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THE MODERATING EFFECTS OF STATUTORY LAWS AND REGULATIONS OF RISK FACTORS AND MANAGEMENT IN THE KINGDOM OF SAUDI ARABIA CONSTRUCTION INDUSTRIES

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Abstract. *Purpose* – Construction projects are fraught with hazards that have a detrimental impact on schedules, estimates, and quality. The project execution phase exposes contractors to internal and external hazards, either implicitly or explicitly. A project's achievement is contingent on the proper handling of internal and external hazardous concerns. This study investigates the connection linking internal and external risk factors with risk management in Saudi Arabian contractors and the moderation role of government bylaws linking this connection.

Research methodology – This study investigates 303 Saudi Arabian contractors to explain the influence of internal hazards, external hazards, and governmental by-laws on risk management by applying the Partial Least Squares Structural Equation Modeling (PLS-SEM) method.

Findings – The outcome indicates that internal hazards (active leadership, team competency, and skills and effective communication), external hazards (technological, political, cultural, and economic factors), and government by-laws (also, its moderation role with external hazards) are positively connected with risk management resulting a moderate effect. Furthermore, the outcome also highlights that the moderating influence of government by-laws with internal risk factors is insignificant.

Research limitations – The current research model depicted 74.4% of the overall variation in risk management. Other latent variables can explain the 25.6% remaining overall variation in risk management which can be taken into account for future aspects of effective construction risk management.

Practical implications – This study raises the efficiency of Saudi Arabian contractors by improving project output delivery. This study made recommendations to boost risk management usage.

Originality/Value – This research was conducted for the first time in the Kingdom of Saudi Arabia, and it is an original work.

Keywords: government bylaws, internal risks, external risks.

JEL Classification: G18, L74, L78, N65.

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1. Introduction

Every construction project involves risk (Mohamadi, 2021). Unpredictability results from the negative implications of risk influencing the project's efficacy (Qazi et al., 2021). The project manager's primary objective is to apply efficient methods for risk management to complete a project without compromising scope, quality, budget and schedule (Panthi et al., 2021). Risk management refers to effectively identifying and resolving known risks that can happen as an outcome of design, material, management, finance, equipment, and labor

(Ratnaningsih et al., 2018). Prior studies carried out in Saudi Arabia indicated that economic growth is adversely affected as a result of inadequate handling of risk management (Abdulmoneim et al., 2021).

Worldwide, cost and time overrun are universal issues in both governmental and private projects, but they are especially prevalent in Saudi Arabia, where they result in enormous annual losses of public expenditures. Cost and time overrun have serious consequences not merely for Saudi Arabia's governmental projects, but also the nation's financial stability and social standing. Although various studies have been conducted to explore the factors influencing KSA projects, little focus has been placed on project management techniques and practice (Alotaibi et al., 2016). Project complexity, lack of familiarity, ineffective communication, insufficient project management expertise and equipment challenges are major factors that contribute to projects failing in the Saudi Arabian construction sector. It was recommended that to lessen a project's unanticipated risk, project risk management frameworks ought to be revised to provide direction to clients and other participants (Ikediashi et al., 2014).

2. Literature review

2.1. Project and risk management review

In risk management, there are numerous misunderstandings concerning the distinctions between negative and positive risks. Many researchers identify "risk" with negative consequences; thus, they wrongly equate "positive risk" with beneficial attributes, which leads to awful outcomes. When considering potential events that can influence a project, many experts and professionals often only take negative risks – events that, if they take place, could significantly affect the project. Positive risks refer to potential outcomes that can be beneficial, advantageous and favorable for the project, e.g., a prospective policy amendment that would be advantageous to the project, time-saving technology is presently being manufactured and could shortly be deployed and the efficiency of the project is improved once the request for extra resources is granted (Everitt, 2022).

The project manager creates a budget for the project's requirements. Projects frequently require revisions as they go. As a result, when a project is substantially completed below budget, it is technically a mistake that was caused by the project manager's poor calculations or improper planning. The majority of project leaders work to minimize the possibility of underestimating a project's cost, although it is difficult to argue against the benefits of saving extra money for the business (Edubirdie, 2022).

Throughout their existence, companies encounter risks, uncertainties and unexpected challenges, which have a detrimental effect on their profitability and marketplace. A system for risk management is necessary to identify these hazards for reducing or eliminating them. Highly organized procedures and methods (e.g., operational documentation) are part of risk management that should be adopted inside a company. The use of advanced algorithms in information systems for effective risk management allows for a reduction in human mistakes, which is one of the numerous advantages that information systems provide to any firm (Taherdoost, 2021).

2.2. Construction sector in Saudi Arabia

According to Zhao (2022), risk analysis approaches have advanced from merely rating hazards based on their relevance or severity to contemplating how they interact with one another. The focus of construction risk management study has switched from general to specific categories of construction projects (e.g., prefabricated and green buildings, etc.).

Prior studies have demonstrated that Saudi Arabian construction projects have performed poorly over the last thirty years. Contractors have encountered difficulties and challenges fulfilling quality standards while completing projects on schedule and under planned cost when using conventional risk management techniques. Projects in the KSA construction sector failed due to ineffective, inferior, substandard and inadequate practice of risk management methods and techniques (Algahtany et al., 2016).

During the designing and execution phase, risk factors have a significant influence on the timely completion of a project. By incorporating the results of extensive literature studies and a survey of the construction sector in the KSA, a risk management framework was created that comprises identifying and analyzing the risks and mitigation strategies, which are the essential elements of the model. The model has been demonstrated to be helpful and effective in analyzing and quantifying the influence of hazard elements as well as in aiding in the development of an appropriate risk mitigation plan, especially during the initial design phase (Albogamy & Dawood, 2015).

2.3. Risk factors in Europe

Hamid and Waterman (2018) carried out a qualitative study in the United Kingdom, highlighting major hazards such as poor contracting and procurement procedures, project scope modifications, project complexity, inflation, growing material costs, and design modifications. In Cyprus, Vacanas and Danezis (2021) applied the relative importance index method and found that the key significant hazards include improper work schedule, issues with the contractor's ability to finance the project, a lack of productivity, errors and omissions in the consultant's designs and modifications required by the client.

