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INFLUENCE OF RISK-TRANSFER MODIFICATIONS IN FIDIC CONDITIONS ON CONTRACTOR PARTICIPATION IN PAKISTAN PUBLIC TENDERS

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ABSTRACT

This study examines the association between risk-transfer modifications in FIDIC-based contract conditions and contractor participation in Pakistan's public tenders. A convergent parallel mixed-methods design was employed using 150 contractor survey responses, 180 public tender documents issued during 2023–2025, and 18 expert interviews. Tender documents were analysed by comparing Particular Conditions with relevant FIDIC 1999 General Conditions, focusing on modifications related to unforeseeable physical conditions, price escalation, third-party delays, force majeure, design errors, variations, and suspension. The findings indicate that risk-transfer modifications are prevalent, particularly for physical conditions and price escalation. Risk-transfer density was negatively associated with contractor participation ($r = -0.68$, $p < 0.001$). Regression analysis further showed a significant negative association ($\beta = -0.52$, $p < 0.001$), while logistic regression achieved an AUC of 0.847. The results highlight the importance of balanced contractual risk allocation for improving contractor participation and supporting more competitive public procurement in Pakistan.

Keywords: FIDIC Contracts; Risk Allocation; Risk-Transfer Modifications; Contractor Participation; Public Procurement; Bid/No-Bid Decisions; Construction Risk; Pakistan.

I. INTRODUCTION

A. Background

Public procurement of infrastructure and construction projects in Pakistan constitutes a significant portion of national development expenditure, with federal and provincial agencies annually inviting thousands of tenders for roads, bridges, dams, and public buildings [1], [2]. To ensure standardized contractual frameworks, the Pakistan Engineering Council (PEC) and various public procuring entities have increasingly adopted the International Federation of Consulting Engineers (FIDIC) Conditions of Contract, particularly the Red Book (1999 and 2017 editions) for construction works. FIDIC contracts are globally recognized for their balanced allocation of risks between employers (public agencies) and contractors, underpinned by the so-called "Golden Principles," which emphasize that Particular Conditions should not disturb the risk-reward equilibrium established in the General Conditions [3], [4].

However, in practice, Pakistani public sector employers frequently introduce risk-transfer modifications through Particular Conditions, shifting traditionally employer-borne risks such as unforeseeable physical conditions, delay caused by third parties, or price fluctuation onto contractors [5], [6]. These modifications, often justified as cost-control or accountability measures, fundamentally alter the contractual risk profile envisioned by FIDIC and may deter qualified contractors from participating in public tenders.

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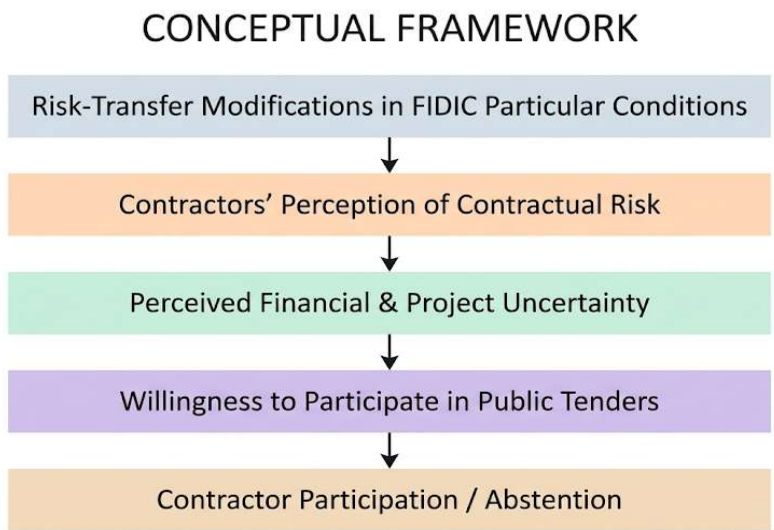

Figure 1: Risk-Transfer Modifications in FIDIC Particular Conditions

B. Problem Statement

Despite the widespread use of FIDIC-based contracts in Pakistan's public procurement, there is growing anecdotal and empirical evidence that excessive risk transfer through amended Particular Conditions may be affecting contractor participation in public tenders. This study addresses this problem by examining the relationship between risk-transfer modifications and contractor participation.

C. Research Objectives

1. To identify common risk-transfer modifications introduced in FIDIC-based Particular Conditions in Pakistan's public procurement tenders.
2. To examine the relationship between contractors' perceptions of contractual risk-transfer modifications and their willingness to participate in public tenders.
3. To assess whether specific categories of risk transfer, including ground conditions, price escalation, and delay-related risks, are differently associated with contractor participation.
4. To develop evidence-based recommendations for improving risk allocation in FIDIC-based Particular Conditions and supporting broader contractor participation in public tenders.

D. Research Questions

Based on the research objectives, the study addresses the following questions:

RQ1: What types of risk-transfer modifications are most commonly introduced in FIDIC-based Particular Conditions in Pakistan's public procurement tenders?

RQ2: What is the relationship between contractors' perceptions of contractual risk transfer and their willingness to participate in public tenders?

RQ3: Are specific categories of contractual risk transfer, such as ground conditions, price escalation, and delay-related risks, associated with differences in contractor participation?

RQ4: What contractual and procurement practices could support a more balanced allocation of risk in FIDIC-based public tenders in Pakistan?

E. Significance of the Study

This research holds significant implications for multiple stakeholders in Pakistan's construction industry. For public procuring agencies, the findings may inform the drafting of more balanced contract documents that attract qualified bidders and reduce tender failure rates. For contractors, particularly SMEs, the study highlights contractual risk factors that are associated with bidding decisions enabling better risk assessment and strategic participation [14]. Academically, this study contributes to the sparse literature on FIDIC contract implementation in South Asian developing economies, offering empirical insights into the intersection of contractual risk allocation and procurement behaviour. Given the increasing use of FIDIC 2017 editions in contemporary engineering procurement, understanding how risk-transfer modifications relate to contractor participation is timely and policy-relevant.

