb; which indicates that the sample is adequate for applying factor analysis. Bartlett's test of sphericity defines whether the correlation matrix is an identity matrix or not, which could indicate that the variables are unrelated. The multicollinearity among the variables are checked using Bartlett’s test of sphericity. The value derived from Bartlett’s test should be less than 0.05 (Field, 2009). The KMO and Bartlett’s test values of the objective have been found to be above the defined standard. The KMO value of the sample data is calculated at 0.818 and Bartlett's test is found to be significant ($p<0.001$), which shows that the data set is appropriate for factor analysis.

Table 3
TOTAL VARIANCE EXPLAINED

Component	Rotation Sums of Squared Loadings		
	EigenValues	% of Variance	Cumulative %
1	5.852	25.444	25.444
2	3.124	13.583	39.027
3	2.758	11.992	51.019
4	2.338	10.166	61.185
5	2.204	9.581	70.766
6	2.086	9.072	79.838

Note: Extraction method: Principal Component Analysis of Project Performance of Construction Projects.

Table 3 displays the initial and post rotation eigenvalues associated with each component. Further, eigenvalues show the variance explained by a specific component. Six components explained the quite high amount of variance. Thus, components with more than 1 eigen values were extracted and remaining components below than 1 eigenvalue were not taken into account. The cumulative variance explained by the six extracted factors is 79.83 %, which is considered to be good value for optimum factor analysis results. The results of factor analysis concluded that the present data has six primary factors, which explained 79.83% of total variance for risk factors. which is higher than the 60% recommended by (Hair et al., 2010). Therefore, six factors are explained including 23 items, were extracted and are shown in Table 4**.**

Reliability is the consistency of the items which is checked through the questionnaire. Each construct included in a survey has a number of items that measure the internal consistency. There are various techniques available that evaluate the internal consistency. Schumacker & Lomax (2004) states that in AMOS the standardized value of the composite reliability is more than 0.70, where it should be accepted and interpreted by Cronbach’s alpha. Table 4 shows the composite reliability outcomes which represent an acceptable range and also demonstrate the measurement items for each construct have an internal consistency, represented by Cronbach’s alpha. Each construct has a Cronbach’s alpha value exceeding 0.70, accordingly, it is an acceptable value for this method (shown in Table 4). We have tested the construct validity with the help of convergent and discriminant validity. The outcomes of convergent validity are presented in Table 4, where the AVE value of each construct is higher than 0.5 suggesting that this research attained the standards. Likewise, checked the discriminant validity of this research, to measure the range of all constructs of the proposed model is dissimilar from other constructs (Schumacker & Lomax, 2004). As indicated by the results in Table 4, all AVEs of each construct are more than the threshold limit and validate discriminant validity. One more assessment was made to check the convergent and discriminant validity, through assessing the factor loading value for all items of the factors were above 0.5 as suggested by (Schumacker & Lomax, 2004) and result shows that each variable of latent constructs have adequate convergent and discriminant validity. Once the factors were classified and entitled, then we confirm the internal consistency of the items in each factor by computing Cronbach's alpha coefficient. According to (Hair et al., 2010) the Cronbach's alpha coefficient greater than 0.7 is measured as high which shows internal consistency. Moreover, Table 4 indicates the factors which shows factor loadings more than 0.7. It highlights that all the factors are observed to be significant and contributes in interpretation of the factors. The factors extracted are managerial risk, construction risk, resource risk, financial risk, design risk, and project performance.

Table 4
RELIABILITY AND PRINCIPAL COMPONENT ANALYSIS OF PROJECT PERFORMANCE OF CONSTRUCTION PROJECTS FOR EACH CONSTRUCT

Items	α	CR	AVE	1	2	3	4	5	6
Financial Risk	0.93	0.94	0.80						
FR15				0.91					
FR18				0.89					
FR21				0.88					
FR24				0.87					
Managerial Risk	0.91	0.93	0.76						
MR1					0.91				
MR4					0.89				
MR8					0.86				
MR13					0.82				
Construction Risk	0.88	0.92	0.74						
CR12						0.91			
CR3						0.90			
CR14						0.90			
CR19						0.72			
Project Performance	0.89	0.91	0.73						
Cost							0.88		
Time							0.88		
Quality							0.86		
Client Satisfaction							0.77		
Resource Risk	0.87	0.90	0.70						
RR7								0.89	
RR11								0.85	
RR5								0.84	
RR10								0.75	
Design Risk	0.92	0.94	0.84						
DR22									0.93
DR17									0.91
DR23									0.90

Note: Cronbach Alpha (α), Composite Reliability (CR), Average Variance Extracted (AVE). Extraction Method: Principal Component Analysis of Project Performance of Construction Projects Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 6 iterations.