In Norway, Zidane and Andersen (2018) employed an inductive approach and identified major risks such as user concerns, drawing errors, workplace concerns, owner's lack of support, modification in drawings, delays in verification of finished job, ineffective communication, lack of resources, internal organizational rules, regulations and bureaucratic procedures, lack of engineering judgment and inadequate plans.

In Finland, Jussila and Lähtinen (2020) employed the thematization method and identified weather, builder, manpower, plan, plot, life situation, monetary and building permits as key risk factors. In Denmark, Larsen et al. (2016) used the relative importance index and Spearman's rank correlation and found that the key risk factors are mistakes in building works, lack of material quality and unresolved or insufficient project finance.

In Sweden, Adam et al. (2017) used the Kiviat diagram method and found that the key risk concerns include weather, human behavior, project, material, administration, finances, and communication. In the United Kingdom, Agyekum-Mensah and Knight (2017) employed qualitative research method and found that the main risk factors include inadequate use of building methods, inadequate space and logistical management, inadequate resource management, constraints on health and safety, inadequate knowledge and expertise, poor hazard management, kitchen sink syndrome, unexpected situations, drawing errors, uncertain project goals, lack of project management skills, poor decision making, ineffective communication and inadequate planning.

In Portugal, Brito (2021) used the rating criteria evaluation method and found that external factors, design issues, manpower, machines and materials are the significant risk factors. In addition, Arantes and Ferreira (2015) employed the relative importance index and Spearman's rank correlation and found that the key risk factors are external, manpower and machine, consultant, governmental, materials, drawings, contractor, contractual relation and developer.

2.4. Risk factors in Asia

In China, Chang et al. (2019) used the PLS-SEM approach and proposed that external interferences, contractors' operations, cost and financing and economic climate are the key risk factors. In addition, Zhang et al. (2021) employed the triangulation method and found that the equipment safety protection, subsurface environment, contractor-related risks and team-leading-related risks are the most significant risk factors.

In Iran, Befrouei and Taghipour (2015) employed comprehensive literature analysis and recommended that defining the goals, allocating resources, and the organizational environment are the key risk factors. In Taiwan, Lin and Chen (2021) employed structural equation modeling and found that the most significant risk factors are client (challenges with consultant and contractor cooperation, communication lack and decision changes), design (miscommunication, unsatisfactory drawings and layouts and inadequate practice of actual operations), contractor (lack of site control, inaccurately following construction planned activities and rectifying construction defect), subcontractor (correcting construction work, poor site control and uneducated operators) and external hazards (fabrication methods and legislative limitations).

In India, Sharma and Gupta (2020) used the risk priority and relative importance index method and recommended unexpected fluctuations in inflation rates, difficulties in permit approvals, lack of professional experience, lack of project management expertise and miscoordination or miscommunication between construction parties are the key risk factors. In addition, Prasad et al. (2019) used the importance index method and found that the contractor's financial issues, monetary troubles, client's lag in settling claims, the contractor's latency in paying for additional jobs and the contractor's delayed payment to vendors are the major hazards in India.

In Indonesia, Mubarak et al. (2017) used the severity index method and found that financial, natural calamities, governmental laws and policies and social politics are the key risk factors. In addition, Wibowo et al. (2018) used the risk breakdown structure approach and proposed economic hazards, legal and contract hazards, construction hazards, income hazards, maintenance and operation hazards, political hazards, social hazards and acts of God as potential hazards. In Malaysia, Yap et al. (2021) employed the importance index method and found that the contractor's financial difficulties, ineffective vendors, ineffective site administration and control, excessive number of client change orders and poor project planning are major hazards.

In Pakistan, Kamal et al. (2022) employed a relative importance index and found that poor site management, rework affected by cost performance and ineffective project management expertise are the major risk concerns. In Kazakhstan, Hossain et al. (2022) used Spearman's rank correlation and relative importance index and found that the external factors, contractual-relationship factors, contract factors, machine and manpower factors and materials factors are the most significant risk factors.

In Bangladesh, Assafi et al. (2022) used the relative importance index method and recommended that manpower, materials, consultant, contractor, contract, external and client-related factors are the key risk factors. In Nepal, Gain et al. (2022) employed the relative importance index and found that the amendments in regulations, weather situations, unexpected circumstances, variation orders, productivity, functionalities, poor organizational structure, poor drafting of contracts, poor site management, financial difficulties, labor shortage, inadequate construction methods, poor decision-making, inferior quality, material shortage and drawings issues are the main hazard concerns.

In Sri Lanka, Santoso and Gallage (2020) combined quantitative and qualitative methods and proposed that the internal and external factors are the most significant hazards. In Laos, Bounthipphasert et al. (2020) employed the severity index method and proposed that major risk factors are the lack of equipment, monetary challenges, funding problems, late payments and cash flow for the contractor.

2.5. Risk factors in the Middle East

In UAE, El-Sayegh et al. (2021) used the risk severity approach and found that design modifications, inadequate or erroneous sustainable design data and client financial shortages are significant risk factors. In Oman, Al-Harthi et al. (2021) used a constant comparative method and proposed that the socio-political, monetary, managerial, environmental, logistics and technical risks are the major risk factors.

In Yemen, Kassem et al. (2019) used the Kruskal–Wallis test method and found that internal hazards, governmental judgment delays, inaccurate cost projections and amendments made during construction are the major risk factors. In Egypt, Khodeir and Nabawy (2019) applied a risk breakdown structure approach and found that project management hazards, financial hazards, external hazards and technical hazards are major hazards.

In Morocco, Bajjou and Chafi (2020) used the relative importance index method and found that consultant, contractor, owner, monetary, communication, plans, contracts, materials, manpower, machines and external are the major risk factors. In Jordan, Bekr (2018) employed the importance index, frequency index and severity index method and indicated external-related, owner-related, consultant-related and contractor-related risks are major risk factors.