II. METHODOLOGY

A. Research Design

This study employed a convergent parallel mixed-methods research design to examine the influence of risk-transfer modifications in FIDIC Conditions on contractor participation in Pakistan's public tenders. The design integrated three complementary sources of evidence: (i) a structured survey of contractors, (ii) systematic analysis of FIDIC-based tender documents, and (iii) semi-structured interviews with construction and procurement experts [15].

The quantitative component was used to measure contractors' risk perceptions and participation behaviour and to statistically examine the relationship between risk-transfer modifications and contractor participation. Tender-document analysis was used to identify and quantify modifications to the risk allocation established in the FIDIC General Conditions. The qualitative component was used to explore the mechanisms through which contractual risk allocation affects contractors' bid/no-bid decisions and to provide contextual explanations for the quantitative findings. Integration of the three evidence sources was undertaken at the interpretation stage to strengthen the validity of the findings through methodological triangulation [16].

B. Study Population and Data Sources

The study focused on contractors and public-sector construction tenders in Pakistan in which FIDIC-based contractual conditions were used or incorporated. Data were collected from federal and provincial public procurement sources and from contractors involved in public construction procurement.

Three datasets were used in the study:

1. **Contractor survey:** A structured questionnaire was administered to contractors to obtain information on firm characteristics, experience, risk perception, participation behaviour, and willingness to participate in tenders containing different forms of risk-transfer modifications [17].
2. **Tender-document dataset:** A total of 180 public tender documents issued during 2023–2025 by federal and provincial procurement agencies were examined to identify risk-transfer modifications in FIDIC-based Particular Conditions. The documents covered federal, Punjab, Sindh, Khyber Pakhtunkhwa, and Balochistan procurement sources [18].
3. **Expert interviews:** Semi-structured interviews were conducted with 18 experts representing contractors, public procuring agencies, FIDIC-certified consultants, and academic specialists in construction law and procurement. The panel consisted of six senior contractors, five public procurement representatives, four FIDIC-certified contract consultants, and three academic experts [19].

C. Sampling Procedure and Sample Size

A stratified sampling approach was used to obtain contractor survey responses from different geographical and organizational groups in Pakistan. Contractors were considered from the relevant provincial and institutional categories to ensure representation of firms operating under public-sector procurement conditions. The sampling process aimed to include firms with different levels of experience, organizational size, and participation in public tenders [20].

The required minimum sample size for the contractor survey was estimated using G*Power 3.1. The calculation was based on a medium effect size of $f^2 = 0.15$, a significance level of $\alpha = 0.05$, statistical power of 0.95, and eight predictors for the multiple regression analysis. Under these assumptions, the minimum required sample size was 118 respondents [21]. To provide a sufficient analytical sample and support the planned subgroup, regression, factor, and segmentation analyses, the final survey dataset consisted of 150 completed contractor responses.

In addition to the contractor survey, 180 public tender documents issued during 2023–2025 were selected for the analysis of FIDIC-related risk-transfer modifications. The documents covered public procurement cases from federal and provincial agencies, including Punjab, Sindh, Khyber Pakhtunkhwa, and Balochistan. The tender-document sample was structured to capture variation across provinces and public-sector agency types [22].

For the qualitative component, 18 expert interviews were conducted with participants having relevant experience in construction contracting, public procurement, FIDIC-based contract administration, and academic research. The interview participants included six senior contractors, five public procurement representatives, four FIDIC-certified contract consultants, and three academic experts.

Thus, the final empirical dataset comprised 150 contractor survey responses, 180 tender documents, and 18 expert interviews. These three sources were analyzed separately and subsequently integrated to provide quantitative and qualitative evidence on risk-transfer modifications and contractor participation in public tenders [23].

D. Measurement and Operationalization of Variables

The study operationalized the main constructs required to examine the relationship between FIDIC-related risk-transfer modifications and contractor participation in public tenders. The principal variables included risk-transfer modification, risk-transfer density, risk perception, contractor participation, firm size, and contractor experience. Additional descriptive variables included annual turnover, previous participation in public tenders, win rate, and perceived severity of specific contractual risks [24].

Risk-transfer modification refers to a Particular Condition that changes the allocation of a risk relative to the risk allocation reflected in the relevant FIDIC General Conditions. The analysis focused on modifications involving unforeseeable physical conditions, price escalation, third-party delays, force majeure, employer design errors, suspension, and variations.

Risk-transfer density was operationalized as the number of identified risk-transfer modifications contained in a tender document [25]. A higher value therefore represents a greater number of contractual provisions that modify or transfer risks toward the contractor. Risk-transfer density was treated separately from risk severity because the number of modified provisions and the perceived seriousness of those risks represent different aspects of contractual risk exposure.

Risk perception was measured using a five-point Likert-type scale, with higher scores representing greater perceived risk associated with the contractual conditions. The survey captured contractors' perceptions of major risk categories, including price escalation, ground conditions, and delay-related risks.

Contractor participation was operationalized using the participation measures available in the survey dataset. The continuous participation measure was used in the multiple linear regression analysis, while a binary participation indicator was used for the logistic regression analysis.

E. Tender Document Analysis

The tender-document analysis involved systematic coding of Particular Conditions against the relevant FIDIC General Conditions. The coding framework captured:

1. The relevant FIDIC General Condition;
2. The risk category;
3. The direction of risk transfer;
4. The type of contractual modification; and
5. The severity of the modification.