Table 5
FACTOR CORRELATION MATRIX

Construct	FR	MR	CR	RR	DR	PP
FR	1					
MR	0.282	1				

CR	0.292	0.351	1			
RR	0.374	0.467	0.206	1		
DR	0.339	0.358	0.314	0.142	1	
PP	0.340	0.419	0.459	0.286	0.249	1

Note: Correlation is significant at the 0.05 level.

The correlation between each factor that is included in the research model was calculated to identify any multicollinearity problem. Spearman's rho correlation analysis was employed among construction risk and project performance to examine the relationship among the variables. As per (Field, 2009) the correlation coefficient value should not be more than 0.80 to avoid multicollinearity. Table 5 shows that the maximum correlation between the factors is 0.467, therefore, there is no problem of multicollinearity.

Confirmatory Factor Analysis of Risk and Performance of Construction Projects: Measurement Model

Measurement model was generated with help of factor analysis, and provides the results of how well-defined components (exogenous variables) measure latent variables (Fornell & Larcker, 1981), as reported in the former section. Moreover, Confirmatory factor analysis (CFA) is employed to check confidence and strength in the measurement model. CFA is a technique to verify the structure of the set of observed variables that have been extracted by using EFA. EFA is the initial step to develop the new model or theory and for data reduction. But after EFA, CFA helps in testing validating the existing theory/model. The measurement model developed using CFA shows that the observed variables were loaded in accordance with the pattern discovered in EFA.

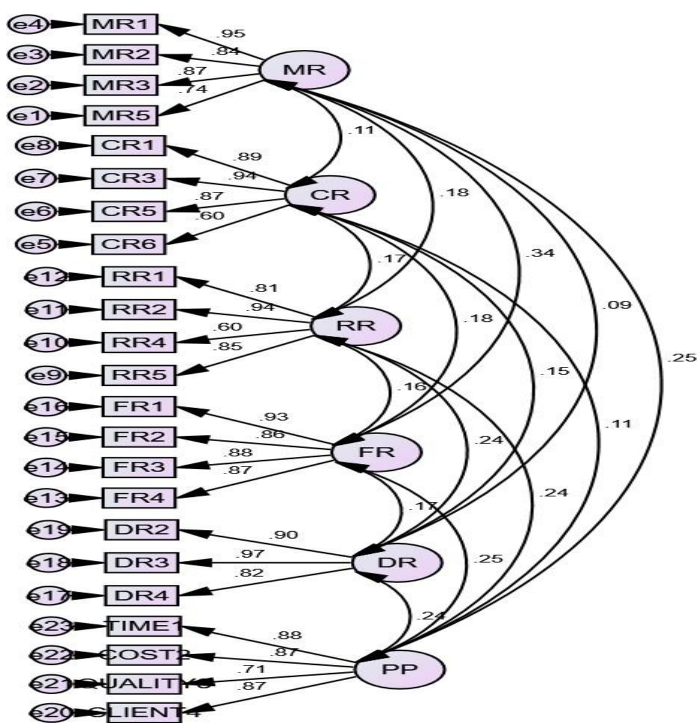

FIGURE 2
MEASUREMENT MODEL

Figure 2 represents the six factors of the measurement model which show the correlation relationship measured among the factors. The result of confirmatory factor analysis of project performance includes the significant value of regression coefficient i.e. $p<0.05$, and the validity results which include convergent and discriminant validity and importantly model fit indices are shown above.

Validity of Measurement Model

Reliability, convergent validity, and discriminant validity tests are the basis for the measurement model. It evaluates how well the variables measure the latent factors through reliability and validity. According to (Hair et al., 2010) internal consistency is measured through individual manifest and factors reliability tests, and then, the validity of the variables is tested through convergent and discriminant validity.

In CFA, the most vital validity that needs to be checked is construct validity. Construct validity is defined by (Bagozzi & Phillips, 1991) as

"It is the extent to which a set of measured items actually reflects the theoretical latent construct of those items designed to measure".

