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Development of a Dispute-Risk Index (DRI) and FIDIC-Based Proactive Tool for Early Dispute Prevention in Water Supply Projects in Nepal

by

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I hereby declare that the thesis entitled "**Development of a Dispute-Risk Index (DRI) and FIDIC-Based Proactive Tool for Early Dispute Prevention in Water Supply Projects in Nepal**", submitted to the Department of Civil Engineering in partial fulfillment of the requirements for the degree of Master of Science in Construction Management, is a record of original work done under the guidance of Er. Subash Kumar Bhattarai and Assoc. Prof. Nagendra Bahadur Amatya. This thesis contains only work completed by me except for the consulted material, which has been duly referenced and acknowledged.

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CERTIFICATE OF THESIS APPROVAL

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ABSTRACT

Water supply projects in Nepal face persistent disputes causing delays, cost overruns, and service delivery failures. Despite multilateral financing and FIDIC MDB Harmonised Contracts (2010) governing most projects, no structured early-warning tool exists for dispute prevention in the sector. To develop a Dispute Risk Index (DRI) and FIDIC-based proactive tool for early dispute prevention by: (1) identifying and ranking dispute drivers across project lifecycles; (2) developing a DRI integrating impact and likelihood; and (3) formulating FIDIC provisions into a practical checklist.

A sequential mixed-methods design was used. Literature review and expert validation identified 36 dispute drivers. A Likert-scale questionnaire (n=68 stakeholders) yielded Relative Importance Index (RII) rankings. In-depth interviews with six senior experts assessed likelihood of occurrence. DRI was calculated by combining normalized RII weights with frequency indices. Top drivers were mapped to FIDIC clauses, and a checklist was developed and validated.

Overall DRI was 61.03%. Pre-construction DRI (64.41%) exceeded construction (59.93%) and post-construction (58.38%), revealing pre-construction as the most vulnerable stage. Top drivers included delayed site handover (RII=0.779), high variation volume (RII=0.776), and contractor capacity (RII=0.753). Consultants showed strong ranking alignment (ρ=0.94-0.96); contractors showed weak alignment (ρ=0.15-0.23). Case validation confirmed all priority drivers in actual projects. A 33-question stage-wise checklist was developed.

Disputes stem from cumulative lifecycle weaknesses, not isolated events. Pre-construction vulnerability is highest. Effective prevention requires lifecycle governance, disciplined FIDIC application, and early-warning tools. The DRI and checklist enable shift from reactive resolution to proactive prevention.

Keywords: *Dispute Risk Index (DRI); FIDIC MDB Harmonised Contracts; Early Warning System; Dispute Prevention; Water Supply Projects; Project Life Cycle; Nepal*

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AHP	Analytic Hierarchy Process
BoQ	Bill of Quantities
BOT	Build-Operate-Transfer
DAAB	Dispute Avoidance/Adjudication Board
DAB	Dispute Adjudication Board
DB	Dispute Board
DBO	Design-Build-Operate
DNP	Defects Notification Period
DRI	Dispute Risk Index
E&M	Electrical and Mechanical
EIA	Environmental Impact Assessment
EOT	Extension of Time
EPC	Engineering, Procurement, and Construction
ESMP	Environmental and Social Management Plan
FIDIC	International Federation of Consulting Engineers
FSE	Fuzzy Synthetic Evaluation
IPC	Interim Payment Certificate
MDB	Multilateral Development Bank
O&M	Operation and Maintenance
QA/QC	Quality Assurance / Quality Control
RII	Relative Importance Index
SCADA	Supervisory Control and Data Acquisition
SDG	Sustainable Development Goal
TOC	Taking-Over Certificate
WB	World Bank

CHAPTER 1: INTRODUCTION

1.1 Background

Access to safe and reliable drinking water is one of the most fundamental requirements of human wellbeing. In Nepal, this recognition is not merely a development aspiration, it is a constitutional guarantee. The Constitution of Nepal promotes clean drinking water and sanitation as fundamental rights, placing the delivery of water supply services within a formal framework of public responsibility and civic entitlement (THE CONSTITUTION OF NEPAL, 2015). This legal foundation elevates water supply projects beyond ordinary infrastructure works; they are expressions of the state's obligation to its citizens and are, accordingly, among the most consequential public investments that Nepal undertakes.

The sector has attracted substantial attention from national planners and international development partners alike. The Asian Development Bank, the World Bank, and other multilateral institutions have committed significant financing to water supply and urban infrastructure in Nepal, reflecting a shared recognition that reliable service delivery is both a development imperative and a prerequisite for achieving the Sustainable Development Goals, particularly SDG 6, which calls for universal access to safely managed water and sanitation by 2030. Despite this sustained investment, however, the delivery record of water supply projects in Nepal tells a more complicated story than the scale of financing alone might suggest.

In practice, water supply projects in Nepal are persistently affected by implementation problems that compromise their outcomes. Delays, cost escalation, quality shortfalls, and breakdowns in stakeholder coordination are not isolated occurrences but recurring features of how the sector performs. A nationwide assessment of completed piped water schemes in Nepal revealed that only a small proportion of systems were functioning well, while a substantial share required major repair or could not supply water on a year-round basis (Ministry of Water Supply, 2023). This underscores weaknesses not only in how projects are designed but also in how they are administered, monitored, and handed over. These findings suggest that project success should not be judged solely by completion of construction works, but also by the quality of planning, execution, testing, commissioning, and post-handover performance (ADPC, 2021).

Among the governance challenges affecting water supply project delivery, disputes occupy a particularly damaging position. Disputes between contractors, engineers, employers, government agencies, and affected communities routinely lead to work stoppages, adversarial relationships, delayed certifications, and, in more serious cases, project stagnation or termination. Their effects are not confined to the parties directly involved; they ripple outward into delays in service provision, erosion of public trust, and weakened value for public money. What makes disputes especially problematic in Nepal's water supply sector is that they tend to develop gradually rather than emerge suddenly, accumulating from unresolved tensions in contract administration, design management, payment processing, and stakeholder coordination, yet the sector currently lacks a structured early warning system capable of detecting and responding to these tensions before they harden into formal conflict.

This study responds directly to that gap. It is premised on the understanding that disputes in water supply projects are not inevitable events that must simply be managed after the fact. They are, in large part, the product of identifiable and preventable conditions that can be detected early, assigned appropriate risk weights, and addressed through timely, contract-aligned action. The Dispute Risk Index (DRI) developed in this research is designed to serve exactly that purpose: to provide project teams, contract administrators, and sector stakeholders with a practical and evidence-based tool for recognizing dispute risk before it escalates, and for linking that risk to the preventive mechanisms already embedded in the FIDIC MDB Harmonised Conditions of Contract (Fidic, 2010) that govern most externally financed water supply works in Nepal.