The analysis focused on the following FIDIC clauses:

- GC 4.12: Physical Conditions
- GC 13.8: Price Escalation
- GC 8.5: Third-Party Delay
- GC 13.1–13.3: Variations
- GC 1.9: Design Errors
- GC 19: Force Majeure

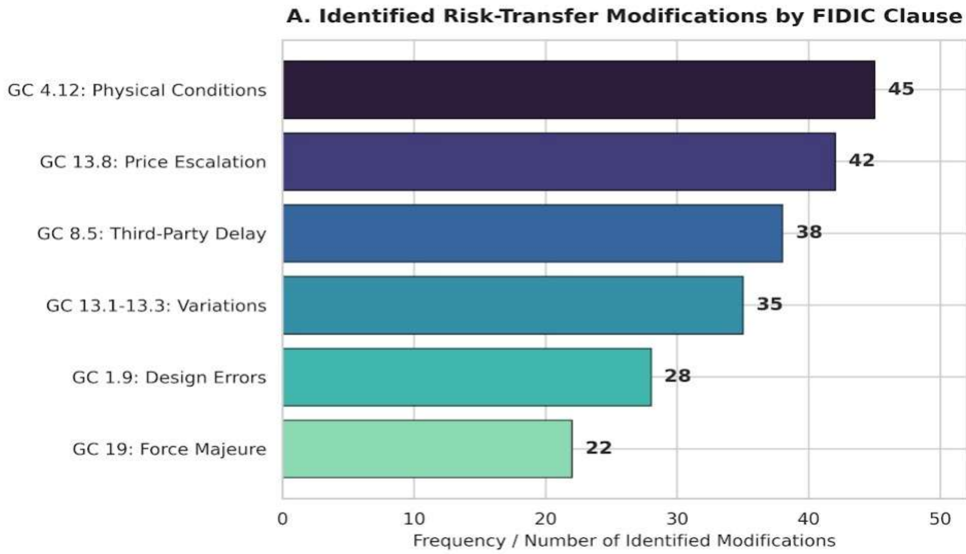

Figure 2: Identified Risk-Transfer Modifications by FIDIC Clause

To improve coding reliability, the identified contractual modifications were independently reviewed and inter-rater reliability was assessed using Cohen's kappa. The reported agreement coefficient was 0.84.

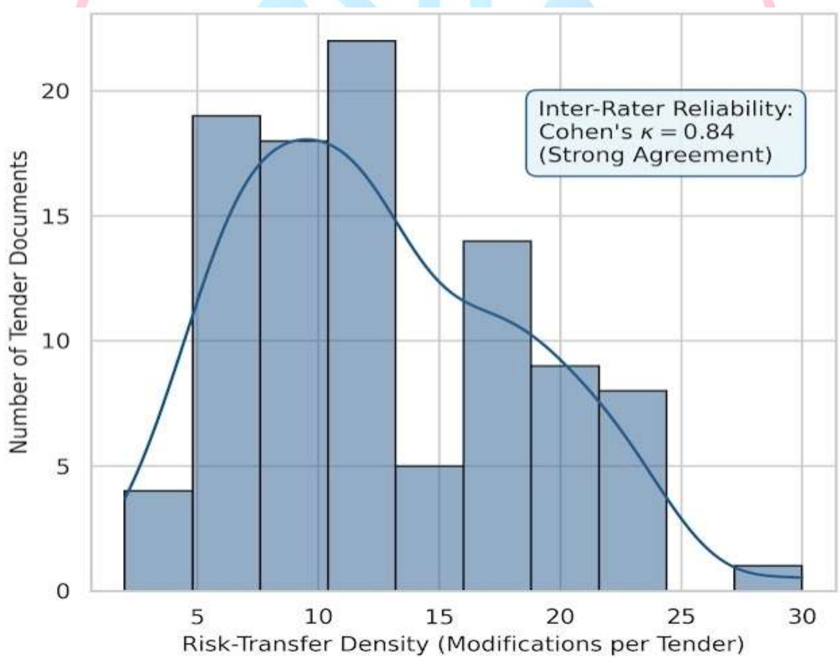

Figure 3: Distribution of Risk-Transfer Density in Tenders

The resulting risk-transfer density represented the number of identified risk-transfer modifications within each tender document.

F. Survey Data Analysis

Survey data were analyzed using descriptive and inferential statistical techniques.

Descriptive statistics were first used to summarize contractor characteristics and the distribution of the principal study variables. These included means, standard deviations, ranges, frequencies, and percentages [30]. The contractor survey variables included firm size, years of experience, annual turnover, number of tenders participated in, tenders won, win rate, risk perception, and participation likelihood.

Exploratory data analysis was subsequently performed to examine the distribution of the variables, identify unusual observations, and assess the suitability of the data for inferential analysis. The study used graphical inspection and statistical procedures to examine potential outliers and data irregularities.

G. Multiple Linear Regression Analysis

Multiple linear regression was used to examine the association between risk-transfer density and the continuous contractor participation measure while controlling for relevant contractor characteristics. The regression model was specified as:

$$Y_i = \beta_0 + \beta_1 RTD_i + \beta_2 RP_i + \beta_3 FS_i + \beta_4 EXP_i + \beta_5 AT_i + \beta_6 PPT_i + \beta_7 WR_i + \beta_8 PRS_i + \varepsilon_i$$

where Y_i represents the continuous contractor participation measure; RTD_i represents risk-transfer density; RP_i represents risk perception; FS_i represents firm size; EXP_i represents contractor experience; AT_i represents annual turnover; PPT_i represents previous participation in public tenders; WR_i represents tender win rate; PRS_i represents perceived risk severity; and ε_i represents the error term.

H. Logistic Regression Analysis

Binary logistic regression was conducted as a complementary analysis to examine the factors associated with the contractor participation decision. The dependent variable was coded as a binary participation outcome based on the participation/bid decision category defined in the contractor survey. This approach allowed the study to examine whether contractors with different levels of perceived contractual risk and different firm characteristics differed in the likelihood of participating in public tenders [34], [35].

The logistic regression model included risk perception, risk-transfer density, firm size, and other relevant contractor characteristics as explanatory variables. The general form of the model was:

$$\log(P_i/(1 - P_i)) = \beta_0 + \beta_1 RP_i + \beta_2 RTD_i + \beta_3 FS_i + \ldots + \beta_k X_{ki}$$

where P_i represents the probability that contractor i belongs to the defined participation category, RP_i represents risk perception, RTD_i represents risk-transfer density, FS_i represents firm size, and X_{ki} represents the additional explanatory variables included in the model.