The construct validity consists of two parts i.e. convergent validity and discriminant validity. The convergent validity refers to

"The extent to which the items of the specified constructs should converge or share a high proportion of variance in common" (Bagozzi & Phillips, 1991).

To determine the convergent validity of the measured constructs the Cronbach's alpha, composite reliability (CR) scores, and average variance extracted (AVE) are computed (Chandra 2015).

Internal consistency of the measurement items is calculated by computing Cronbach's alpha coefficient (Doloi et al., 2012). It assumes all indicators measuring a construct are reliable in the AMOS model. Hair et al. (2010) states that the value of Cronbach's alpha must be higher than 0.7. CR is similar to Cronbach alpha, but in CR, internal consistency is measured by using the standardized loadings of the manifest variables and is considered as a better measure of internal consistency. The value greater than 0.7 is acceptable for CR (Hair et al., 2010). However, (Fornell & Larcker, 1981) suggested that for the convergent validity, AVE criterion can be used, where AVEs values should be higher than 0.50. A minimum AVE value of 0.5 represents acceptable convergent validity as it shows that on an average, over 50% of the variance of its items is explained by construct (Hair et al., 2010).

Discriminant validity means the extent to which one construct is truly different from another construct

"When the construct is unique and it explains some phenomenon which other measures do not then the discriminant validity exists" (Hair et al., 2010).

Fornell- Larcker criterion and cross loading of indicators are used to compute discriminant validity (Hair et al. The discriminant validity is checked by comparing the AVE values with the maximum shared value (MSV) and average shared value (ASV). The AVE of two constructs are compared with the square of correlation estimate between these two constructs. The AVE estimates should be greater than the squared correlation estimates (Hair et al., 2010).

"The latent construct should explain more of the variance in its measurement items than the variance it shares with other constructs to get the optimum discriminant validity" (Hair et al., 2010).

There are two conditions of discriminant validity which should be met to make the model valid i.e. AVE>MSV and AVE>ASV. Measurement model was calculated on the basis of the above-mentioned criterion. Reliability and validity are given in Table 6. It indicates that Cronbach's alpha and composite reliability values of individual constructs are greater than 0.7, moreover, all the values of AVE were greater than the values of MSV and ASV. The measurement model is accepted based on calculated values of reliability and validity.

One more way to measure the discriminant and convergent validity of observed indicators by calculating standardized regression weights. As shown in Table 7 the standardized regression weights for all constructs are more than 0.60, an acceptable value approves that the observed variables have sufficient convergent and discriminant validity.

Table 6
MODEL VALIDITY MEASURES

Construct	CR	AVE	MSV	ASV	MaxR(H)	MR	CR	RR	FR	DR	PP
MR	0.91	0.73	0.12	0.05	0.94	**0.85**					
CR	0.90	0.70	0.03	0.02	0.93	0.11	**0.83**				
RR	0.880	0.65	0.06	0.04	0.92	0.18	0.17	**0.80**			
FR	0.94	0.78	0.12	0.05	0.94	0.33	0.17	0.15	**0.87**		
DR	0.93	0.81	0.06	0.03	0.95	0.08	0.14	0.24	0.16	**0.90**	
PP	0.90	0.70	0.06	0.05	0.91	0.25	0.11	0.24	0.25	0.23	**0.83**

Note: CR, composite reliability; AVE, average variance extracted; MSV, maximum shared value; AVS, average shared value. Numbers on the diagonal (in boldface) are square root of average variance extracted. Other numbers (in italic) are the values of correlation.

Table 7
STANDARDIZED REGRESSION WEIGHTS AND T- VALUE OF THE FINAL STRUCTURAL EQUATION MODEL

Items	t-value	1	2	3	4	5	6
Financial Risk							
FR1		0.93					
FR2	21.02	0.86					
FR3	17.93	0.88					
FR4	19.01	0.87					
Managerial Risk							
MR1	14.80		0.95				
MR2	13.12		0.84				
MR3	13.74		0.87				
MR5			0.74				
Construction Risk							
CR1	10.32			0.89			
CR3	10.59			0.94			
CR5	10.18			0.87			
CR6				0.60			
Resource Risk							
RR1					0.81		
RR2	15.02				0.94		
RR4	18.02				0.60		
RR5	9.99				0.85		
Design Risk							