1.2 Statement of Problem

The Asian Development Bank's active Nepal portfolio includes a significant water and urban infrastructure component, and the World Bank maintains ongoing water sector commitments with a pipeline of upcoming procurement packages. This sustained investment reflects the sector's strategic importance, but it also raises the stakes for effective project delivery. Poor outcomes in water supply projects do not merely represent a financial loss; they translate directly into reduced public health protection, weakened economic productivity, and slower progress toward national development targets (ADPC, 2021).

Yet the delivery performance of water supply projects in Nepal is frequently compromised by disputes. Research on construction disputes globally and in comparable developing-country contexts consistently demonstrates that disputes are closely associated with delays, cost growth, deteriorating inter-party relationships, and reduced project quality. In water supply projects, these consequences carry additional weight because system functionality depends on the integrated performance of multiple interdependent components, such as treatment facilities, transmission mains, storage reservoirs, distribution networks, and metering and control systems, meaning that contractual disagreements affecting any one component can cascade into broader delivery failures.

The central problem this study addresses is not simply that disputes occur in Nepal's water supply projects. It is that dispute risks are consistently identified too late, managed too reactively, and treated as isolated contractual events rather than as early symptoms of broader governance and administration weaknesses. The evidence suggests that many disputes in the sector originate during project preparation, in inadequate site investigations, ambiguous contract documents, unclear risk allocation, and unresolved land and compensation matters, long before physical construction begins (Olaimat & Marey-Perez, 2026). They intensify during implementation through variation-related disagreements (Khalifa & Mahamid, 2019), payment delays (Shaikh et al., 2020), authority-related stoppages, and weak claims administration. And they persist into the post-construction period through contested commissioning outcomes, defect rectification disputes, and unresolved final accounts (Olaimat & Marey-Perez, 2026).

A further dimension of the problem is institutional. Nepal's federal restructuring has distributed responsibilities for water supply planning and delivery across federal, provincial, and local government tiers without always ensuring that corresponding technical and administrative capacities have been established at each level. The resulting fragmentation of decision-making authority, combined with overlapping institutional mandates and inconsistent documentation practices, creates an environment in which the procedural discipline required for effective dispute prevention is difficult to maintain consistently (ADPC, 2021).

Compounding these challenges is the underutilization of available contractual mechanisms. The FIDIC MDB Harmonised Conditions of Contract (Fidic, 2010), which governs most multilateral bank-financed water supply works in Nepal, contains well-developed provisions for dispute prevention including advance notice requirements, timely Engineer determinations, structured claims management, and standing Dispute Boards. These mechanisms are specifically designed to enable early identification and resolution of contractual tensions. However, evidence from project implementation in Nepal indicates that they are routinely activated only after disputes have already escalated, limiting their effectiveness to adjudication rather than avoidance (Boswell, 2006). The result is a sector in which disputes are more expensive, more damaging, and more frequent than they need to be.

This study identifies the principal gap as the absence of a locally grounded, phase-sensitive, and FIDIC-aligned early warning framework that connects dispute drivers across pre-construction, construction, and post-construction stages with the contractual procedures available for their management (Olaimat & Marey-Perez, 2026). Without such a framework, project teams lack an objective and practical basis for monitoring dispute exposure, prioritizing emerging risks, and triggering timely preventive action before contractual positions become entrenched and project impacts accumulate.

1.3 Objectives

The primary objective of this study is to develop Dispute Risk Index (DRI) and FIDIC-based Proactive Tool for Early Dispute Prevention in water supply Projects in Nepal. Whereas, specific objectives are:

i. To identify and rank the dispute drivers arising across the pre-construction, construction, and post-construction phases of water supply projects in Nepal, based on their perceived impact on dispute occurrence.
ii. To develop a Dispute Risk Index (DRI) that integrates the impact and likelihood of each dispute driver into a composite measure of dispute exposure across the project lifecycle.
iii. To examine the FIDIC MDB Harmonised Contract provisions associated with the highest-ranked dispute drivers and to formulate it into a practical, stage-wise checklist as a proactive tool for early dispute prevention.

1.4 Research Questions

This study is guided by the following research questions:

i. What are the major dispute drivers arising across the pre-construction, construction, and post-construction phases of water supply projects in Nepal, and what is their relative level of impact on dispute occurrence?
ii. How can the identified dispute drivers be quantified by integrating their perceived impact and likelihood of occurrence into a Dispute Risk Index (DRI) for water supply projects?
iii. Which provisions of the FIDIC MDB Harmonised Contract are associated with the highest-ranked dispute drivers, and how can these provisions be translated into a practical, stage-wise checklist as a proactive tool for early dispute prevention?

1.5 Significance of the Study

This study is significant on several interconnected levels: practical, contractual, institutional, and academic and its relevance extends across multiple groups of stakeholders involved in Nepal's water supply sector.

At the practical level, the study provides project teams with two immediately usable tools: a Dispute Risk Index that quantifies overall dispute exposure and ranks its contributing factors, and a stage-wise checklist that translates contractual obligations into straightforward monitoring questions. For clients, contractors, consultants, and contract administrators, these tools offer a common reference point for identifying emerging risks, assigning responsibility for early intervention, and maintaining the procedural discipline that dispute prevention requires (Zack, 2015).

At the contractual level, the study makes an important contribution by demonstrating how the existing provisions of the FIDIC MDB Harmonised Conditions of Contract (Fidic, 2010) can be applied more effectively as preventive governance instruments rather than reactive remedial mechanisms.

At the institutional level, the findings are relevant to government agencies, development partners, and sector regulators responsible for overseeing water supply project delivery in Nepal. The Dispute Risk Index offers a potential basis for sector-level monitoring of dispute exposure across project portfolios, and the checklist could be incorporated into standard project monitoring frameworks and procurement guidelines (ADPC, 2021).

At the academic level, the study addresses a gap in construction dispute prevention research in Nepal and the broader developing-country infrastructure literature. It contributes a context-specific, empirically grounded framework that integrates risk quantification with contract governance, an approach rarely attempted in existing studies, providing a foundation for future research to build on and refine the DRI methodology.

1.6 Scope and Limitations

This study focuses specifically on water supply projects in Nepal, examining dispute risk across all three phases of the project lifecycle: pre-construction, construction, and post-construction. The geographical and sectoral boundaries are Nepal and water supply infrastructure respectively, with the FIDIC MDB Harmonised Conditions of Contract (2010) serving as the contractual reference point given its direct relevance to the sector's dominant project delivery model.