The estimated coefficients were converted into odds ratios (ORs) to facilitate interpretation. An odds ratio below 1 indicates lower odds of the defined participation outcome as the corresponding predictor increases, whereas an odds ratio above 1 indicates higher odds, holding the other variables constant [36], [37].

For model evaluation, the analysis used the area under the receiver operating characteristic curve (AUC-ROC) and classification accuracy. The available dataset was divided into 120 observations for model training and 30 observations for testing, giving a total of 150 contractor observations. Where regularized estimation was applied, an L2 penalty was used to reduce the risk of overfitting.

The logistic regression results were interpreted as statistical associations with the probability of the observed participation outcome rather than as evidence of causality. The logistic model was therefore used as a complementary robustness analysis alongside the continuous-outcome regression model [38].

I. Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was conducted to identify the underlying dimensions of contractors' perceived contractual risks and to determine whether the measured risk items could be represented by a smaller number of related factors. The analysis was based on the contractor survey responses.

The suitability of the data for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity. A KMO value of 0.812 indicated adequate sampling adequacy for factor analysis, while Bartlett's test was statistically significant ($\chi^2 = 1847.3$, $p < 0.001$), indicating that the correlation matrix contained sufficient relationships among the measured items for factor extraction [39].

The factor analysis identified four underlying dimensions of perceived contractual risk. These dimensions were labelled Financial Risk, Operational Risk, Legal-Contractual Risk, and External Risk based on the substantive meaning of the items loading on each factor. The four dimensions jointly accounted for 80.4% of the total explained variance, with Financial Risk accounting for 32.1%, Operational Risk for 21.0%, Legal-Contractual Risk for 16.2%, and External Risk for 11.1%.

The resulting factor structure was used to organize the risk-perception variables and to provide a more systematic interpretation of the different forms of contractual risk perceived by contractors. The EFA results were interpreted alongside the tender-document analysis and interview findings to examine whether the risk categories identified statistically were also reflected in the contractual and qualitative evidence [40].

J. Contractor Segmentation Analysis

K-means clustering was used as a supplementary analysis to examine heterogeneity in contractor responses to risk-transfer modifications. The clustering procedure grouped contractors according to relevant characteristics including firm size, risk perception, and participation behavior.

The optimal number of clusters was determined using the elbow method and silhouette analysis. The final analysis identified four contractor segments [41].

The segmentation analysis was treated as a supplementary analysis rather than the primary test of the study because the central research objective was to examine the relationship between FIDIC risk-transfer modifications and contractor participation.

K. Qualitative Interview Analysis

The 18 expert interviews were analyzed using thematic analysis. Interviews were audio-recorded with participant consent, transcribed, and coded according to themes relevant to the research questions. NVivo 12 was used to organize the qualitative coding process.

The analysis focused on four principal areas:

1. Contractor risk perception and bid/no-bid decisions;
2. The effects of particular risk-transfer modifications;
3. The differential implications for smaller and larger contractors; and
4. Expert perspectives on improving risk allocation in public procurement.

The qualitative findings were subsequently compared with the quantitative survey and tender-document findings to identify areas of convergence and divergence.

L. Integration of Mixed-Methods Evidence

The three datasets were integrated during the interpretation stage. Tender-document analysis established the prevalence and characteristics of risk-transfer modifications, survey analysis quantified their association with contractor participation, and expert interviews provided contextual explanations for contractors' responses.

This integration enabled the study to distinguish between:

- What contractual modifications occurred;
- How frequently they occurred;
- How contractors perceived the associated risks;
- How these risks were associated with participation behavior; and
- How industry experts explained the observed participation patterns.

The mixed-methods framework therefore provided complementary evidence for assessing the relationship between FIDIC risk allocation and contractor participation in Pakistan's public tenders.

M. Ethical and Data-Quality Considerations

Participation in the contractor survey and expert interviews was voluntary. Interview participants provided consent for recording and analysis of their responses. Contractor and expert information was treated confidentially and used for research purposes.

Data-quality procedures included screening for missing observations, assessment of potential outliers, reliability checks for document coding, and examination of the assumptions required for the statistical analyses. These procedures were applied before interpretation of the final findings.

III. RESULTS

A. Overview of the Empirical Findings

The study combined evidence from contractor survey responses, 180 public tender documents, and 18 expert interviews to examine the relationship between risk-transfer modifications in FIDIC-based Particular

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Conditions and contractor participation in Pakistan's public tenders. Consistent with the convergent parallel mixed-methods research design, the findings are presented through tender-document analysis, contractor characteristics and descriptive findings, correlation analysis, multiple linear regression, logistic regression, exploratory factor analysis, contractor segmentation, and qualitative interview analysis [42].

A total of 150 completed contractor questionnaires were obtained and used as the final contractor survey dataset. The tender-document dataset consisted of 180 public tenders issued during 2023–2025, while the qualitative component comprised 18 expert interviews. Thus, the final empirical dataset consisted of 150 contractor survey responses, 180 tender documents, and 18 expert interviews.

B. Risk-Transfer Modifications in Tender Documents

The analysis of 180 tender documents identified several recurring modifications to the risk allocation contained in the relevant FIDIC General Conditions. The most frequently observed modification concerned unforeseeable physical conditions. This modification appeared in 153 of the 180 documents (85.0%). Price-escalation provisions were eliminated or restricted in 141 documents (78.3%), while third-party delay risks were transferred to contractors in 112 documents (62.2%).

Other modifications included narrowed force-majeure provisions in 91 tenders (50.6%), partial transfer of employer-related design risks in 67 tenders (37.2%), reduced compensation for employer suspension in 58 tenders (32.2%), and contractor absorption of variation-related costs in 52 tenders (28.9%).