DR2	17.83					0.90	
DR3	19.02					0.97	
DR4						0.82	
Project Performance							
Cost	17.66						0.87
Time							0.88
Quality	12.68						0.71
Client Satisfaction	17.43						0.87

Goodness of fit Results of Structural Model

Goodness of SEM was verified to evaluate the hypothesized effect of the risk factors on construction project performance. The model developed by the researcher needs to reproduce the observed covariance matrix using the indicator of measurement items, this can be done by observing goodness of fit indices. There are three goodness of fit indices categories i.e. absolute, incremental, and absolute badness of fit indices. Table 8 shows goodness of fit results. It can be seen that all the model fit indices are within the range of the recommended criterion given by (Hair et al., 2010). The chi-square value of the current model is significant as the sample size of the study is large. As per (Hair et al., 2010) the value of chi- square is sensitive to the sample size when the sample size is above 200. However, chi-square/degree of freedom value for the research model is 1.46, which is an acceptable value and threshold limit of below 3 as suggested by (Hair et al. 2010). The proposed model is found to be significant with p-value>0.05. Also, the goodness of fit (GIF) value is found to be more than the limit defined by (Hair et al., 2010) of 0.90.

As specified by the (Hair et al., 2010) the Root Mean Residual (RMR) for the model with respect to absolute badness of fit indices is considered at 0.08, which is within the range. Likewise, 0.044 is computed for Root Mean Square Error of Approximation (RMSEA), we got it within the stated range. The values of Normed Fit Index (NFI), Comparative Fit Index (CFI), and Tucker Lewis Index (TLI) for the measurement model also found to be above the satisfactory limit of 0.90, this shows that the model is highly significant as it confirms the strong uni-dimensionally of the scales used in the model to achieve the current objective. The minimum limit of CFI to be fit is 0.95 Hair et al. (2010) and the CFI value for the current measurement model is 0.97, which shows the model is fit for the study. All the goodness of fit indices is found to be significant and fit for the study.

A summary of GOF attributes for the model is given in Table 8 shows the best-fit model.

Table 8
Model Fit Indices of Structural Equation Model

Model Fit Indices	Recommended Criterion (Hair et al.,2010)	Measurement Model
Absolute Goodness of Fit		
Chi-Square	-	314.56
Probability	p-value>0.05	0.000
Chi-Square/Degree of Freedom (CMIN/DF)	<3	1.46
Goodness of Fit	>0.9	0.90
Absolute Badness of Fit		
Root Mean Residual (RMR)	0.03-0.08	0.08

Root Mean Square Error of Approximation (RMSEA)	0.03-0.08	0.044
Incremental Fit Measure		
Comparative Fit Index (CFI)	>0.95	0.97
Normed Fit Index (NFI)	>0.90	0.93
Tucker Lewis Index (TLI)	>0.90	0.97

Note. Values compiled from AMOS output, 2019

Results of Structural Equation Modeling and hypothesis testing

Current study analysed the measurement and structural models by performing structural equation model (SEM) through AMOS 5.0 (Arbuckle, 2003). Even though our study applied the SEM technique, the study should be known as exploratory in nature. With the help of CFA, we confirmed the measurement model after that the results of the comprehensive structural model are drawn.

Table 7 and 8 showed the outcomes of each exogenous and endogenous construct of the measurement model. Study analysis the measurement model to identify the standardized coefficient and t-values for each variable of all the constructs. Researchers examined the standard error, standardized coefficient weights, and critical ratio for all the 23 variables. Thus, the measurement model is found to be adequate fit, further continuing to the following level, model has been tested without any alteration to variables of all the factors.

Path coefficients in SEM are denoted as standardized beta coefficients (β). Variation in the endogenous variables for the amount vary in the exogenous variables for each unit is indicated by path coefficients (Hair et al., 2010). The proposed model is compared with the help of β values among all the paths, showing that endogenous variables are affected by a higher β value. T-test is performed to measure the significance level of path coefficient (s) and also measuring the significance of hypothesis. Hair et al. (2010) refers that t-statistics values must be greater than or equal to cut off value 1.96 at the 5% level of significance. Moreover, Figure 3 summarizes the standardized path coefficients (statistically significant at $p < 0.05$) of the final model of the risk factors impacting performance of construction projects in India.