The study is both diagnostic and applied in scope. Diagnostically, it investigates the causes, distribution, and relative significance of dispute risk across the project lifecycle. On the applied side, it develops practical tools, the DRI and the checklist, intended for real-world use by project practitioners rather than purely academic contribution. This dual focus reflects the study's broader purpose: to bridge the gap between research-based understanding of dispute drivers and the operational demands of day-to-day project governance in Nepal's water supply sector.

Several limitations should be acknowledged. The survey sample of 68 respondents, recruited through snowball sampling, may introduce homophily bias and limit representativeness across the full stakeholder population. All responses are self-reported, reflecting perceptions of dispute impact rather than documented dispute records, meaning rankings capture professional judgement rather than objective frequency data. The study is further geographically confined to Nepal, limiting transferability to other national or sectoral contexts. Future research could address these limitations through larger random samples, incorporation of actual dispute records, and cross-country comparative analysis.

CHAPTER 2: LITERATURE REVIEW

2.1 Sectoral Context of Nepal's Water Supply Project

Water supply infrastructure in Nepal occupies a position that is far more strategic than routine civil engineering. Access to safe drinking water is recognized as a fundamental right in the Constitution of Nepal (THE CONSTITUTION OF NEPAL, 2015), situating the sector within a formal architecture of public responsibility and civic entitlement. Accordingly, every water supply project undertaken in the country carries not only technical and contractual dimensions but also a broader social mandate linked to public health, economic productivity, and household welfare. In recent years, this mandate has been reinforced by international commitments under SDG 6, which calls for universal access to safely managed water and sanitation services by 2030.

Despite this strong policy commitment, the sector continues to grapple with a persistent implementation gap. A nationwide assessment of piped water schemes in Nepal revealed that only a small proportion of completed systems were functioning well, while a substantial share required major repair or could not supply water on a year-round basis (Ministry of Water Supply, 2023). This pattern indicates that the quality of planning, execution, contract administration, and post-handover management is as consequential as the scale of physical investment. Weaknesses in contract management during construction are known to lead to long-term functionality failures.

The governance landscape of the sector adds further complexity. Following the federal restructuring of Nepal's government, responsibilities for water supply planning and delivery were redistributed across federal, provincial, and local tiers. However, this redistribution has not always been matched by corresponding increases in technical, administrative, or regulatory capacity at the subnational level (ADPC, 2021). In this environment, dispute prevention cannot be addressed solely through improved contract administration on individual projects; it also requires engagement with the broader governance conditions that shape how projects are prepared, approved, monitored, and closed out across the sector as a whole.

2.2 Conceptual Clarification of Conflict, Claims, and Disputes

In construction management scholarship and industry practice, the terms conflict, claim, and dispute are frequently used interchangeably, though they refer to distinct stages of an escalation process. A precise understanding of these distinctions is foundational for this study because it shapes how dispute risk is conceptualized, measured, and prevented.

Conflict arises when project participants hold incompatible expectations or interpret contractual obligations differently. A claim represents the contractual formalization of a perceived entitlement, typically for additional time or payment arising from an event the claiming party contends falls outside its contractual risk (Seppälä, 2005). A dispute emerges when a claim, or the underlying conflict, fails to reach resolution through the parties' routine administrative processes. Research confirms that a dispute does not arise until a claim has been submitted and rejected or ignored, underscoring the importance of claims management as a critical filter in the escalation chain.

For the purposes of this study, conflict is treated as an early warning signal detectable through operational indicators such as communication breakdowns and delayed approvals. Claims are understood as contractual expressions of accumulated project stress that require timely, documented, and fair response. Disputes, as the terminal stage in this escalation sequence, represent governance failures at which earlier mechanisms such as notices, determinations, and collaborative engagement did not function as intended. This conceptual framework underpins the study's rationale for a proactive Dispute Risk Index.

2.3 Dispute Exposure across the Water Supply Project Lifecycle

A central argument in the contemporary construction disputes literature is that dispute risk should be understood as a lifecycle phenomenon rather than a stage-specific event (Olaimat & Marey-Perez, 2026). This perspective is especially pertinent to water supply projects, where design, procurement, construction, commissioning, and handover form an interconnected sequence in which unresolved problems from earlier stages regularly surface as contractual conflicts in later ones.

During the pre-construction stage, the foundations for later disputes are often laid through weaknesses in project preparation. Inadequate site investigations, ambiguous contract documents, unrealistic baseline programmes, unclear risk allocation, and unresolved land acquisition or resettlement obligations create the structural conditions under which disagreements are likely to arise once physical work commences (Cakmak & Cakmak, 2014) (Olaimat & Marey-Perez, 2026). Research on construction disputes in developing-country infrastructure projects consistently identifies contract document quality and completeness of pre-construction planning as among the most influential factors shaping dispute exposure during implementation.

Once construction begins, the character of dispute risk shifts from structural to operational. At this stage, projects are exposed to variation orders arising from design changes (Khalifa & Mahamid, 2019), payment and certification delays (Shaikh et al., 2020), disagreements over extension of time, coordination failures with third-party utilities or authorities, quality nonconformities (Cakmak & Cakmak, 2014), and lapses in claim administration (Seppälä, 2005). Research on small-town water supply projects in Nepal has documented that cost and time overruns are near-universal, with an average cost overrun exceeding 28% and an average delay of more than two years per project (Kumar Mishra et al., 2020).

The post-construction and commissioning stage is often underestimated as a source of dispute exposure. In water supply projects, completion requires demonstrating that the entire system performs as specified under actual operating conditions. Disputes frequently arise from contested test outcomes, incomplete as-built documentation, defects discovered after Taking-Over, and delays in releasing retentions or final payments (Olaimat & Marey-Perez, 2026). The Melamchi Water Supply Project in Nepal illustrates how governance challenges, stakeholder dynamics, and contractual tensions can persist well beyond the completion of physical construction, with dispute-generating conditions reshaping the project's trajectory for years after structural works were substantially complete.

The lifecycle perspective thus reinforces a fundamental proposition: that dispute prevention must be designed and exercised across all phases of a project, not deployed reactively only after problems have crystallized (Olaimat & Marey-Perez, 2026). This observation directly informs the structure and rationale of the Dispute Risk Index developed in this study.

2.4 Risk Management, Early Warning, and Dispute Prevention in Water Supply Projects

Risk management and dispute prevention occupy closely related conceptual territory in the project management literature. Many of the risks that threaten project delivery, such as design uncertainty, unforeseen site conditions, payment delays, and coordination failures, are also among the primary drivers of contractual disputes. An effective risk management system, one that identifies, assesses, allocates, and monitors risks throughout the project lifecycle, should simultaneously function as a mechanism for dispute prevention.

