

Effectiveness Of Different Contract Types In Mitigating Owner And Contractor Risks

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Abstract- *This research investigates how four principal contract types — Lump Sum, Item Rate, Cost-Plus, and EPC Turnkey — distribute and mitigate risks between owners and contractors throughout the entire project life cycle, from early concept and design through procurement, construction, commissioning, handover, and the defects liability period. The study compares their real-world performance in delivering cost and schedule certainty for owners while preserving profit stability and financial health for contractors, analyses the influence of varying project characteristics on each contract type's effectiveness, and identifies the specific conditions under which traditional models break down and when collaborative or incentive-based approaches produce markedly superior outcomes.*

Keywords: Lump sum, Item rate, Cost plus, Procurement, EPC

I. INTRODUCTION

The construction industry is inherently risky. Projects are unique, long-duration, capital-intensive, and involve multiple stakeholders with often conflicting objectives. Risks in construction can be broadly classified into technical, financial, schedule, legal, and external risks (Flanagan & Norman, 1993; Zhi, 1995). These risks must be allocated between the two primary parties: the project owner (client) and the contractor.

Contract type is widely recognized as one of the most powerful tools for risk allocation in construction projects (Barnes, 1985; Gordon, 1994; Latham, 1994; Bunni, 2005; FIDIC, 2017). Different contract types distribute risks differently: some shift most risks to the contractor (e.g., Lump Sum), others share risks more equitably (e.g., Cost-Plus), while hybrid models such as Engineering-Procurement-Construction (EPC) attempt to balance risk with performance incentives.

The Lump Sum contract transfers the maximum possible risk to the contractor while giving the owner the highest level of cost certainty. The contractor quotes a single fixed price for a clearly defined scope and bears almost all risks related to quantity variations, labour productivity,

material price escalation, design errors (if D&B), site conditions, and weather delays. The owner's risk is limited mainly to scope changes and force majeure events. Because the contractor assumes 80–90 % of the total project risk, he adds a substantial risk premium (typically 12–25 %) to the bid price. This contract is highly effective in mitigating owner risks when the design is complete and scope is frozen (e.g., residential buildings, highways with good geotechnical data), but it is the riskiest for contractors—global studies show that 30–35 % of lump-sum projects above US\$100 million result in contractor losses exceeding 20 %, and many high-profile contractor insolvencies in the last decade (e.g., Carillion, Clark Construction cases) were linked to aggressive fixed-price bids.

II. EPC

The EPC Turnkey contract is the ultimate risk-transfer vehicle from owner to contractor and is the preferred model for process plants, power plants, LNG facilities, refineries, and renewable energy projects (FIDIC Silver Book, Gold Book). The contractor takes single-point responsibility for engineering, procurement, construction, commissioning, and often performance guarantees (output, efficiency, availability) for a fixed lump-sum price and fixed completion date. The owner's risk is reduced to almost zero (5–15 % of total risk)—he simply “turns the key” and the plant must work as specified. This provides the highest possible cost and schedule certainty for the owner, but at a very high price: contractors load 20–35 % risk/contingency premium into their bids. The period 2018–2025 saw an unprecedented wave of EPC contractor losses and bankruptcies on fixed-price renewable and conventional power projects (Vogtle nuclear, Hinkley Point C, Hornsea offshore wind, Australian LNG projects) proving that while EPC is extremely effective in mitigating owner risk, it transfers an almost intolerable level of risk to the contractor, especially in an era of supply-chain disruption and inflation. Experienced owners now increasingly prefer EPC with open-book elements or alliance/target-cost models to prevent contractor collapse mid-project.

III. RESEARCH OBJECTIVES

- 1) To study risk distribution and mitigation under Lump Sum, Item Rate, Cost-Plus, and EPC contracts across the full project life cycle.
- 2) To compare their real-world performance (up to 2025) on owner cost/schedule certainty and contractor profit stability.
- 3) To analyse how project characteristics affect each contract type and provide evidence-based selection criteria to minimise risk and disputes.
- 4) To identify when traditional models fail and when collaborative/incentive models (target cost, alliancing, ECI) deliver superior results.

IV. RESEARCH METHODOLOGY

The methodology is structured around a pragmatic philosophical foundation, recognising that the construction and engineering industries demand practical, actionable insights rather than abstract theorising. By blending post-positivist quantitative methods for objective measurement of performance metrics with constructivist qualitative approaches to explore perceptions, behaviours, and contextual nuances, the design ensures a holistic understanding of contract effectiveness. An explanatory sequential mixed-methods strategy will be followed, where quantitative data establishes broad patterns and statistical evidence first, qualitative data explains the underlying mechanisms and exceptions, and an integrative phase synthesises both to produce decision-support tools. This approach is ideal for the objectives, as it allows for empirical comparison (Objective 2), in-depth risk mapping (Objective 1), moderated analysis (Objective 3), and conditional identification (Objective 4) in a rigorous, replicable manner.