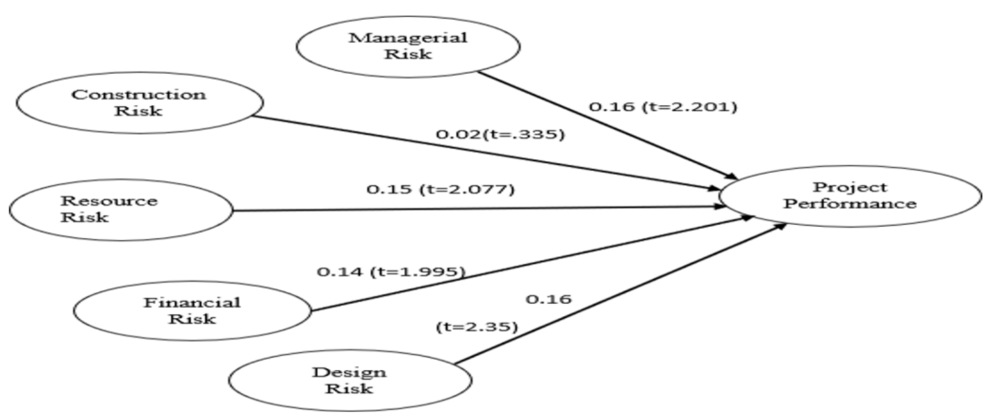

FIGURE 3
FINAL PATH MODEL OF RISK FACTORS INFLUENCING CONSTRUCTION PROJECT PERFORMANCE

Figure 3 and Table 9, highlights that four out of the five hypotheses statistically significant at 5% significance level. It includes managerial risk to project performance with β= 0.16, t-value=2.20, p=0.028. Resource risk to project performance with β=0.15, t-value=2.07, p =0.038. Financial risk to project performance with β=0.14, t-value=1.99, p=0.046. Design risk to project performance with β=0.16, t-value=2.35, p=0.019. These results show that the above factors have a significant impact on project performance. While construction risk has not shown significant impact as it is not supported by the analysis, with β=0.02, t-value=0.335, p=0.738.

Table 9
STANDARDIZED EFFECTS DECOMPOSITION OF THE PATH MODEL

Hypotheses	Path	Standardized Path Coefficient	p value	t-value (1-tail)	Results
H1	MR→PP	0.16*	0.028	2.201	Significant
H2	CR→PP	0.02*	0.738	0.335	Insignificant
H3	RR→PP	0.15*	0.038	2.077	Significant
H4	FR→PP	0.14*	0.046	1.995	Significant
H5	DR→PP	0.16*	0.019	2.354	significant

Note: MR=Managerial Risk; PP = Project Performance; CR= Construction Risk; RR=Resource Risk; FR=Financial Risk; DR=Design Risk.
Note: All *standardized coefficients significant at $p < 0.05$.

DISCUSSION

The hypothesized paths of risk impacting performance of construction projects in the structural model were found to be statistically significant. The results revealed that 5 risk factors identified as potentially impacting construction project performance. The study concluded that 3 of those risk factors were most significant. It is concluded that the managerial risk, design risk and financial risk factors were the dominant risk factors that have significant impact on performance of construction projects. Further, managerial risk has been found utmost significant factor impacting on project performance in construction projects in India. Influence of the managerial risk is found to be the most significant because of poor site management and supervision, inadequate planning and scheduling, inadequate coordination among the stakeholders, and project manager competence. Undoubtedly, the construction project managerial risk has played a significant role in impacting project performance. These results are therefore justifiable by (Habibi & Kermanshachi, 2018) as managerial risk results in time-overrun and cost -overrun. The effect of managerial risk is in agreement with the results stated by (Sambasivan & Soon, 2007) which states that managerial risk eventually was a source of delay in construction projects. Moreover, these issues have also been faced in Malaysia's construction projects (Shehu et al., 2014).