Research by Kalogeraki and Antoniou (2024) (Kalogeraki & Antoniou, 2024) demonstrated that construction disputes arise not from isolated events but from the interaction of contractual conditions, triggering incidents, and process failures. In this model, the absence of timely notices, undocumented instructions, delayed determinations, and poor record-keeping function as amplifiers that convert manageable project tensions into entrenched contractual positions. The Navigant Construction Forum has similarly argued that disputes follow recognizable patterns and that early recognition is essential if parties wish to resolve problems before positions become rigid (Zack, 2015). Industry guidance provided by Arcadis (Arcadis, 2022) further confirms that recurring patterns of dispute can be managed more effectively when project organizations pay deliberate attention to the warning signs that repeatedly precede claims and formal conflict.

The present study's proposed Dispute Risk Index draws on these insights by combining impact-weighted indicators of dispute-prone conditions with likelihood assessments from experienced practitioners (Zayed et al., 2008). This approach is consistent with the risk management literature's emphasis on measuring both the severity and the probability of risk events as the basis for prioritized intervention, and reflects the growing recognition that risk management becomes most useful as an ongoing governance mechanism that tracks warning signals throughout the full project lifecycle.

2.5 FIDIC as a Contractual Framework for Dispute Prevention

The International Federation of Consulting Engineers, known by its French acronym FIDIC, has developed one of the most widely used families of standard contract forms in international construction and engineering practice (Fidic, 2010). FIDIC contracts are notable not only for their procedural detail and risk-allocation logic, but also for the extent to which they embed dispute-prevention mechanisms within the ordinary machinery of contract administration. Understanding FIDIC's role in dispute prevention requires attention to both its structural diversity across the suite of contract forms and its internal governance logic, which operates through notices, determinations, claims procedures, and standing dispute boards.

2.5.1 The Rainbow Suite

FIDIC's suite of contracts, often referred to informally as the Rainbow Suite due to the colour-coded presentation of its individual forms, is organized around the primary procurement question of who designs the works and who bears execution risk (Fidic, 2010). This design responsibility question, rather than the technical sector in which a project falls, drives the choice of FIDIC form.

The **Red Book**, formally titled the Conditions of Contract for Construction, is FIDIC's classic form for employer-designed engineering and building works (Fidic, 2010). It places design responsibility with the Employer and provides for contract administration through an Engineer who is engaged by the Employer but is required to act impartially in the exercise of contractual determinations. The Red Book's internal architecture, including its provisions for extensions of time, claims, variations, and dispute adjudication, reflects a long-developed body of practice and is the foundational template from which the Pink Book was subsequently adapted.

The **Yellow Book**, or Conditions of Contract for Plant and Design-Build, shifts design responsibility to the Contractor and is used where the Employer can specify desired outcomes and performance standards without needing to retain detailed control over the design process (Fidic, 2010). The unification of design and execution responsibility under a single contractor reduces certain categories of scope-related dispute, though it introduces corresponding risks where the Employer's requirements are imprecisely drafted.

The **Silver Book** is FIDIC's Engineering, Procurement, and Construction turnkey form and is intended for projects where the Employer requires a high degree of cost and time certainty and is willing to transfer significant risk to the Contractor, including responsibility for ground conditions and the accuracy of the Employer's requirements (Fidic, 2010). This risk profile makes careful project preparation and specification clarity especially important, as poorly allocated risks in Silver Book projects are known to generate substantial disputes.

The **Green Book** is a simplified short form suitable for lower-value or less complex projects, while the **Gold Book** covers Design-Build-Operate arrangements over an extended operational period. The **White Book** provides terms for client-consultant services engagements, and the **Emerald Book** addresses underground works, where geotechnical uncertainty is a defining feature (Boswell, 2006).

The practical significance of the Rainbow Suite for dispute prevention lies in FIDIC's own Golden Principles, which require that the procurement form used be appropriate to the project's design and risk structure, that Particular Conditions be drafted clearly and without distorting the underlying risk-reward balance, and that formal disputes be referred to a DAAB or DAB before arbitration.

2.5.2 Relevance of the FIDIC MDB Harmonised Book (2010)

The FIDIC MDB Harmonised Construction Contract, commonly referred to as the Pink Book, is the contractual form most directly relevant to this study. It was developed through a collaborative process between FIDIC and the heads of procurement of participating multilateral development banks, including the Asian Development Bank and the World Bank, specifically to address the inefficiencies and dispute risks that arose from the earlier practice of each MDB independently amending the standard Red Book through varying and sometimes inconsistent Particular Conditions. By incorporating the most commonly required MDB provisions directly into the General Conditions, the Pink Book significantly reduced the volume of bank-specific amendments needed in any given project and thereby reduced the contractual ambiguity that had previously contributed to disputes on MDB-financed projects (Boswell, 2006).

The Pink Book is of direct relevance to Nepal's water supply sector because the majority of significant water supply investments in Nepal are financed in whole or in part through multilateral development banks, including the Asian Development Bank and the World Bank. These institutions have integrated the Pink Book into their standard bidding documents, making it the default contractual framework for externally financed water supply construction in the country. For this study, its relevance is therefore not merely academic; it is the actual contract form governing the majority of high-value water supply projects against which dispute drivers and preventive mechanisms must be analyzed.

2.5.3 FIDIC MDB Harmonised Book's Internal Dispute-Prevention Logic

The most important feature of the Pink Book for this study is not its individual clauses in isolation, but the integrated governance logic they collectively embody. The contract is designed around the premise that disputes are best prevented through procedural predictability, early identification of emerging problems, and structured channels for resolution before positions harden. This logic operates through three interrelated mechanisms: timely communication and notice discipline, fair and prompt Engineer determinations, and the standing presence of a Dispute Board throughout the contract period.

Clause 1.3 establishes communication requirements that ensure all material exchanges between parties are properly made and recorded. Clause 8.3 requires the Contractor to submit and update a detailed programme, which functions as the baseline against which progress, delay, and extension of time entitlements are measured. Clause 20.1 sets out the notice requirements for Contractor's claims, requiring that claims be notified within 28 days of the relevant event and substantiated within a further 42 days (Fidic, 2010). These time limits are preventive in design: they encourage the early surfacing of potential disputes while the events in question are still fresh and verifiable. Clause 3.5 requires the Engineer to make fair determinations whenever the contract requires a decision, creating a first-level resolution mechanism that can address emerging disagreements before they require external adjudication (Seppälä, 2005).