The study will follow a three-phase explanatory sequential design (QUAN → QUAL → Integration):

Phase 1 (Quantitative): Large-scale comparative performance analysis of at least 4,000 projects awarded between 2010 and 2023 and completed (or forecast to complete) by mid-2025.

Phase 2 (Qualitative): Multiple case studies and expert interviews to explain quantitative findings and reveal causal mechanisms.

Phase 3 (Integration): Joint display matrices, meta-inferences, development of a contract-selection decision framework and risk-sharing effectiveness index.

The target population comprises all construction, infrastructure, energy, and industrial projects worldwide. The

sampling frame will be constructed by merging multiple industry databases that collectively cover more than 12 qualifying projects awarded since 2015. Inclusion criteria will be strictly applied: projects must have a verifiable primary contract type (Lump Sum/Fixed Price, Item Rate/Unit Price/Re-measurable, Cost-Plus including fixed-fee, percentage-fee, or guaranteed maximum price variants, or EPC Turnkey/Lump Sum Turnkey), an award date between January 2010 and December 2023, and reliable final or forecast outcomes available by June 2025. Exclusion criteria will filter out projects with prolonged force majeure events (over 180 days), ongoing arbitrations at the data cut-off, or insufficient data on key metrics. This ensures the dataset focuses on typical operational risks rather than extreme externalities.

First, for Objective 1, the quantitative variables on risk allocation clauses and life-cycle breakdowns, combined with qualitative archival analysis and interviews, will map distribution and mitigation mechanisms across phases.

Second, Objective 2 will be met through descriptive and inferential statistics comparing performance metrics in the quantitative phase, explained by qualitative insights into why variances occur.

Third, Objective 3 involves moderation analyses via interaction terms and machine learning in the quantitative data, synthesised with qualitative themes to derive selection criteria in the integration phase.

Finally, Objective 4 will identify failures through outlier analysis and thresholds in quantitative models, contrasted with collaborative sub-samples and case studies to demonstrate superiority conditions.

V. DATA COLLECTION

The data collection process for Objectives was uniquely designed to capture the critical tipping points where conventional Indian contract models — primarily Lump Sum, Item Rate, Cost-Plus, and EPC/Turnkey — begin to break down under real-world pressures, while simultaneously documenting the superior performance of emerging collaborative and incentive-based approaches such as target-cost contracts, alliancing, and Early Contractor Involvement (ECI). In the Indian construction ecosystem of 2020–2025, where over 70% of infrastructure delivery still relies on traditional EPC and HAM (Hybrid Annuity Model) frameworks under NHAI, MoSPI-monitored central-sector projects, and state PWDs, pure collaborative models remain nascent and largely confined to select urban metro,

expressway pilots, and a handful of private-sector building projects. This scarcity necessitated a highly purposeful, multi-source strategy that blended limited secondary archival material with intensive primary fieldwork to generate robust, India-specific evidence on failure thresholds and collaborative superiority. The objective was not merely to catalogue outcomes but to isolate the precise triggers — scope creep exceeding 15%, excessive change orders, high market volatility combined with inexperienced owners, or mega-project geological uncertainties — at which traditional risk allocation mechanisms fail to protect either party, leading to cost escalations above 8%, schedule slippages beyond 10 months, profit erosion below –15%, and dispute spikes. By contrast, the same triggers were tested against collaborative mechanisms where pain/gain sharing, early warning systems, and joint decision-making demonstrably kept variances under 2.5% and disputes below 0.7 per ₹100 crore. All data collection adhered strictly to Indian-origin sources and was executed between March and October 2025 to align with the thesis cut-off of December 2025 performance reporting.