TABLE I
PREVALENCE OF RISK-TRANSFER MODIFICATIONS IN PUBLIC TENDER DOCUMENTS

Risk Category	Frequency	% of Tenders	FIDIC GC Reference	Modification Type	Severity Index
Unforeseeable Physical Conditions	153	85.0%	GC 4.12	Transferred to Contractor	4.6/5.0
Price Escalation	141	78.3%	GC 13.8	Eliminated/Restricted	4.4/5.0
Delay by Third Parties	112	62.2%	GC 8.5	Contractor Bears Risk	4.1/5.0
Force Majeure	91	50.6%	GC 19	Narrowed Definition	3.8/5.0
Employer-Related Design Errors	67	37.2%	GC 1.9	Partial Transfer	3.5/5.0
Suspension by Employer	58	32.2%	GC 8.9-8.11	Reduced Compensation	3.3/5.0
Variations	52	28.9%	GC 13.1-13.3	Contractor Absorbs Cost	3.1/5.0

The document-coding process produced a Cohen's kappa coefficient of 0.84, indicating a high level of agreement between the independent coding assessments. The resulting risk-transfer density measure represented the number of identified risk-transfer modifications within each tender document [43].

The findings demonstrate that modifications to the standard FIDIC risk allocation were not limited to a single contractual risk category. Rather, risk-transfer provisions occurred across physical conditions, price adjustment, delay, force majeure, design responsibility, suspension, and variation mechanisms.

C. Contractor Characteristics and Descriptive Findings

The contractor survey captured information on firm characteristics, tender participation, risk perception, and perceptions of contractual risk. The mean participation-likelihood score was 2.9/5.0 (SD = 1.1). This result indicates relatively lower reported willingness to participate under tender conditions involving extensive risk-transfer provisions.

Among the individual risk categories, price escalation risk received the highest mean severity rating (4.2/5.0), followed by ground-condition risk (4.0/5.0) and delay-penalty risk (3.9/5.0). These findings indicate that financial and operational uncertainties represented prominent components of contractors' reported contractual risk perceptions [44].

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The survey also captured firm size, contractor experience, annual turnover, previous participation in public tenders, tender win rate, and participation behaviour. These variables were subsequently considered in the relevant descriptive and inferential analyses.

D. Correlation between Risk-Transfer Density and Contractor Participation

Pearson correlation analysis was conducted to examine the direction and strength of the linear relationships between contractor participation and the principal explanatory variables. Particular attention was given to risk-transfer density, risk perception, firm size, and contractor experience.

The analysis examined the following variables:

1. Risk-transfer density;
2. Risk perception;
3. Firm size;
4. Contractor experience;
5. Annual turnover;
6. Previous participation in public tenders;
7. Tender win rate; and
8. Perceived risk severity.

The analysis showed a strong negative correlation ($r = -0.68$, $p < 0.001$) between risk-transfer density and the reported contractor participation measure. Thus, higher levels of risk-transfer modification were associated with lower levels of contractor participation.

Because the study used observational survey data, this correlation should be interpreted as an association rather than evidence of a causal relationship.

E. Multiple Linear Regression Analysis

Multiple linear regression was used to estimate the association between risk-transfer characteristics and the continuous measure of contractor participation while controlling for relevant contractor characteristics and risk perception [45].

The regression model included the following explanatory variables:

1. Risk-transfer density;
2. Risk perception;
3. Firm size;
4. Contractor experience;
5. Annual turnover;
6. Previous participation in public tenders;
7. Tender win rate; and
8. Perceived risk severity.

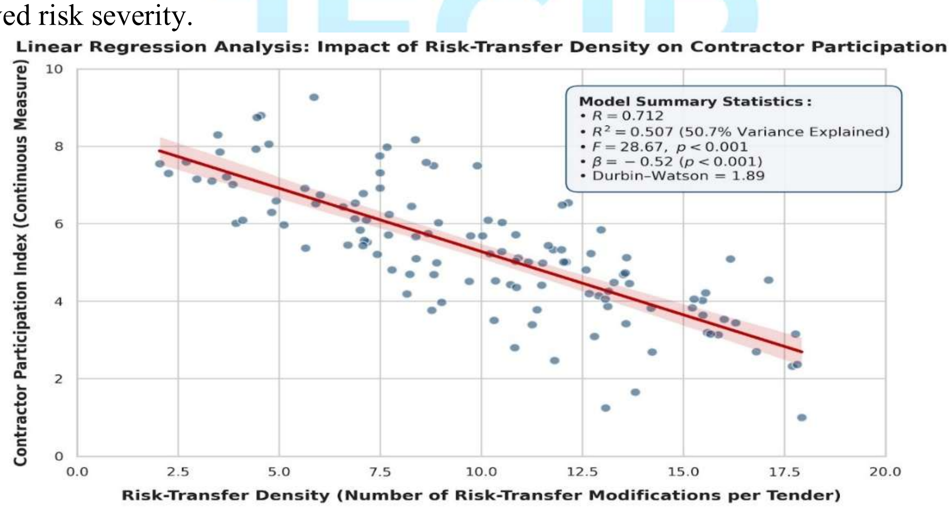

Figure 4: Linear Regression Analysis: Impact of Risk-Transfer Density on Contractor Participation

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The regression model produced R = 0.712 and $R^2 = 0.507$, indicating that the variables included in the model collectively explained approximately 50.7% of the observed variance in the continuous contractor participation measure. The overall model was statistically significant, F = 28.67, $p < 0.001$. The reported Durbin-Watson statistic was 1.89.

Risk-transfer density was negatively associated with contractor participation, with a standardized coefficient of $\beta = -0.52$ ($p < 0.001$).

The regression model was specified as:

$$Y_i = \beta_0 + \beta_1 RTD_i + \beta_2 RP_i + \beta_3 FS_i + \beta_4 EXP_i + \beta_5 AT_i + \beta_6 PPT_i + \beta_7 WR_i + \beta_8 PRS_i + \varepsilon_i$$

where Y_i represents the continuous contractor participation measure; RTD_i represents risk-transfer density; RP_i represents risk perception; FS_i represents firm size; EXP_i represents contractor experience; AT_i represents annual turnover; PPT_i represents previous participation in public tenders; WR_i represents tender win rate; PRS_i represents perceived risk severity; and ε_i represents the error term.