Taken together, these provisions constitute what might be described as a signal chain: a sequence of procedural obligations that, when observed consistently, convert routine project tensions into manageable administrative matters rather than allowing them to accumulate into formal disputes. The quality of dispute prevention under the Pink Book therefore depends critically on the extent to which project teams actually apply this signal chain in practice

2.5.4 Roles, Determinations, and Contract Administration Discipline

The Engineer's role under the Pink Book is a central element of the contract's dispute-prevention architecture. Unlike some other procurement forms, the Pink Book places the Engineer in a position that combines supervisory authority with a duty of impartial determination. Clause 3.5 requires the Engineer to consult with both parties before making determinations, thereby embedding a procedural commitment to fairness at the heart of contract administration (Fidic, 2010). When the Engineer consistently fulfils this duty, emerging disagreements are addressed through a structured and authoritative process that reduces the likelihood of either party accumulating a grievance that later transforms into a formal dispute.

However, research on contract administration in developing-country construction environments, including Nepal, consistently highlights institutional challenges in fulfilling this role effectively. Limited technical capacity within project implementation units, overlapping authority between Employer personnel and Engineer staff, delayed approval processes, and the absence of unified documentation systems can impair the timeliness and quality of Engineer determinations. When determinations are delayed or avoided, issues that should have been resolved administratively are instead allowed to drift, accumulating into a backlog of unresolved matters that eventually crystallizes into formal claims and disputes. This administrative drift is one of the most consistent findings in the empirical literature on dispute causation in developing-country water supply projects.

2.5.5 Claims Management under the FIDIC MDB Harmonised Book

The claims management provisions of the Pink Book, primarily Clause 20.1 for Contractor's claims and Clause 2.5 for Employer's claims, are designed with a dual purpose. On one hand, they provide formal channels through which parties can assert their contractual entitlements. On the other hand, they are intended to function preventively by creating procedural discipline around how, when, and on what basis entitlement must be communicated.

The 28-day notice requirement under Clause 20.1 is particularly significant. By requiring the Contractor to notify the Engineer promptly when it becomes aware of an event or circumstance giving rise to a potential claim, the clause ensures that the

Employer and Engineer can investigate the matter while it is still current, assess mitigating actions, and begin the process of record-keeping and evaluation before facts become disputed. When this notice obligation is not observed, either because site staff treat it as optional or because the project culture discourages formal communication, the claims process loses its preventive function and instead becomes a retrospective and often adversarial exercise (Seppälä, 2005). Research on water supply projects in Nepal and comparable developing-country contexts indicates that lapses in notice compliance and claims administration are among the most frequently cited contributors to dispute escalation (Kalogeraki & Antoniou, 2024).

2.5.6 Dispute Board Mechanisms for Dispute Avoidance

The Dispute Adjudication Board provisions under Clause 20.4 of the Pink Book represent the most explicitly preventive element of the contract's dispute governance architecture (Fidic, 2010). A standing Dispute Board, appointed at the commencement of the contract and maintained throughout its duration, is able to conduct regular site visits, review project correspondence and progress reports, and provide informal advice when parties begin to diverge on contractual interpretation (Owen et al., 2003). This standing engagement allows Board members to develop familiarity with the project's technical and commercial history, making their interventions more informed and more likely to result in early resolution.

FIDIC's guidance on Dispute Boards is explicit that their primary purpose is avoidance rather than adjudication. The standing board model is expressly preferred over ad hoc appointment because the latter allows Board members no opportunity to build the contextual understanding needed for effective early intervention (Jaynes, 2006). The distinction is practically important: a Dispute Board that is only activated after a formal dispute has been declared cannot perform the preventive functions for which it was designed.

Despite these provisions, evidence from Nepal's water supply projects suggests that Dispute Board mechanisms are rarely deployed in the proactive, preventive manner that the Pink Book contemplates. Boards, where they exist, are often convened only after significant disputes have already developed, limiting their effectiveness to adjudication rather than avoidance. Integrating active Dispute Board engagement with the early-warning framework proposed in this study represents an important practical opportunity to shift project governance toward genuinely preventive dispute management.

2.6 Empirical Review of Dispute Drivers in Water Supply Projects

Global evidence consistently links construction disputes to three broad categories of factors: people and organization (unclear roles, poor coordination, weak record-keeping), process (missed notices, informal instructions, delayed determinations), and product and technical factors (ambiguous scope, design errors, unforeseen site conditions) (Cakmak & Cakmak, 2014) (Olaimat & Marey-Perez, 2026).

Research specifically focused on water supply and sanitation projects in developing countries has documented that a high proportion of these projects experience time and cost overruns. A study of Nepal's Second Small Towns Water Supply and Sanitation Sector Project found that only two out of 65 projects were completed on a planned schedule, with an average cost overrun of 28.27% and an average delay of 2.1 years per project (Kumar Mishra et al., 2020). Causative factors included variation orders, earthquake and rainfall disruptions, authority-related delays, and adjudication processes- all aligning with dispute drivers examined in the broader construction literature (Cakmak & Cakmak, 2014) (Khalifa & Mahamid, 2019).

Research on conflict in developing-country infrastructure projects further highlights that contextual factors, project characteristics, and local implementation conditions all contribute to dispute formation (Boudet et al., 2011). Factors such as the involvement of international financial institutions, the complexity of stakeholder arrangements, and the adequacy of public consultation mechanisms have all been shown to influence the likelihood of conflict in water supply and pipeline projects. For Nepal, the combination of complex multi-tier governance (ADPC, 2021), active donor financing, diverse community interests, and technically demanding project requirements creates a context in which the cumulative probability of dispute is elevated even before construction begins.

After a detailed literature review, a few causes of disputes have been identified and summarized in the Figure 2-1 and Table 2-1 below.