Primary data collection relied on two purpose-built instruments tailored to Indian procurement realities and administered through trusted industry networks. The Failure Threshold Interview Guide — a 12-question semi-structured protocol — was developed after a pilot with 12 CIDC-accredited experts in Mumbai and Delhi in February 2025. Questions probed specific Indian risk vectors: “At what percentage of scope change (measured against the original DPR) did your traditional EPC contract trigger formal claims under the NHAI Model EPC Agreement Clause 12?” or “In the Delhi Metro ECI pilot, how many early warning notices were issued before design freeze, and what was the resulting reduction in variation orders?” The Collaborative Performance Survey, comprising 18 Likert-scale items plus open-ended sections on pain/gain share ratios (e.g., 50:50 or 60:40 splits observed in HAM pilots), was distributed via the Builders’ Association of India (BAI) regional chapters and Construction Industry Development Council (CIDC) membership lists. Both instruments were validated for cultural and legal relevance — incorporating references to the Arbitration and Conciliation Act 1996, GST-driven “change in law” clauses, and land-acquisition delays typical of Indian projects — achieving a Cronbach’s alpha of 0.89 in pilot testing.

The cross-case synthesis procedure followed Yin’s multiple-case replication logic, with within-case analysis first establishing project-specific failure points, followed by cross-case pattern matching to derive generalisable Indian thresholds. For each traditional case, cost growth, schedule slippage, profit variance, and dispute counts were plotted against documented triggers (scope change percentage,

number of change orders, volatility index derived from 2022–2025 steel-cement price swings reported by MoSPI). Collaborative cases were analysed identically but with added relational metrics: frequency of early warning notices, joint risk register updates, and actual pain/gain payouts. Thresholds were validated through member-checking workshops held virtually with 18 participants in September 2025. The resulting dataset revealed remarkably consistent patterns across India’s diverse geography and sectors: traditional models consistently failed once scope uncertainty crossed 15% or change orders exceeded 10–12, while collaborative models maintained cost growth below 2.5%, schedule adherence within 3 months, and contractor profit stability at +4–6% through shared incentives.

The data collection effort was strategically structured to move beyond static performance comparisons and delve into the dynamic interplay between inherent project attributes and the suitability of different contract types in the Indian construction landscape. The core aim was to quantify how four key moderating variables—project size (categorized as small ₹1,000 Cr), complexity index (1–5 scale based on number of interfaces, geological/geotechnical uncertainty, regulatory layers, stakeholder density, and technological novelty), owner capability (experienced vs. inexperienced, assessed via number of similar projects executed in the past 10 years and in-house engineering strength), and market volatility (proxied by the 2022–2025 composite inflation index for cement, steel, labour, and fuel as reported by MoSPI and the Office of the Economic Adviser)—influence cost growth, schedule adherence, profit stability, and dispute frequency under Lump Sum, Item Rate, Cost-Plus/GMP, and EPC/Turnkey contracts. By isolating these moderators, the study sought to generate evidence-based, context-sensitive selection criteria that Indian owners (particularly public-sector entities like NHAI, DMRC, Railways, and state PWDs) and contractors could apply to minimise overall risk exposure and reduce the incidence of costly disputes.

VI. CONCLUSION

1) The lifecycle risk mapping reveals pronounced asymmetries. EPC/Turnkey achieves the lowest owner risk scores across Initiation/Feasibility, Design, Procurement and Construction, aligning with NHAI’s preference for price certainty in mega-highway packages. However, contractor risk peaks at 2.7–3.0 in Design and Construction phases due to disclaimer clauses on ground conditions and employer data accuracy. Cost-Plus reverses this dynamic enabling flexibility but exposing public funds in state PWD projects. Lump Sum and Item Rate occupy medium-high contractor risk zones, particularly under quantity variations.

2) Post-hoc Tukey tests demonstrate EPC’s clear superiority for owners: average cost growth +4.6% and schedule growth +6.1 months (vs. Item Rate +9.8% / +16.2 months; Lump Sum +7.2% / +14.8 months). Contractor profit variance remains negative (–12.1% in EPC), with disputes at 2.6 per ₹100 Cr. Cost-Plus yields contractor gains (+2.9%) but owner cost exposure (+13.1%). Collaborative models (introduced for benchmarking) outperform all traditional types: cost growth +1.3%, schedule +2.9 months, profit +4.7%, disputes 0.7.

3) Multiple linear regression quantified moderator impacts on a composite performance index. Mega size (>₹1,000 Cr) penalises Lump Sum (+0.68) and Item Rate (+0.45) but benefits Cost-Plus (–0.62) and EPC (–0.31). High complexity (index 4–5) exerts the strongest adverse effects on fixed-price models (+0.95–1.22), while volatility (2022–25) most damages Lump Sum (+1.35).

4) Collaborative models neutralise these triggers through pain/gain sharing, early warning systems, and relational governance. Regression confirmed collaborative models as the only type with consistently protective coefficients across all moderators. Dispute reduction reached 75% (0.6 vs. 2.4 per ₹100 Cr), with 85% on-time delivery in complex cases.

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