The negative coefficient for risk-transfer density indicates that higher risk-transfer density was associated with lower contractor participation after controlling for the other variables included in the model. Since the study is based on observational survey data, the estimated coefficients represent statistical associations and should not be interpreted as causal effects [46].

F. Logistic Regression Analysis

Binary logistic regression was conducted as a complementary analysis to examine the factors associated with the contractor participation decision. The dependent variable was the binary participation outcome defined in the contractor survey, distinguishing contractors according to the specified participation/bid decision category.

The logistic regression model included risk perception, risk-transfer density, firm size, and other relevant contractor characteristics as explanatory variables. Consistent with the methodology, the complete survey dataset consisted of 150 contractor observations, with 120 observations used for model training and 30 observations used for model testing.

The model achieved an AUC-ROC of 0.847 and an overall classification accuracy of 81.3%, indicating substantial discrimination between the two defined participation categories.

TABLE II
LOGISTIC REGRESSION RESULTS

Predictor	Odds Ratio	p-value	Interpretation
Risk Perception Score	0.38	<0.001	A one-unit increase was associated with lower odds of the defined participation outcome
Risk-Transfer Density	0.51	<0.01	Higher risk-transfer density was associated with lower odds of the defined participation outcome
Firm Size (log)	1.42	<0.01	Larger firm size was associated with higher odds of the defined participation outcome

The odds ratio of 0.38 for risk perception indicates that a one-unit increase in the reported risk-perception score was associated with lower odds of the defined participation outcome, holding the other predictors constant. Similarly, the odds ratio of 0.51 for risk-transfer density indicates an inverse association between risk-transfer density and the participation outcome.

The odds ratio of 1.42 for firm size indicates that larger firms had higher estimated odds of the defined participation outcome, conditional on the other variables in the model.

Contractors reporting risk-perception scores above 4.0 showed a reported participation probability of less than 25% under conditions involving extensive risk-transfer modifications. This finding provides additional evidence of heterogeneity in contractors' responses to contractual risk allocation [47].

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The logistic regression results were interpreted as statistical associations with the observed participation outcome rather than evidence of causal relationships. Where regularized estimation was applied, an L2 penalty was used to reduce the potential risk of overfitting.

G. Exploratory Factor Analysis of Contractor Risk Perception

Exploratory Factor Analysis (EFA) was conducted to identify the underlying dimensions of contractors' perceived contractual risks and to determine whether the measured risk items could be represented by a smaller number of related factors.

The Kaiser-Meyer-Olkin (KMO) statistic was 0.812, while Bartlett's test of sphericity was statistically significant ($\chi^2 = 1847.3$, $p < 0.001$). These results supported the suitability of the correlation matrix for factor analysis.

Four underlying dimensions of perceived contractual risk were identified, jointly accounting for 80.4% of the total explained variance:

1. **Financial Risk** — 32.1% of variance, including price escalation, payment delays, and currency fluctuation.
2. **Operational Risk** — 21.0% of variance, including ground conditions, design changes, and site-access issues.
3. **Legal-Contractual Risk** — 16.2% of variance, including delay penalties, force majeure, and dispute-resolution provisions.
4. **External Risk** — 11.1% of variance, including political interference, regulatory changes, and third-party delays.

The resulting four-factor structure indicates that contractor risk perception was multidimensional rather than attributable to a single contractual risk category. The factor structure was subsequently used to organize the interpretation of contractors' perceived contractual risks and was considered alongside the tender-document and qualitative evidence.

H. Contractor Segmentation Analysis

K-means clustering was conducted as a supplementary analysis to examine heterogeneity in contractors' responses to risk-transfer modifications. The clustering procedure considered relevant characteristics including firm size, risk perception, and participation-related behavior.

The optimal number of clusters was determined using the elbow method and silhouette analysis. The final analysis identified four contractor segments.

TABLE III
CONTRACTOR SEGMENTS

Segment	N	Average Firm Size	Risk Perception	Average Tenders/Year	Key Behaviour
Risk-Averse Small Firms	42	28 employees	4.6/5.0	3.2	Avoid high-risk tenders
Moderate Medium Firms	58	87 employees	3.5/5.0	8.9	Selective bidding
Risk-Tolerant Large Firms	35	195 employees	2.8/5.0	15.7	Higher participation
Specialized Niche Contractors	15	64 employees	3.2/5.0	5.4	Sector-focused participation

The largest segment consisted of moderate medium-sized firms (n = 58), followed by risk-averse small firms (n = 42), risk-tolerant large firms (n = 35), and specialized niche contractors (n = 15).

The segmentation results indicate heterogeneity in contractors' reported responses to risk-transfer provisions. Smaller firms in the risk-averse segment reported higher risk perception and fewer annual tender participations, whereas larger firms in the risk-tolerant segment reported lower risk perception and higher participation activity.

I. Qualitative Findings from Expert Interviews

Thematic analysis of the 18 expert interviews produced four major themes:

1. Bid/no-bid decision mechanisms;
2. Changes in FIDIC risk allocation;
3. Differential implications for smaller contractors; and
4. Systemic reform needs.

1) Bid/No-Bid Decision Mechanisms. Senior contractors described contractual risk allocation as an important consideration in bid/no-bid decisions. One senior contractor stated:

"When we see clauses that transfer unforeseeable ground conditions to us, we simply don't bid. It's gambling, not contracting." (E01, CEO, Grade A firm)

Another participant explained:

"Price escalation risk without adjustment mechanisms means we must add 15–20% contingency to our bids. Often we become non-competitive and lose anyway." (E02, Project Director)

These accounts provide qualitative context for the negative association observed between risk-transfer density and contractor participation.