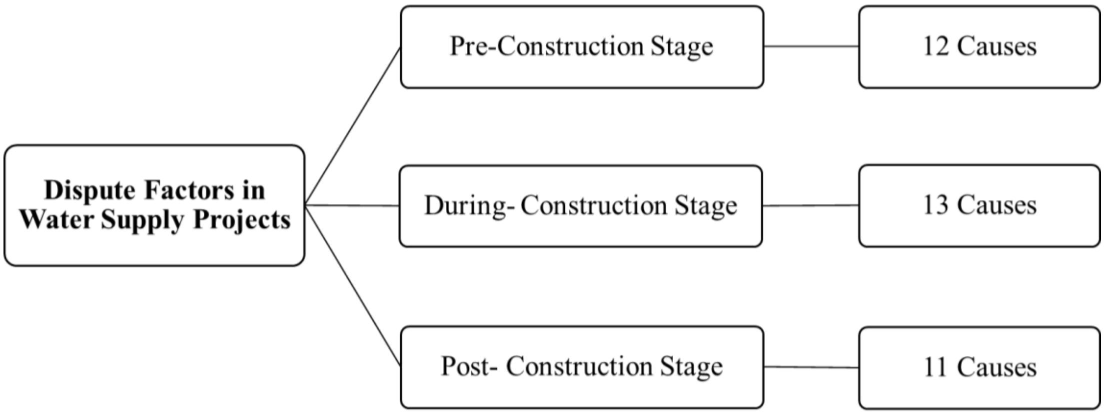

Figure 2-1: Classification of Dispute Factors by Construction Stage

Table 2-1: Dispute Factors Definition

S.N.	Factor Name	Factor Definition	Sources
(A)	PRE-CONSTRUCTION STAGE		
1	Incomplete/late design drawings & specifications	Design deliverables (drawings, specs, schedules) are incomplete, inconsistent, or issued late relative to construction needs.	(Shaikh et al., 2020); (Cakmak & Cakmak, 2014)
2	Ambiguous or contradictory contract documents	Contract documents contain ambiguities, conflicting requirements, or unclear precedence (e.g., drawings vs BoQ/specs).	(Cakmak & Cakmak, 2014); (Matarneh, 2024); (Barakat et al., 2020)
3	BoQ/quantity errors and measurement baseline weakness	Bills of Quantities (BoQ) contain errors/omissions, or measurement rules are unclear for pipelines, chambers, and appurtenances.	(Khalifa & Mahamid, 2019); (Enshassi et al., 2010)
4	Inadequate process and milestone design	Design basis is inadequate for demand, distribution pressures, or treatment performance requirements.	(Shaikh et al., 2020)
5	Inadequate geotechnical/to	Site investigations are insufficient to characterize subsurface	(Olaimat & Marey-Perez, 2026)

S.N.	Factor Name	Factor Definition	Sources
	pographic/site investigation	conditions including rock strata, groundwater levels, contamination, and soil variability along pipeline corridors, at river crossings, or at structure locations.	
6	Poor mapping of existing utilities and assets	Existing underground utilities and infrastructure assets are not accurately located, recorded, or communicated in the Contract documents	(Shaikh et al., 2020); (Cakmak & Cakmak, 2014)
7	Delayed site handover/ land acquisition/ resettlement/ Compensation Disagreement	Required land, wayleaves, and access permissions for pipeline corridors and facilities are not secured at start.	(Cakmak & Cakmak, 2014)
8	Environmental/ social approvals not ready	Statutory approvals and safeguards instruments are incomplete, contested, or delayed	
9	Unrealistic baseline programme	Tender/contract programme is not constructible given access constraints, approvals lead times, and utility shutdown windows.	(Shaikh et al., 2020)
10	Contractor's Capacity	Contractor lacks relevant water infrastructure capability increasing execution stress and claims likelihood.	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020); (Barakat et al., 2020)
11	Unclear Engineer authority/ slow Employer decision-making	Roles, delegations, and decision rights are unclear; approvals and determinations are delayed or inconsistent.	(Cakmak & Cakmak, 2014)

S.N.	Factor Name	Factor Definition	Sources
12	Unclear financing structure and institutional responsibility	Employer's financial arrangements or advance payment processes are delayed, creating early cash flow stress and mobilization delays.	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020)
(B)	DURING- CONSTRUCTION STAGE		
13	Unforeseeable physical conditions	Physical conditions encountered differ materially from what an experienced contractor could reasonably foresee (e.g., rock strata, groundwater, obstructions).	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020)
14	Utility relocation delays and third-party interface failures	Relocation/protection of existing utilities is delayed or poorly coordinated, including utility owner approvals and third-party works.	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020)
15	Delayed Engineer approvals	Engineer review/approval of submittals is slower than required for the programme (materials, equipment, method statements, ITPs).	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020)
16	Late instructions/drawings/clarifications during construction	Engineer/Employer issues late clarifications or revised drawings affecting work sequencing (e.g., alignment changes, chamber details).	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020); (Barakat et al., 2020)
17	High volume of Variations/change orders (scope growth)	Frequent changes to scope/specifications due to design development, stakeholder requests, or unforeseen constraints.	(Khalifa & Mahamid, 2019); (Enshassi et al., 2010); (Alnuaimi et al., 2010)
18	Delays caused by authorities	Permits/inspections by authorities (roads, environmental, health)	(Shaikh et al., 2020)

S.N.	Factor Name	Factor Definition	Sources
		take longer than planned, affecting access and work methods.	
19	Supply chain and customs delays	Delays occur in manufacturing, delivery, or clearance of critical pipes, valves, pumps, and E&M/SCADA items.	(Shaikh et al., 2020); (Cakmak & Cakmak, 2014)
20	Delayed payment, IPC Certification and Cash flow Stress	Interim payment applications are delayed, disputed, or under-certified; Employer payment is late.	(Shaikh et al., 2020); (Cakmak & Cakmak, 2014)
21	Disputes over valuation	Disagreement on valuation method for dayworks, provisional sums, omissions, and remeasured quantities.	(Shaikh et al., 2020); (Cakmak & Cakmak, 2014)
22	EOT, concurrent delay, and acceleration disagreements	Disputes arise over delay responsibility (concurrency), entitlement to EOT, and whether acceleration was instructed or constructive.	(Atanasov, 2026)
23	Quality non-conformities and failed tests	Work fails inspection/testing (e.g., pipe jointing leaks, pressure test failure, disinfection failure, WTP performance).	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020)
24	MDB audit/integrity compliance issues	MDB-funded projects may face audits/inspections; integrity non-compliance (fraud/corruption) can trigger payment suspension or termination actions.	(Shaikh et al., 2020)
25	Late notices, weak records, and claims	Contractual notices are issued late or without substantiation; project records (daily reports,	(Seppälä, 2005)

S.N.	Factor Name	Factor Definition	Sources
	administration failures	programmes, measurement records) are inadequate.	
(C)	POST-CONSTRUCTION STAGE		
26	Delayed Taking-Over due to incomplete punch list/tests/documentation	Taking-Over is delayed because outstanding works, documentation, or completion tests are not concluded.	(Shaikh et al., 2020)
27	Disputes over commissioning and performance test criteria	Commissioning tests and performance benchmarks (capacity, quality, reliability) are disputed or interpreted differently by parties.	(Cakmak & Cakmak, 2014); (Shaikh et al., 2020); (Olaimat & Marey-Perez, 2026)
28	Defects during Defects Notification Period	Defects occur after Taking-Over (pipeline leaks/bursts, pump failures, instrumentation faults) during the Defects Notification Period.	(Cakmak & Cakmak, 2014); (Olaimat & Marey-Perez, 2026)
29	Restricted access/coordination for defect rectification	Contractor access to site/network for defect rectification is constrained by utility operations, safety rules, or community restrictions.	(Shaikh et al., 2020)
30	Extension of DNP and delayed Performance Certificate	Defects persist or re-occur, prompting Employer/Engineer to extend DNP and delay issuance of Performance Certificate.	(Cakmak & Cakmak, 2014)
31	Final measurement, final statement and close-out disagreement	Final account reconciliation (variations, remeasurement, claims) is contested, delaying contract close-out.	(Shaikh et al., 2020); (Cakmak & Cakmak, 2014); (Olaimat & Marey-Perez, 2026)