In Kuwait, Alenezi (2020) employed the relative importance index method and found that the planning and schedules, contracts, governmental rules, changes, environment, finances, machines, workforce and materials are the significant risk factors. In Algeria, Salhi and

Messaoudi (2021) employed the relative importance index and structural equation modeling method and found that the inferior quality of construction, cost overruns, delays in activities completion, failure to meet goals, project failure, decreased productivity, material wastage and manpower mismanagement are major risk factors. In Qatar, Castillo et al. (2019) employed a relative importance index and found that external factors, site-consultant factors, resource factors, owner factors and contractor factors are significant risk factors.

2.6. Risk factors in Saudi Arabia

Abdellatif and Alshibani (2019) used the frequency index and relative importance index method and found that the difficulties in getting drawings approval, slow process of timely payment, delays in materials acquisition and funding challenges are major hazards. Alsuliman (2019) used the relative importance index method and recommended that the constructor's limited technical and financial capabilities, granting the project to the constructor with the lowest bid, late payments and negligence of the engineering sector by ministries are major risk factors.

Alajmi and Memon (2022) employed a critical analysis of the literature review and recommended that ineffective communication, lack of worker's expertise, monetary issues, delays in material procurement and supplies, management issues, slow decision-making and inadequate planning are major risk concerns. Rahman et al. (2016) employed structural equation modeling and found that the contractual and project management factors, owner and consultants factors, labor factors, communication and information technological factors, drawings and documentation factors, site management factors and materials and machines factors are the significant risk factors.

Alshihri et al. (2022) used the risk importance and relative importance index method and found that the lack of site management, skilled labor shortage, inadequate planning, variation orders, awarding projects to the lowest bidder, payment delays and monetary issues are major risk factors. Seddeeq et al. (2019) used a significant index method and proposed that poor cost estimation, inadequate defining of work scope during tendering, mistakes in drawings, inadequate planning, scope change and design flaws are major risk factors.

Khalifa and Mahamid (2019) used the severity index and found that the project's financial issues, poor workmanship, ineffective coordination, mistakes in drawings and client's addition jobs are major risk concerns. Assaf et al. (2019) used the significance index and found that discrepancies in the specifications and drawings, design flaws, a contractor's lack of effectiveness, a modification in the quantity of materials, and variation orders are significant risk factors. Durdyev and Hosseini (2020) used a risk matrix, frequency-adjusted importance index and relative importance index and found that the rising material costs, incorrect budgeting and inaccuracies in the contractual documents and design are major risk factors.

Alshakhrit et al. (2019) used descriptive statistics and proposed that inadequate planning and communication, lack of materials, material supply delays, lack of skilled labor and poor expertise are major risk factors. Abduljawwad and Almaktoom (2021) used the relative importance index and recommended that inadequate supervision, lack of clear instructions from client and consultant, miscalculation of project duration, ineffective communication, obtaining permission from a regulatory authority, legal challenges, miscalculation of project expenses and monetary difficulties are major risk concerns.

Mathar et al. (2020) used the significance index method and found that the contractor's cash flow projection, lack of planning and controlling, the project's influence on the general public, competence of the contractor and availability of competent labor are major hazards. Alotaibi et al. (2019) employed the Mann-Whitney U test and relative importance index and found that imprecise project requirements, insufficient training, poorly law enforcement, ineffective communication, lack of a cohesive plan, inadequate awareness and expertise and increased expenses are major risk factors.

2.7. Conceptual framework and formation of hypotheses

Figure 1 illustrates internal risk factors (team competency and skills, active leadership and effective communication) and external risk factors (technology factors, economic factors, cultural factors and political factors) are termed independent variables. Government bylaws is a moderating variable and risk management (administrative or management risks, financial risks, material risks, equipment and labor risks and design risks) is a dependent variable.

The prediction of a specific relationship or event between variables is termed a hypothesis. Creswell and Creswell (2018) identified two types of hypotheses i.e. directional and non-directional. In the directional hypothesis, directional effects on other variables are predicted while in the non-direction hypothesis, relationships among variables are designated without directional effect. In this study, the directional hypothesis approach (three direct and two indirect hypotheses) is adopted to investigate the effect of internal and external risk factors on managing risks.

1. Hypothesis 1: Internal risk factors have a substantial connection with risk management.
2. Hypothesis 2: External risk factors have a substantial connection with risk management.
3. Hypothesis 3: There is a substantial link between government bylaws and risk management.
4. Hypothesis 4: The influence of government bylaws on the relationship between internal risk variables and risk management.
5. Hypothesis 5: The influence of government bylaws on the on the relation between external risk factors and risk management.

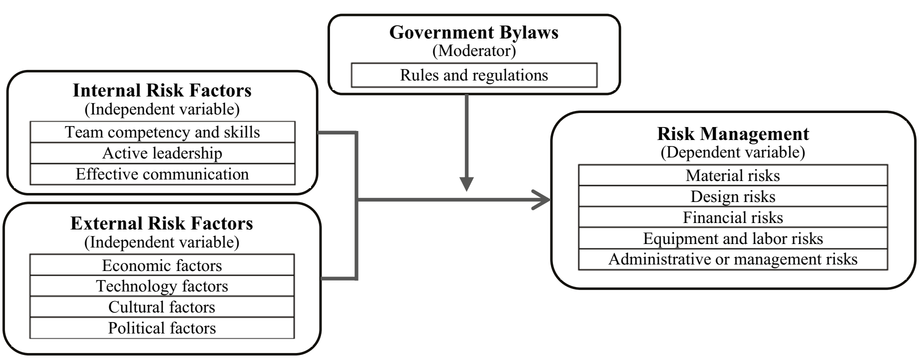

Figure 1. Conceptual framework

3. Methodology

3.1. Theory-of-knowledge

Experts and researchers frequently exhibit a philosophical paradigm that is founded on a certain body of knowledge and the nature of social reality. The positivist paradigm, which is a quantification strategy applied in this work, generalizes the knowledge process necessary to enhance and identify parameter descriptive accuracy and their connection through statistically analysing them (Creswell & Creswell, 2018).