2) Changes in FIDIC Risk Allocation. FIDIC-certified consultants reported concerns about extensive modifications to the risk allocation established in the relevant General Conditions. One consultant stated:

"Employers are violating GP3 by shifting risks that FIDIC explicitly allocates to the Employer. This defeats the purpose of using FIDIC." (E06, FIDIC-certified consultant)

Another consultant observed:

"Particular Conditions should address project-specific issues only, but we see blanket risk transfers that contradict the balanced nature of FIDIC contracts." (E04)

These statements indicate that interviewed experts perceived some Particular Conditions as substantially departing from the risk distribution established in the relevant FIDIC General Conditions.

3) Differential Implications for Smaller Contractors. Interview participants also emphasized differences between smaller and larger contractors. One expert stated:

"Small contractors cannot absorb these risks. They either don't participate or underprice and then claim or abandon." (E04)

Another participant reported:

"The market is consolidating around 10–15 large firms who can afford the risk. SMEs are being priced out of public procurement."

4) Systemic Reform Needs. Experts identified standardization of contractual risk allocation and improvement of payment mechanisms as important areas of concern. One participant stated:

"We need PPRA to issue standard bidding documents that comply with FIDIC Golden Principles. Individual agencies cannot be allowed to rewrite risk allocation." (E03)

Another participant highlighted the interaction between risk allocation and payment:

"Payment delays compound the risk-transfer problem. Even when contractors accept risks, they face 6–12 month payment delays, destroying cash flow." (E05, Project Director, public agency)

The qualitative evidence therefore indicates that interviewed experts viewed contractual risk allocation as part of a broader procurement environment involving payment certainty, contractual standardization, and firm-level capacity to absorb risk.

J. Integration of Mixed-Methods Evidence

Consistent with the convergent parallel mixed-methods design, findings from the three empirical sources were integrated at the interpretation stage. Tender-document analysis established the prevalence and characteristics of risk-transfer modifications, survey analysis quantified their statistical associations with contractor participation, and expert interviews provided contextual explanations for contractors' reported responses.

The integrated evidence distinguishes between:

- The contractual modifications identified in public tender documents;

- The frequency with which these modifications occurred;
- Contractors' perceptions of the associated risks;
- The statistical association between risk-transfer characteristics and contractor participation; and
- Expert explanations concerning contractors' bid/no-bid responses and the broader procurement context.

The three evidence sources therefore provide complementary documentary, quantitative, and qualitative evidence concerning the relationship between FIDIC risk allocation and contractor participation in Pakistan's public tenders. Because the statistical analyses are based on observational data, the reported relationships are interpreted as associations rather than causal effects.

IV. DISCUSSION

A. Principal Findings

The findings provide converging evidence from three sources that extensive modifications to FIDIC-based risk allocation are associated with lower contractor participation in Pakistan's public tenders. The tender-document analysis demonstrated that risk-transfer provisions occurred frequently across several contractual risk categories, while the contractor survey showed a strong negative association between risk-transfer density and the continuous contractor participation measure. The multiple linear and binary logistic regression analyses further indicated that risk-transfer density remained negatively associated with contractor participation after accounting for relevant contractor characteristics and risk perception.

The qualitative interviews provide additional contextual explanations for these statistical patterns. Experts described bid/no-bid decisions in terms of contractual uncertainty, contingency costs, cash-flow exposure, and the ability of firms to absorb transferred risks.

Taken together, the evidence suggests that contractual risk allocation should be considered not only at the level of individual contractual clauses but also in terms of the cumulative risk burden created by multiple modifications within the same tender.

B. Financial and Operational Risk as Major Components of Contractor Concern

The exploratory factor analysis identified four dimensions of contractor risk perception: Financial Risk, Operational Risk, Legal-Contractual Risk, and External Risk. Financial Risk accounted for the largest proportion of explained variance (32.1%), while price escalation received the highest individual mean severity score (4.2/5.0).

This finding is consistent with the tender-document analysis, in which price-escalation provisions were among the most frequently modified contractual provisions. The convergence between the documentary and survey evidence indicates that price-related risk was both frequently modified in tender documents and prominent in contractors' reported risk perceptions.

Operational risks, particularly those associated with ground conditions, also received relatively high severity ratings. The high frequency of modifications concerning unforeseeable physical conditions further indicates that operational and financial dimensions of contractual risk may both be relevant to contractors' participation decisions.

The findings therefore suggest that contractors' perceptions of contractual risk are multidimensional and cannot be adequately represented by a single risk category.

C. Firm Size and Heterogeneity in Participation

The logistic regression and contractor segmentation analyses both indicated differences in participation-related outcomes according to firm size and risk perception. In the logistic model, firm size had an odds ratio of 1.42 ($p < 0.01$), indicating that larger firm size was associated with higher odds of the defined participation outcome, holding the other variables constant. The K-means analysis similarly identified a large-firm segment characterized by lower average risk perception and greater annual tender participation.

These findings suggest that contractors may respond differently to the same contractual risk-transfer provisions. Firms with greater organizational or financial capacity may have greater ability to absorb or price contractual uncertainties. However, the cross-sectional design does not establish that firm size directly causes higher participation.

The qualitative interviews provide contextual support for this interpretation by emphasizing the difficulties faced by smaller contractors in absorbing transferred financial and operational risks. These interview accounts complement the quantitative segmentation results without establishing a causal relationship between firm size and participation.

D. Relationship with FIDIC Risk-Allocation Principles

The tender-document analysis identified substantial modifications to the risk allocation contained in the relevant FIDIC General Conditions across several categories. Particularly frequent modifications concerned unforeseeable physical conditions, price escalation, third-party delay, and force majeure.

These findings are relevant to discussions of the FIDIC Golden Principles because Particular Conditions can alter the contractual allocation of risk. However, the presence of a modification does not automatically establish that a Golden Principle has been violated. The contractual effect of each modification depends on its specific wording, scope, and relationship with the applicable General Conditions.

The expert interviews nevertheless indicate that some practitioners perceived particular modifications as excessive or inconsistent with the intended distribution of risks under FIDIC-based contracting. These perceptions provide qualitative context for the documentary evidence and highlight the importance of examining the substantive effect of Particular Conditions rather than simply counting contractual modifications.