S.N.	Factor Name	Factor Definition	Sources
32	As-built drawings, asset data, and O&M manuals incomplete or rejected	Contractor delivers incomplete or non-compliant as-built records, O&M manuals, or training deliverables required for operation of water assets.	(Olaimat & Marey-Perez, 2026)
33	Post-commissioning drinking-water quality non-compliance	After commissioning, supplied water fails quality standards (microbial/chemical or taste/odour), triggering remedial works and operational restrictions.	(Shaikh et al., 2020)
34	Operator training/operational readiness gaps	Inadequate training/handover results in operator misuse or suboptimal operation, leading to incidents blamed on construction defects.	(Cakmak & Cakmak, 2014)
35	Supplier warranty and interface disputes	Equipment failures trigger disagreements among Contractor, suppliers, and Employer on warranty scope, commissioning conditions, and interface responsibility.	(Shaikh et al., 2020); (Cakmak & Cakmak, 2014)
36	Ineffective use of Dispute Board/amicable settlement	Parties fail to refer disputes promptly to the Dispute Board or to pursue amicable settlement, leading to entrenched positions and arbitration.	(Boswell, 2006)

2.7 Existing Dispute Risk Indices and Models and Their Limitations

A growing body of research has attempted to move beyond qualitative description of dispute causes toward quantitative modelling of dispute risk. Zayed (2008) (Zayed et al., 2008) developed a Dispute Risk Index using Fuzzy Synthetic Evaluation (FSE) to convert expert judgements on dispute frequency and severity into a composite numerical measure, demonstrating that financial and administrative drivers such as payment delays, weak contract administration, and unclear specifications can be as influential as technical defects. The primary limitation of this approach is its heavy reliance on cross-sectional expert opinion, which introduces respondent variability, and its limited connection to specific contractual procedures.

The dispute causation framework developed by Kalogeraki and Antoniou (2024) (Kalogeraki & Antoniou, 2024) classifies dispute antecedents across contractual, technical, managerial, and external domains, explaining why routine stressors such as a payment delay or a design change do not automatically produce disputes, they do so only when combined with procedural failures that prevent timely resolution. Multi-criteria decision-making approaches, particularly the AHP-based prioritization model of Zayed (2008) (Zayed et al., 2008), bring methodological rigour to the weighting of dispute factors across financial, technical, political, and legal dimensions, though their sensitivity to expert panel composition limits transferability across project types and national contexts. Escalation-focused models such as the litigation risk index proposed by concentrate on the transition from ordinary disagreement to formal legal proceedings but do not adequately account for how notice discipline and timely Engineer determinations affect the trajectory of claims under time-barred contractual systems (Fidic, 2010).

More recent applications of machine learning and artificial intelligence to dispute prediction introduce methodological sophistication but are constrained by the scarcity of high-quality structured project data in developing-country environments and by interpretability limitations that reduce their usefulness as governance tools (Olaimat & Marey-Perez, 2026).

Taken together, the existing models reveal four recurring gaps: an actionability gap (risk is diagnosed without linking outputs to contractual procedures); a measurement gap (process-compliance indicators that govern entitlement are overlooked); a localization gap (few tools are calibrated to Nepal's water supply context); and a validation gap (limited evidence that active use of dispute risk alerts reduces escalation). These gaps directly justify the present study's proposed Dispute Risk Index.

2.8 Research Gap and Conceptual Position of the Present Study

Although dispute-related research in Nepal's water supply sector has touched on delay analysis, case evidence, and broader dispute literature, a critical gap remains: no study has built a framework specific to Nepal that ranks dispute drivers across a project's full lifecycle, combines their impact and likelihood into a single measurable index, and then ties those findings directly to actionable clauses in the FIDIC MDB Harmonised Contract. This study is designed to fill that gap by offering a framework that is at once lifecycle-sensitive, contractually grounded, and practically oriented.

Most existing research treats risk assessment and contract management as separate exercises. Studies that quantify dispute risk rarely connect their findings to contractual procedures, while those that examine contractual mechanisms seldom offer a quantified measure that practitioners can use to set priorities. This study bridges that divide by constructing a Dispute Risk Index that brings together empirically weighted impact scores and expert-assessed likelihood ratings, then maps the highest-priority dispute drivers against the relevant provisions of the FIDIC MDB Harmonised Conditions of Contract. That integration is the study's core methodological contribution.

Underlying the entire research is a particular view of why disputes arise in Nepal's water supply projects: not from unpredictable events or unavoidable complexity, but from accumulated governance shortfalls poor project preparation, weak procedural discipline, fragmented institutional coordination, and a persistent tendency to apply contractual tools reactively rather than preventively. The Dispute Risk Index and the accompanying proactive checklist developed here are intended to give practitioners a working instrument for spotting and correcting these shortfalls before they harden into formal claims. In doing so, the study aims to support a broader shift in practice, away from dispute resolution, which responds to conflict after the fact, and toward early dispute governance, which works to prevent the conditions that allow conflict to escalate.

This shift from reaction to prevention is the thread running through the rest of the thesis. It shapes the research design, the choice of analytical methods, and the way the findings are interpreted in the chapters that follow.

CHAPTER 3: METHODOLOGY

This chapter gives a clear overview of the research methods used to meet the study objectives. It explains the research design and methodology, framework, study area, population size, sample size determination, data collection methods, data analysis procedures, and the research matrix. Figure 3-2 presents a visual summary of the overall research process followed in the study.

First and foremost, relevant literature regarding dispute drivers in water supply projects were studied to understand the detailed overview of the study and also to get the ideas about the previous research conducted in the related field. The selected research questions made it necessary to do research on identifying key dispute factors in water supply projects in Nepal. To cover an extensive amount of the information regarding the topic of this study, technical reports, national and international journals, and standard contract forms were studied as a part of the literature.

3.1 Research Design and Methodology

3.1.1 General

The research methodology follows a structured approach. Before beginning the main study, the first task was to identify the research gap, which made it clear why this research was necessary. Once the gap was identified, the research objectives were set to define the purpose of the study. After that, the research design was prepared, including the development of both theoretical and conceptual frameworks. These frameworks served as a guide throughout the study by showing the main concepts, variables, and how they are connected.

In the data collection stage, relevant information was gathered from both primary and secondary sources. After collection, the data was processed, analyzed, and interpreted to produce meaningful results. The findings were then validated, and their significance was carefully discussed in the results and discussion section. Finally, the study concluded with key conclusions and recommendations, highlighting the main insights and suggesting areas for future research or practical application.