3.2. Research design

Quantitative cross-sectional research is employed in the present study and the unit of analysis is big-size Saudi Arabian contractors. Qualitative research is exploratory research that analyses non-numerical data (e.g., interviews, group discussions, etc.) using semi-structured or non-structured techniques. The opinions, motivations and reasons for understanding can be best described by adopting qualitative research. It is recommended for small population sizes. Structured techniques that analyse numerical data to quantify behaviors, opinions and attributes for the formation of facts are best described by adopting quantitative research (Leavy, 2017).

3.3. Population

In 2021, there are 4071 total registered contractors with the Saudi Contractors Authority working in the KSA. Out of 4071 registered contractors, 3795 are Saudi contractors and 276 are non-Saudi contractors. Saudi Arabian contractors fall into one of four categories; very small companies (1 to 5 workers), small companies (6 to 49 workers), medium companies (50 to 249 workers) and big companies (more than 250 workers). There are 361 big companies, which represent 8.87% of all contractors. Chief Executive Officers, project managers, construction managers, engineers, supervisors, and foremen make up the population.

3.4. Sampling

This study employed a simple probability sampling technique since each group has a discrete and definite probability. The sample attributes can be inferred and outcomes based on population can be concluded. The outcomes from the present research are the representation of all attributes among KSA contractors. There are two types of sampling techniques available i.e., probability sampling (cluster, stratified, simple random, systematic, and multi-stage sampling) and non-probability sampling (snowball, quota, convenience and judgment sampling). Every representative of the population has an equal likelihood of being selected for the sample when employing probability sampling. There are no statistical inferences and no specific probability structure (not randomized) in non-probability sampling (Taherdoost, 2016). For a population size of 361, this study needs at least 190 participants (Asenahabi & Ikoha, 2023).

3.5. Data collection

Behaviors, attributes and activities are best described using quantitative data collection, which should be systematic, objective and repeatable allowing the researchers and experts to answer research questions in the simplest way. This study employed a questionnaire as an instrument for collecting quantitative data (Burkholder et al., 2019). The physical distribution of questionnaires is chosen to allow for fast responses to any participant questions and to achieve a high response rate, which saves time. In order to collect quantitative data from respondents intended to examine the connection linking to internal risks, external risks and management of risk related to construction, a survey method has been employed (Aarons, 2021). The following techniques and strategies were used in this study to acquire data.

1. Before the survey, the participants were informed.
2. Made heartfelt request in the cover letter.
3. Utilized the current survey scale for pilot research.
4. Ensured that the question items have been structured and formatted properly.
5. Maintained constant follow-up.
6. Distribute the survey to the relevant responder.
7. Increased efforts to obtain accurate results.

3.6. Variable measurement and operationalization

Variable operationalization have been depicted in Table 1.

Table 1. Variable operationalization

Construct	Variable	Scale	Indicators	Source
Internal risk factors	Team competency and skills	5-Point	5	Adeleke et al. (2017), Rehman and Ishak (2021)
	Effective communication	5-Point	5	Adeleke et al. (2017), Rehman and Ishak (2022a)
	Active leadership	5-Point	4	Adeleke et al. (2017), Rehman and Ishak (2022b)
External risk factors	Cultural factors	5-Point	6	Adeleke et al. (2018), Rehman and Ishak (2022c)
	Political factors	5-Point	5	Adeleke et al. (2018), Rehman and Ishak (2022d)
	Economic factors	5-Point	4	Adeleke et al. (2018), Rehman and Ishak (2023)
	Technology factors	5-Point	4	Adeleke et al. (2018)
Construction risk management	Administrative or management risks	5-Point	13	Adeleke et al. (2016a)
	Equipment and labor risks	5-Point	7	Adeleke et al. (2016a)
	Design risks	5-Point	6	Adeleke et al. (2016a)
	Financial risks	5-Point	4	Adeleke et al. (2016a)
	Material risks	5-Point	4	Adeleke et al. (2016a)
Government bylaws	Bylaws	5-Point	5	Adeleke et al. (2016b), Sahib et al. (2022)

4. Analysis and results

4.1. Demographics of the participants

The participants in the current study were 215 males (71%) and 88 women (29%). 2.3% of the responders are comprised of CEOs, 5.3% of PMs, 8.9% of CMs, 36% engineers, 8.3% of supervisors, 11.2% of foremen, and 28.1% of others.

4.2. PLS-SEM analysis and results

Complex relationships between constructs are analyzed using PLS-PM. This study has conducted a two-step procedure for PLS-PM assessment i.e., assessing measurement and structural model (Hair et al., 2022).

The validity and reliability of constructs are assessed using a measurement model. The evaluation of a measurement model takes into account convergent and discriminant validity, internal reliability and individual item reliability. The measurement model is illustrated in Figure 2.