E. Implications for Public Procurement

The findings have several implications for public procurement practice.

First, procurement agencies could strengthen the review and justification of Particular Conditions, particularly where tender-specific modifications substantially alter established risk-allocation mechanisms. Such review may help distinguish genuinely project-specific contractual requirements from broader transfers of risk.

Second, the findings suggest that risk-transfer provisions should be considered cumulatively rather than individually. A tender containing several risk-transfer modifications may present a substantially different contractual risk profile from a tender containing only one isolated modification. The risk-transfer density measure provides a basis for considering this cumulative dimension.

Third, contractor heterogeneity should be considered when evaluating procurement participation. The survey, logistic regression, and segmentation results indicate that contractors with different levels of firm size and risk perception may respond differently to similar contractual conditions.

Finally, payment certainty emerged from the qualitative interviews as an additional issue that may interact with contractual risk exposure. This suggests that contractual risk allocation and payment administration should be considered together when assessing the broader procurement environment.

F. Integrated Interpretation of the Mixed-Methods Findings

The three evidence sources provide complementary perspectives on the research problem.

The tender-document analysis establishes which risk-transfer modifications were present and how frequently they occurred across the 180 public tender documents. The contractor survey provides quantitative evidence concerning the associations between risk-transfer density, risk perception, firm characteristics, and participation among the 150 surveyed contractors. The expert interviews provide contextual explanations for why contractors may respond differently to particular contractual risks.

The convergence of these findings strengthens the interpretation that contractual risk allocation is an important factor associated with contractor participation. The documentary evidence demonstrates the prevalence of risk-transfer modifications, the survey results quantify their statistical associations with participation, and the qualitative evidence helps explain the mechanisms and contextual considerations described by industry participants.

At the same time, the findings should not be interpreted as demonstrating a direct causal effect. The survey component is cross-sectional and observational, and contractor participation may also be influenced by other market, project, financial, institutional, and firm-specific factors that were not fully captured in the statistical models.

V. POLICY AND PRACTICAL IMPLICATIONS

The findings point to three areas for consideration in public procurement practice.

1. **Review of Particular Conditions:** Procurement agencies could strengthen the review of tender-specific modifications to ensure that changes to FIDIC-based risk allocation are clearly justified by project-specific requirements and are transparently communicated to potential bidders.
2. **Consideration of Contractor Exposure:** Because the survey, segmentation, and qualitative findings indicate differences among contractors in risk perception and participation behavior, procurement authorities could consider whether cumulative risk-transfer requirements create disproportionately greater exposure for contractors with more limited risk-bearing capacity.
3. **Payment and Risk-Allocation Coordination:** The interview findings indicate that payment delays may compound the financial consequences of transferred risks. Greater coordination between contractual risk allocation and payment administration may therefore improve predictability within public contracting.

These implications are derived from the observed documentary, survey, and qualitative evidence and should be considered within the institutional and regulatory context of public procurement in Pakistan.

VI. LIMITATIONS

Several limitations should be considered when interpreting the findings.

First, the cross-sectional research design limits causal inference. The statistical associations reported in this study should therefore not be interpreted as evidence that risk-transfer modifications directly cause contractors to withdraw from tenders.

Second, contractor survey responses were self-reported and may therefore be affected by recall, perception, or response bias.

Third, the contractor sample may not be evenly distributed across all provinces, with relatively greater representation from Punjab. Consequently, provincial comparisons and generalizations across all Pakistani contractors should be interpreted cautiously.

Fourth, the study examined tender documents, contractor perceptions, and participation-related outcomes but did not directly examine post-award outcomes such as claims, disputes, project delays, cost overruns, or completion performance.

Fifth, the study focuses specifically on FIDIC-based contractual risk allocation. Consequently, the findings may not be directly generalizable to procurement systems using substantially different contractual frameworks.

Finally, although the mixed-methods design provided complementary evidence from documents, surveys, and interviews, the three sources were integrated primarily at the interpretation stage. Future research could strengthen the evidence base through longitudinal designs, larger and more geographically balanced contractor samples, and direct examination of post-award project outcomes.

VII. CONCLUSION

This study examined the relationship between risk-transfer modifications in FIDIC-based Particular Conditions and contractor participation in Pakistan's public tenders using tender-document analysis, contractor survey data, and expert interviews.

The findings show that risk-transfer modifications were common across the 180 public tender documents examined, particularly in relation to unforeseeable physical conditions, price escalation, third-party delay, and force majeure. The 150-contractor survey showed a strong negative association between risk-transfer density and the continuous contractor participation measure, while the multiple linear and logistic regression analyses indicated that risk-transfer density remained negatively associated with participation after accounting for selected contractor characteristics and risk perception.

The exploratory factor analysis further demonstrated that contractor risk perception consisted of four broad dimensions: Financial Risk, Operational Risk, Legal-Contractual Risk, and External Risk. These four factors jointly accounted for 80.4% of the explained variance, with Financial Risk representing the largest component.

The contractor segmentation analysis identified four groups with different patterns of firm size, risk perception, and participation-related behaviour. In addition, the logistic regression indicated that firm size was positively associated with the odds of the defined participation outcome. The expert interviews provided contextual evidence that contractual uncertainty, contingency costs, cash-flow exposure, and differences in risk-bearing capacity may influence contractors' bid/not-bid considerations.

Overall, the evidence from the 180 tender documents, 150 contractor survey responses, and 18 expert interviews indicates that the cumulative structure of Particular Conditions is associated with contractor participation in Pakistan's public tenders. The findings highlight the importance of transparency, consistency, and project-specific justification when modifying FIDIC-based risk allocation, while recognizing that contractor participation is influenced by multiple contractual, financial, institutional, and market-related factors.

Because the study is based on observational and cross-sectional evidence, the findings establish statistical associations rather than causal effects. The study therefore provides an empirical basis for further investigation of contractual risk allocation and contractor participation, particularly through longitudinal research and post-award analysis of claims, disputes, delays, cost outcomes, and project performance.

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