The second significant factor influencing project performance is design risk because of the change in design, insufficient study and data prior to design, inadequate site investigation mistakes and errors in design/late design documents. The design risk plays a significant role in impacting construction project performance (Zou et al., 2007). Aibinu & Odeyinka (2006) determined that alterations in design were one of the major risks liable for additional costs and time overrun in the construction projects. These problems were being faced in almost all Indian construction projects (Sawhney et al., 2011). Moreover, this finding is indeed similar to the findings of (Larsen et al., 2015) who analysed the risk factors that had the greatest impact on time, cost and quality, and concluded that project schedule, budget, and quality level were affected in significantly different ways. Amongst the five risk factors, the effect of financial risk factor has been found statistically significant, and impacting on performance of projects. Impact of the financial risk is related to project funding problem, price escalation of raw materials/price inflation, has significant correlation with the respective latent variables which cause cost overrun in construction projects. This finding is consistent with the conclusion of a previous study by (Zailani et al., 2016). Moreover, (Enshassi et al., 2009; Anton et al., 2011) states that the financial risk factor has contributed to the poor project performance.

However, the impact of resource risk on project performance of construction projects was found to be the least significant in comparison with other risk. It includes material/ equipment shortage, material changes, that led the project deviatations from the projected time and cost (Nagaraju et al., 2012; Mitikie et al., 2017). Moreover, it has impact on quality as well as client satisfaction (Shanmugapriya & Subramanian, 2015). The fifth risk factor i.e., construction risk factor, included in study is insignificantly correlated with project performance. The project performance with a deeper view relating to risk factors depends on the factors like management risk, design risk, financial risk and resource risk.

CONCLUSION

Several studies on the risk factors affecting project performance in construction projects have been published. On the basis of all acknowledged risk and project performance variables, this study evaluates project performance by measuring the joint effect of risk factors in Indian construction projects. The principal aim of this paper was to evaluate the impact of construction risk on project performance. Questionnaire survey using Likert-scale was used to collect the responses from the respondents. 237 valid responses collected from the construction professionals were used to analyse the data. Exploratory factor analysis was employed to extract the 6 factors of construction projects where 5 independent factors (risk factors) and 1 dependent factor (project performance) was extracted. A theoretical model has been developed, assessing the impact of five risk factors on project performance in the Indian construction projects. AMOS was used to analyse the relationship among 5 risk factors and on project performance. Based on the acceptable GOF indices final structural model was derived. Furthermore, impact of risk factors on the project performance of construction projects was observed. The results of this research work confirm the significance of risk factors impacting project performance. In addition, managerial risk found to be the most dominant risk factor impacting project performance followed by design, financial, resource risk.

Theoretical and Practical Implications

This study has given some implications regarding theoretical and practical views. In terms of theoretical part, it has contributed a guidebook on the risk factors and project performance, particularly, in the perspective of the construction projects. The study identified the risk factors and developed a structural model to evaluate the impact of the risk factors on the project performance in construction projects. By such means it is extending the body of knowledge in project performance of construction projects. Following this, the risk factors and their variables provide exhaustive understanding of which risk arises in construction projects that have an impact on project performance (cost, quality, time, and client satisfaction). Additionally, study identifies the important key risk factors affecting project performance and results approve the significant impact of the risk factors on project performance. These vital outcomes have not been covered in the earlier studies. Hence, findings could be valuable to conduct further research in the area of the construction sector. Lastly, this research work contributes vital methodological addition by employing AMOS, which might be a first empirically tested study in the investigating impact of collective risk factors on performance indicators in construction projects. From the perspective of practical contributions, undoubtedly it provides direction towards the construction project risk and project performance. Construction practitioners can prioritize the identified risk factors and mitigate risks that have more impact on performance of construction projects. Certainly, it is the researchers' anticipation that this research work would be beneficial for construction project practitioners, they would probably get advantage from the results by paying more consideration on the vital risk factors impacting project performance. As the developed model provides vital information to the construction practitioners regarding the likely impacts of significant risk variables on project performance in construction projects so that a proactive risk response strategy can be put in place. For all of those reasons it is essential to encompass the implications of these results in practice.

Limitations and Scope for Future Research

Regardless of endeavour devoted in measuring the impact of risk factors on project performance in Indian construction projects, this study has some limitations. As current dependent variables focus on project performance in terms of time, cost, quality, and client satisfaction, within the context of construction projects, other performance variables such as safety and profitability can be taken into account for the future research. Moreover, this research focused on real estate (buildings) construction projects and did not take into account the civil engineering infrastructure projects. Thus, further, study could be conducted by taking civil engineering (roads, highways, and bridge etc.) infrastructure projects.

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