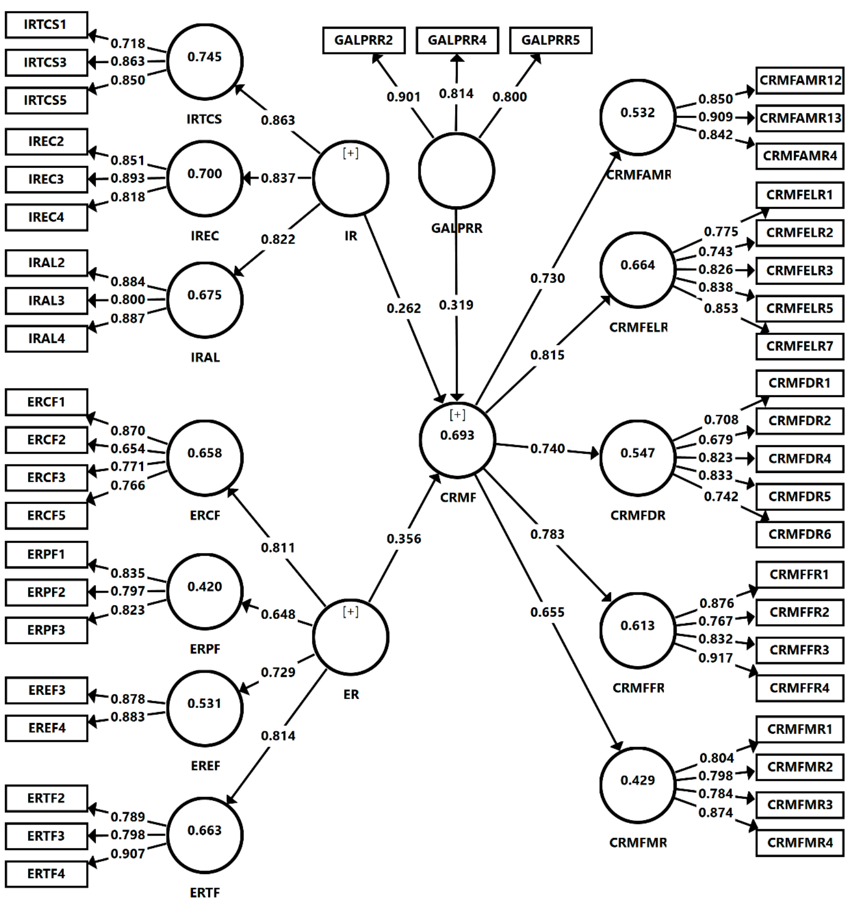

Figure 2. Measurement model

Each construct's outer loading represents the individual item's reliability. Indicators with weak outer loadings (between 0.4 and 0.7) should be deleted by carefully examining the effect of the removal of these items on Composite Reliability (CR) (Hair et al., 2022). Out of 72 items for the current study, 27 items were deleted as loadings for these items are less than 0.4.

The degree to which items of the instrument measure the same construct's various aspects is termed Internal Consistency Reliability (Michalos, 2014). There are two main estimators commonly employed by experts i.e., Cronbach's Alpha (α) and Composite Reliability (CR). In SEM, composite reliability is the degree to which constructs set are related to a given latent variable (Hair et al., 2022).

Table 2 represents the α and CR values. This study meets the quality requirements for internal consistency reliability (α > 0.7 and 0.6 < CR < 0.95) (Hair et al., 2019).

When items in a specific measure converge to reflect the underlying construct, it refers to the convergent validity (Cheah et al., 2018). This study meets the quality requirements for convergent validity (AVE > 0.5 and CR > 0.6) (Fornell & Larcker, 1981).

Discriminant validity is established when two or more constructs are discriminated from one another (Rönkkö & Cho, 2022). The primary goal of attaining discriminant validity is to ensure that constructs are distinctive and have a solid connection with their indicators (Hair et al., 2022). It is established using the Heterotrait-Monotrait ratio of correlations (HTMT), Cross-loading and Fornell-Larcker criterion as illustrated in Table 3 (Sarstedt et al., 2021; Henseler et al., 2015).

The Fornell-Larcker criterion is attained in Table 3.

The HTMT criterion (<0.85) is attained in Table 4.

Cross-loading criterion is attained in Table 5.

Table 2. Loadings, Cronbach's Alpha, CR and AVE

Variable	Item	Loading	α	CR	AVE
IRAL	IRAL2	0.884	0.821	0.893	0.736
	IRAL3	0.800			
	IRAL4	0.887			
IREC	IREC2	0.851	0.815	0.890	0.730
	IREC3	0.893			
	IREC4	0.818			
IRTCS	IRTCS1	0.718	0.743	0.853	0.661
	IRTCS3	0.863			
	IRTCS5	0.850			
ERCF	ERCF1	0.870	0.768	0.851	0.591
	ERCF2	0.654			
	ERCF3	0.771			
	ERCF5	0.766			
EREF	EREF3	0.878	0.710	0.873	0.775
	EREF4	0.883			
ERPF	ERPF1	0.835	0.757	0.859	0.670
	ERPF2	0.797			
	ERPF3	0.823			

End of Table 2

Variable	Item	Loading	α	CR	AVE
ERTF	ERTF2	0.789	0.782	0.871	0.694
	ERTF3	0.798			
	ERTF4	0.907			
CRMFAMR	CRMFAMR4	0.842	0.835	0.901	0.753
	CRMFAMR12	0.850			
	CRMFAMR13	0.909			
CRMFDR	CRMFDR1	0.708	0.816	0.871	0.577
	CRMFDR2	0.679			
	CRMFDR4	0.823			
	CRMFDR5	0.833			
	CRMFDR6	0.742			
CRMFELR	CRMFELR1	0.775	0.867	0.904	0.653
	CRMFELR2	0.743			
	CRMFELR3	0.826			
	CRMFELR5	0.838			
	CRMFELR7	0.853			
CRMFFR	CRMFFR1	0.876	0.871	0.912	0.723
	CRMFFR2	0.767			
	CRMFFR3	0.832			
	CRMFFR4	0.917			
CRMFMR	CRMFMR1	0.804	0.833	0.888	0.666
	CRMFMR2	0.798			
	CRMFMR3	0.784			
	CRMFMR4	0.874			
GALPRR	GALPRR2	0.901	0.790	0.877	0.705
	GALPRR4	0.814			
	GALPRR5	0.800			

Table 3. Fornell-Larcker criterion

Constructs	CRMF AMR	CRMF DR	CRMF ELR	CRMF FR	CRMF MR	ERCF	EREF	ERPF	ERTF	GAL PRR	IRAL	IREC	IRTCS
CRMFAMR	0.868												
CRMFDR	0.442	0.760											
CRMFELR	0.500	0.472	0.808										
CRMFFR	0.461	0.516	0.524	0.850									
CRMFMR	0.414	0.330	0.432	0.370	0.816								
ERCF	0.464	0.504	0.498	0.461	0.383	0.769							
EREF	0.445	0.424	0.446	0.394	0.382	0.494	0.880						
ERPF	0.376	0.420	0.356	0.293	0.221	0.369	0.260	0.819					
ERTF	0.518	0.445	0.569	0.468	0.501	0.469	0.532	0.415	0.833				
GALPRR	0.517	0.494	0.638	0.575	0.486	0.556	0.554	0.401	0.674	0.839			
IRAL	0.561	0.435	0.486	0.554	0.352	0.494	0.437	0.314	0.455	0.481	0.858		
IREC	0.416	0.298	0.381	0.390	0.334	0.351	0.287	0.477	0.437	0.439	0.493	0.855	
IRTCS	0.500	0.467	0.481	0.474	0.459	0.456	0.476	0.556	0.605	0.583	0.565	0.623	0.813

Note: Bold letters AVE square root values and off-diagonal values represent correlations between constructs.

Table 4. HTMT criteria

Constructs	CRMF AMR	CRMF DR	CRMF ELR	CRMF FR	CRMF MR	ERCF	EREF	ERPF	ERTF	GALPRR	IRAL	IREC	IRTCS
CRMFAMR													
CRMFDR	0.518												
CRMFELR	0.582	0.539											
CRMFFR	0.532	0.588	0.589										
CRMFMR	0.479	0.371	0.488	0.432									
ERCF	0.565	0.605	0.597	0.554	0.474								
EREF	0.580	0.531	0.563	0.496	0.492	0.651							
ERPF	0.449	0.500	0.440	0.341	0.259	0.473	0.349						
ERTF	0.605	0.494	0.664	0.528	0.585	0.540	0.687	0.492					
GALPRR	0.620	0.572	0.766	0.679	0.599	0.689	0.732	0.519	0.822				
IRAL	0.679	0.522	0.562	0.650	0.418	0.616	0.577	0.368	0.521	0.575			
IREC	0.502	0.352	0.441	0.461	0.402	0.439	0.374	0.584	0.513	0.525	0.586		
IRTCS	0.620	0.549	0.577	0.593	0.579	0.592	0.664	0.709	0.752	0.748	0.712	0.777	

Table 5. Cross-loading criteria

Items	IRAL	IREC	IRTCS	ERCF	EREF	ERPF	ERTF	CRMF AMR	CRMF DR	CRMF ELR	CRMF FR	CRMF MR	GAL PRR
IRAL2	**0.884**	0.552	0.548	0.402	0.348	0.354	0.449	0.379	0.301	0.463	0.479	0.275	0.468
IRAL3	**0.800**	0.324	0.424	0.423	0.399	0.172	0.273	0.318	0.470	0.333	0.438	0.300	0.295
IRAL4	**0.887**	0.367	0.472	0.452	0.388	0.263	0.431	0.748	0.374	0.442	0.509	0.337	0.458
IREC2	0.376	**0.851**	0.546	0.301	0.273	0.377	0.342	0.251	0.243	0.284	0.308	0.348	0.417
IREC3	0.489	**0.893**	0.624	0.365	0.263	0.518	0.442	0.405	0.338	0.353	0.377	0.271	0.372
IREC4	0.391	**0.818**	0.409	0.222	0.194	0.309	0.327	0.411	0.168	0.340	0.308	0.238	0.335
IRTCS1	0.378	0.358	**0.718**	0.326	0.426	0.238	0.356	0.282	0.243	0.266	0.397	0.307	0.499
IRTCS3	0.469	0.533	**0.863**	0.330	0.335	0.479	0.464	0.415	0.365	0.335	0.337	0.349	0.373
IRTCS5	0.518	0.600	**0.850**	0.450	0.413	0.593	0.628	0.498	0.501	0.544	0.431	0.452	0.560
ERCF1	0.417	0.174	0.244	**0.870**	0.350	0.236	0.320	0.470	0.423	0.418	0.343	0.288	0.366
ERCF2	0.291	0.233	0.314	**0.654**	0.282	0.290	0.180	0.226	0.347	0.233	0.314	0.297	0.298
ERCF3	0.434	0.273	0.460	**0.771**	0.534	0.301	0.522	0.423	0.464	0.425	0.457	0.366	0.573
ERCF5	0.352	0.401	0.365	**0.766**	0.310	0.311	0.359	0.271	0.297	0.424	0.283	0.220	0.428
EREF3	0.344	0.243	0.485	0.426	**0.878**	0.257	0.446	0.295	0.413	0.283	0.337	0.372	0.452
EREF4	0.425	0.262	0.354	0.443	**0.883**	0.201	0.491	0.487	0.335	0.501	0.357	0.301	0.523
ERPF1	0.383	0.513	0.541	0.335	0.257	**0.835**	0.466	0.474	0.388	0.357	0.369	0.257	0.435
ERPF2	0.145	0.361	0.452	0.173	0.197	**0.797**	0.256	0.138	0.289	0.128	0.116	0.090	0.232
ERPF3	0.206	0.276	0.361	0.372	0.176	**0.823**	0.265	0.257	0.341	0.353	0.194	0.168	0.286
ERTF2	0.286	0.389	0.472	0.206	0.295	0.318	**0.789**	0.305	0.242	0.478	0.318	0.362	0.464
ERTF3	0.226	0.131	0.348	0.314	0.423	0.177	**0.798**	0.327	0.273	0.306	0.235	0.289	0.458
ERTF4	0.552	0.517	0.644	0.571	0.563	0.487	**0.907**	0.594	0.529	0.598	0.552	0.551	0.709
CRMFAMR4	0.459	0.312	0.340	0.392	0.300	0.242	0.350	**0.842**	0.305	0.476	0.369	0.323	0.375
CRMFAMR12	0.518	0.343	0.470	0.392	0.535	0.269	0.512	**0.850**	0.424	0.329	0.406	0.390	0.473
CRMFAMR13	0.484	0.422	0.486	0.423	0.328	0.454	0.482	**0.909**	0.417	0.493	0.423	0.365	0.493
CRMFDR1	0.257	0.320	0.276	0.279	0.169	0.365	0.224	0.337	**0.708**	0.335	0.333	0.145	0.245
CRMFDR2	0.210	0.027	0.119	0.264	0.252	0.135	0.225	0.211	**0.679**	0.374	0.299	0.158	0.225
CRMFDR4	0.268	0.137	0.228	0.311	0.215	0.239	0.220	0.277	**0.823**	0.204	0.298	0.137	0.257

End of Table 5

Items	IRAL	IREC	IRTCS	ERCF	EREF	ERPF	ERTF	CRMF AMR	CRMF DR	CRMF ELR	CRMF FR	CRMF MR	GAL PRR
CRMFDR5	0.422	0.412	0.559	0.462	0.325	0.607	0.452	0.410	**0.833**	0.498	0.447	0.340	0.472
CRMFDR6	0.429	0.168	0.467	0.521	0.573	0.170	0.478	0.393	**0.742**	0.331	0.520	0.389	0.572
CRMFELR1	0.332	0.122	0.314	0.381	0.422	0.316	0.454	0.414	0.297	**0.775**	0.313	0.360	0.564
CRMFELR2	0.422	0.242	0.355	0.472	0.376	0.118	0.450	0.405	0.506	**0.743**	0.467	0.362	0.449
CRMFELR3	0.267	0.251	0.296	0.370	0.224	0.393	0.349	0.304	0.306	**0.826**	0.376	0.226	0.460
CRMFELR5	0.430	0.383	0.462	0.370	0.360	0.341	0.445	0.424	0.351	**0.838**	0.479	0.380	0.528
CRMFELR7	0.480	0.499	0.489	0.413	0.405	0.289	0.577	0.456	0.423	**0.853**	0.459	0.397	0.569
CRMFFR1	0.498	0.295	0.342	0.377	0.276	0.196	0.397	0.468	0.503	0.485	**0.876**	0.258	0.453
CRMFFR2	0.360	0.311	0.353	0.283	0.219	0.231	0.259	0.257	0.349	0.304	**0.767**	0.314	0.352
CRMFFR3	0.488	0.337	0.472	0.462	0.484	0.284	0.512	0.406	0.451	0.459	**0.832**	0.350	0.586
CRMFFR4	0.520	0.382	0.442	0.430	0.345	0.286	0.403	0.411	0.439	0.508	**0.917**	0.343	0.542
CRMFMR1	0.270	0.210	0.303	0.269	0.250	0.216	0.427	0.375	0.229	0.498	0.292	**0.804**	0.326
CRMFMR2	0.310	0.358	0.413	0.316	0.296	0.220	0.381	0.307	0.275	0.304	0.299	**0.798**	0.391
CRMFMR3	0.181	0.207	0.362	0.278	0.285	0.085	0.326	0.189	0.190	0.208	0.246	**0.784**	0.389
CRMFMR4	0.360	0.307	0.422	0.379	0.404	0.180	0.476	0.435	0.358	0.359	0.356	**0.874**	0.478
GALPRR2	0.324	0.261	0.447	0.417	0.409	0.351	0.555	0.370	0.418	0.508	0.447	0.453	**0.901**
GALPRR4	0.316	0.219	0.348	0.435	0.441	0.079	0.502	0.334	0.325	0.536	0.433	0.410	**0.814**
GALPRR5	0.542	0.580	0.637	0.534	0.530	0.531	0.622	0.568	0.481	0.554	0.551	0.365	**0.800**

Note: Bold letter represents indicator's outer loading.

The structural model is assessed through the significance of Path Coefficients, Predictive relevance (Q^2), Effect Size (f^2), Coefficient of Determination (R^2) and moderating effect (Hair et al., 2022).

Figure 3 illustrates a structural model.

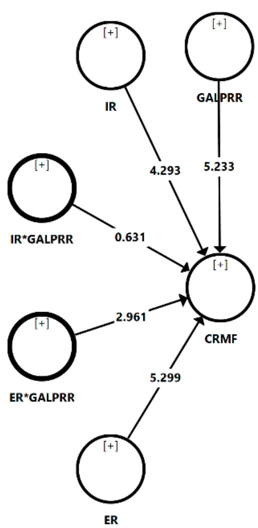

Figure 3. Structural model

This study used two-tailed T-test with 5000 bootstrapping samples and 303 cases for hypothesis testing (illustrated in Table 6) (Hair et al., 2022).

Table 6. Significance of path coefficients

Hypothesis	Relationship	Original Sample (O)	Sample Mean (M)	T Statistics	p Values	Decision
H1	Internal risk factors → Risk management	0.249	0.246	4.293	0.000	Accepted
H2	External risk factors → Risk management	0.355	0.359	5.299	0.000	Accepted
H3	Government by-laws → Risk management	0.252	0.254	5.233	0.000	Accepted
H4	Internal risk factors * Government by-laws → Risk management	–0.040	–0.031	0.631	0.528	Rejected
H5	External risk factors * Government by-laws → Risk management	0.205	0.203	2.961	0.003	Accepted

In-sample predictive power (value ranges 0–1 with the least allowable value being 0.1), which is a statistical measurement of dependent variable variation amount anticipated by the independent variable (or variables) is termed as coefficient of determination (Hair et al., 2019; Lewis-Beck & Lewis-Beck, 2016; Hamilton et al., 2015; Sarstedt et al., 2014). Following Chin (1998), it can be concluded that the R^2 value of 0.744 has substantial predictive power indicating internal risks, external risks and government bylaws mutually explain 74.4% variation in risk management.

Effect size is a measure of how much an exogenous variable has an impact on an endogenous variable in terms of R^2 (Selya et al., 2012). Following Cohen (1988), internal and external risk variables have a moderate impact on risk management, with their respective effect sizes of 0.105 and 0.163 falling into the moderate category.

The Stone-Geisser test has been used in the current study's blindfolded procedures to determine the research model's predictive applicability (Hair et al., 2022). This test, which serves as extra goodness of fit and out-of-sample predictive power, is an indicative measure of predictive relevance for PLS-SEM (Hair et al., 2022; Rigdon, 2012; Sarstedt et al., 2014). Stone-Geisser test is done by blindfolding which is a re-use technique estimating the cross-validated predictive relevance of endogenous construct (Hair et al., 2022).

Following Chin's (2010) recommendation, a value of 0.281 > 0 was obtained using the cross-validated redundancy Q^2 test. It is confirmed that the structural model's key prediction has been validated.

The product indicator technique, which makes use of all likely pair combinations of indicators, was applied for the estimate of the moderating influence of government bylaws on the correlation between internal and external risk factors with risk management (Hair et al., 2022; Becker et al., 2018).

Figure 4 represents the moderation effect of government bylaws among external risk factors and risk management. Government bylaws positively strengthen the connection linking external risk factors and risk management related to construction.

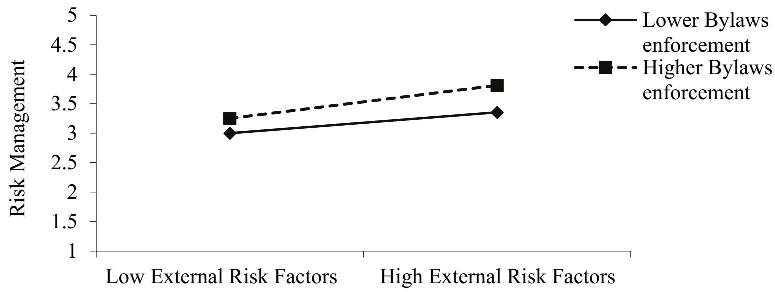

Figure 4. Moderation effect

The effect size of risk management (endogenous latent variable) is calculated based on the R2 when the government bylaws (moderator) is incorporated and omitted from the structural model (Henseler et al., 2009). The moderating effect's strength is calculated using the following formula (Cohen, 1988; Henseler et al., 2009);

$$\text{Effect size}\left(f^2\right)=\frac{R^{2\left(\text{Government Bylaws included}\right)}-R^{2\left(\text{Government Bylaws excluded}\right)}}{1-R^{2\left(\text{Government Bylaws included}\right)}}. \quad (1)$$

Risk management is moderately impacted by the effect size of 0.199 (Cohen, 1988).

5. Discussion

Construction risks are connected to the ambiguity surrounding completion dates, costs, and quality (Yap et al., 2021). In construction sector of low and middle-income country, risk management is relatively new discipline without a foundational framework (Nawaz et al., 2019). Managing risks in construction is a specialized field that focuses on the political, social and economic circumstances of each country (Zhou & Yang, 2020).

The study of Alsuliman (2019) has validated that certain resources in the organization (internal risk factor in current research) e.g., skills and competency, communication free flow, requirements and preferences and active leadership are positively linked with construction risk management. Walker (2015) and Yap et al. (2021) have validated those certain organizational external factors e.g., technical, economical, labor dispute, strikes and political have a positive connection with risk management in construction industry. Accordingly, Mpofu et al. (2017) revealed the impractical duration of the contract, lack of complete design during tendering stage, delays in obtaining government approvals and permits, changes in orders and scope, design changes, lack of scheduling and planning, poor site management and control, lack of productive manpower and delays in decision making are major factors that impact on delays in construction projects.

Organizational success depends on internal risk factors (intangible resources) which include active leadership, team competency and skills and effective communication for the present study (Adeleke et al., 2017; Omer et al., 2021). Intangible resources play an important role in the long run and success of contractors and companies through effectively managing tangible resources (equipment, labor, land and capital, etc.) which are referred to as organization assets (Kamasak, 2017; Inmyxai & Takahashi, 2009).

External risk factors are associated with risk factors outside the control of the project team or organization's jurisdiction (Al-Sabah et al., 2012). External risk factors (cultural factor, political factor, economic factor and technology factor) have a significant strong effect on construction projects (Kassem et al., 2020; Adeleke et al., 2018). The greater part of construction time and cost overruns are caused by improper management of the external risks (technology factor, political factor, cultural factor and economic factor) (Kassem et al., 2020).

Government bylaws are rules that are prepared and adopted by the organization prior to the project execution, considering the procedures and actions associated with incorporating safety and various types of materials at every step of the construction phase (Sarder, 2020). The results of this study show that contractors in KSA are successful at managing construction risk when government bylaws are properly implemented.

Moderation of government bylaws between internal risk factors and construction management among the KSA contractors is a negative relationship. Government bylaws acting between external risk factors and risk management in KSA contractors have a strong positive significant effect.

Organizational control plays a significant role in organization development by being multifaceted and goal-oriented. It is composed of a comprehensive myriad of practices corresponding to conceptions such as interactive, diagnostic, boundary and belief control; bureaucratic, clan and market control; and informal and formal control (Walter et al., 2021). Relationship confirmation among management of construction risks, government bylaws, internal and external risk factors can be clarified hypothetically by organization control theory. Following this theory, implementing and establishing proper control must hypothetically moderate the construction risks occurrence in projects connecting with employees (including the organization itself) with proper controlling, monitoring and compensating assuming that government Acts, laws and policies reduce risk occurrence (Chown et al., 2020). Adoption of organization control procedures results in the reduction of risks in an organization.

6. Conclusions

The construction industry is composed of various market fragments making it non-homogeneous with various players (e.g., sellers and buyers), varying market power and market position. The construction company's efficiency largely depends on government rules and regulations. The contractors' monopoly can be controlled only by the intervention of government policies and regulations in terms of auction-effective framework and tender documentation improvement including short and long-term contracts. This study improves the performance of KSA contractors in the output delivery of projects by establishing the current framework as benchmarking in managing construction risks. The study suggests that economic parameters like importation costs, exchange rates, inflation and deflation are crucial in all building projects. These parameters can also influence the nature of risk that may arise from them. Growing economies play a significant role in the execution of construction projects causing lower risk. The more advanced technology used in the construction industry results in fewer hazards that may develop as an outcome of technology on the projects.

Without taking into account the significance of risk variables where misunderstandings and disputes can create more reputational harm, depending solely on enormous profits and substantial financial returns is insufficient for success in the construction market. When risk concerns are neglected, given insufficient importance, or improperly managed, construction activities and operations are delayed resulting in project failure. During the execution phase in the construction process, the occurrence of risks can be reduced by the implementation of proper monitoring in terms of employee perceptions e.g., risk occurrence is reduced by motivation and compensation for employees who are working in every construction project event resulting in proper control within an organization. As a result, by creating environments that foster productive employee engagement, organizational management may lower risk occurrence within the project e.g., organizing workshops, conferences, trainings and seminars where the interaction of employees from different organizations enabling to enhance the reduction of risk occurrence in KSA contractors. The current research model depicted 74.4% of the overall variation in risk management in the KSA construction sector. Other important latent variables can explain the 25.6% remaining overall variation in risk management which can be taken into account for future aspects of effective construction risk management in the KSA.

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Author contributions

M.A.R., M.S.B.I. and A.Q.A. contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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