Throughout all stages of the study, the literature review provided a strong theoretical base, while consultation with stakeholders or experts helped ensure the research remained relevant, reliable, and useful.

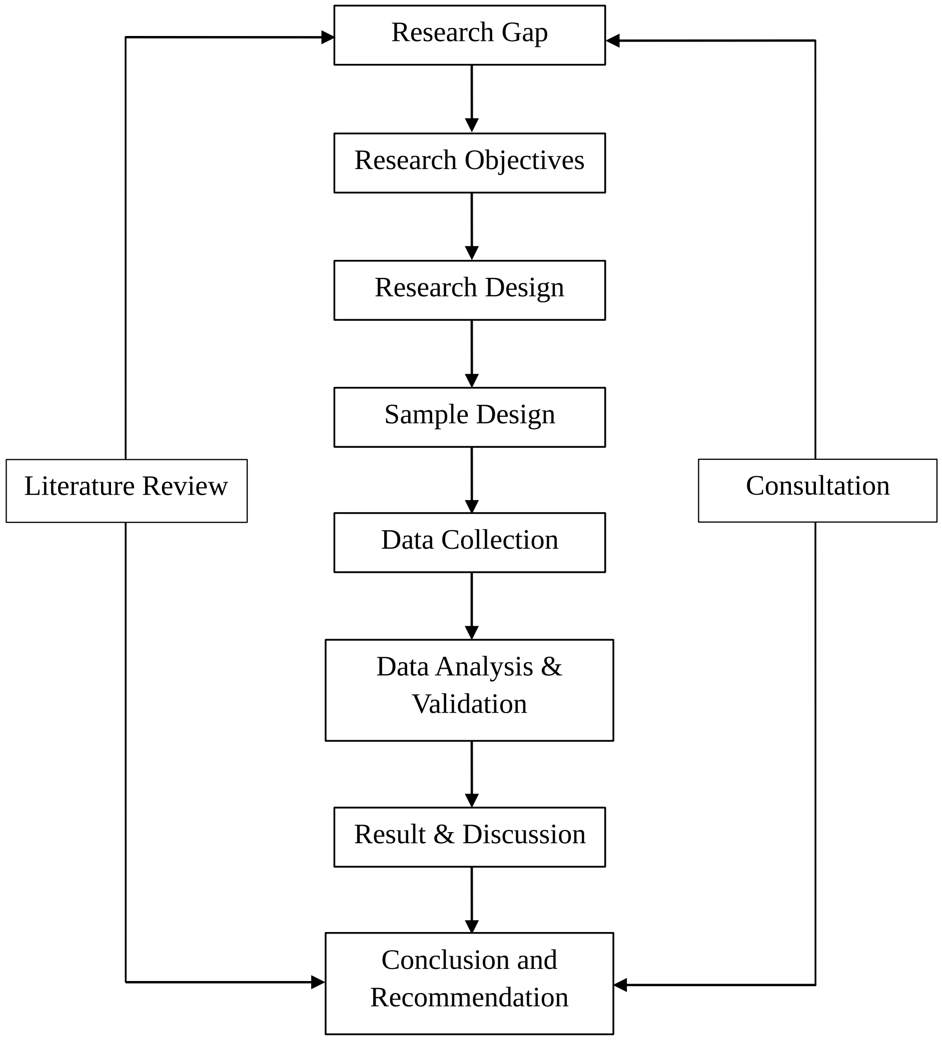

Figure 3-1: General Research Methodology

3.1.2 Research Design

This study employs a mixed qualitative-quantitative survey design to develop a Dispute Risk Index (DRI), examine relevant FIDIC provisions, and prepare an early warning tool for dispute prevention. A mixed-method design was considered appropriate because the study required both quantitative evidences to rank dispute drivers systematically and qualitative insight to interpret them with their likelihood, practical significance, and contractual relevance. This combination helped produce a more comprehensive and practice-oriented understanding of dispute risk in water supply projects.

The study began with a review of relevant literature to identify dispute drivers across the project lifecycle. At the initial stage, 39 factors were identified from both national and international sources. These factors were then reviewed by the first panel of five experts with more than 30 years of experience in the sector. Following this review, 36 dispute drivers were retained for analysis, including 12 related to the pre-construction phase, 13 to the construction phase, and 11 to the post-construction phase. These validated drivers were then converted into a structured questionnaire for stakeholders involved in the water supply sector. Before final administration, the draft questionnaire was pilot tested with second panel of five senior professionals who were not included in the final sample in order to assess its clarity, relevance, and length. Based on their feedback, minor revisions were made.

The final questionnaire consisted of four sections. The first section collected background information about the respondents, such as their professional role, experience in the water sector, and type of project involvement. The remaining three sections focused on the perceived dispute impact of factors associated with the pre-construction, construction, and post-construction stages, as shown in Appendix 3. Responses were measured on a five-point Likert scale, where 1 indicated no impact and 5 indicated critical impact, and respondents were asked to assess the extent to which each factor contributed to dispute occurrence. Participation in the survey was voluntary, and respondents were informed of the purpose of the study, while confidentiality and anonymity of their responses were maintained throughout the research process.

After the questionnaire data were collected through KoboToolbox, in-depth interviews were conducted with third panel of six professionals, each having more than 40 years of experience in the water supply sector. These interviews were used to assess the likelihood of occurrence of each factor in water supply projects, further examine the major dispute drivers identified through the quantitative analysis, and identify any additional factors that could significantly contribute to disputes.

Purposive sampling was adopted for the selection of experts because the study required specialized professional judgment from individuals with substantial experience in Nepal’s water supply sector. Since the research focused on validating dispute drivers, assessing their likelihood of occurrence, and reviewing the practical usability of a FIDIC-based early warning checklist, experts were selected on the basis of their extensive sectoral experience and their ability to provide context-specific insight beyond what could be obtained from the questionnaire survey alone.

Based on the findings, the Relative Importance Index (RII) were assessed. To validate the RII-identified priority dispute drivers against real-world conditions, six Nepal's water supply projects were selected using criterion-based purposive sampling for their relevance. Subsequently, a Dispute Risk Index was developed to quantify dispute risk. The priority dispute drivers were then used for FIDIC clause mapping and procedural analysis, which supported the preparation of an early warning checklist incorporating both the highest-ranked drivers and the relevant provisions of the FIDIC MDB Harmonised Contract Form. The checklist was reviewed by three senior experts in the relevant field for validation. After receiving their comments and feedback, a few revisions were made.

Based on the overall findings and discussions, the study then presented conclusions and recommendations to improve understanding, provide guidance, and support future research in the field.

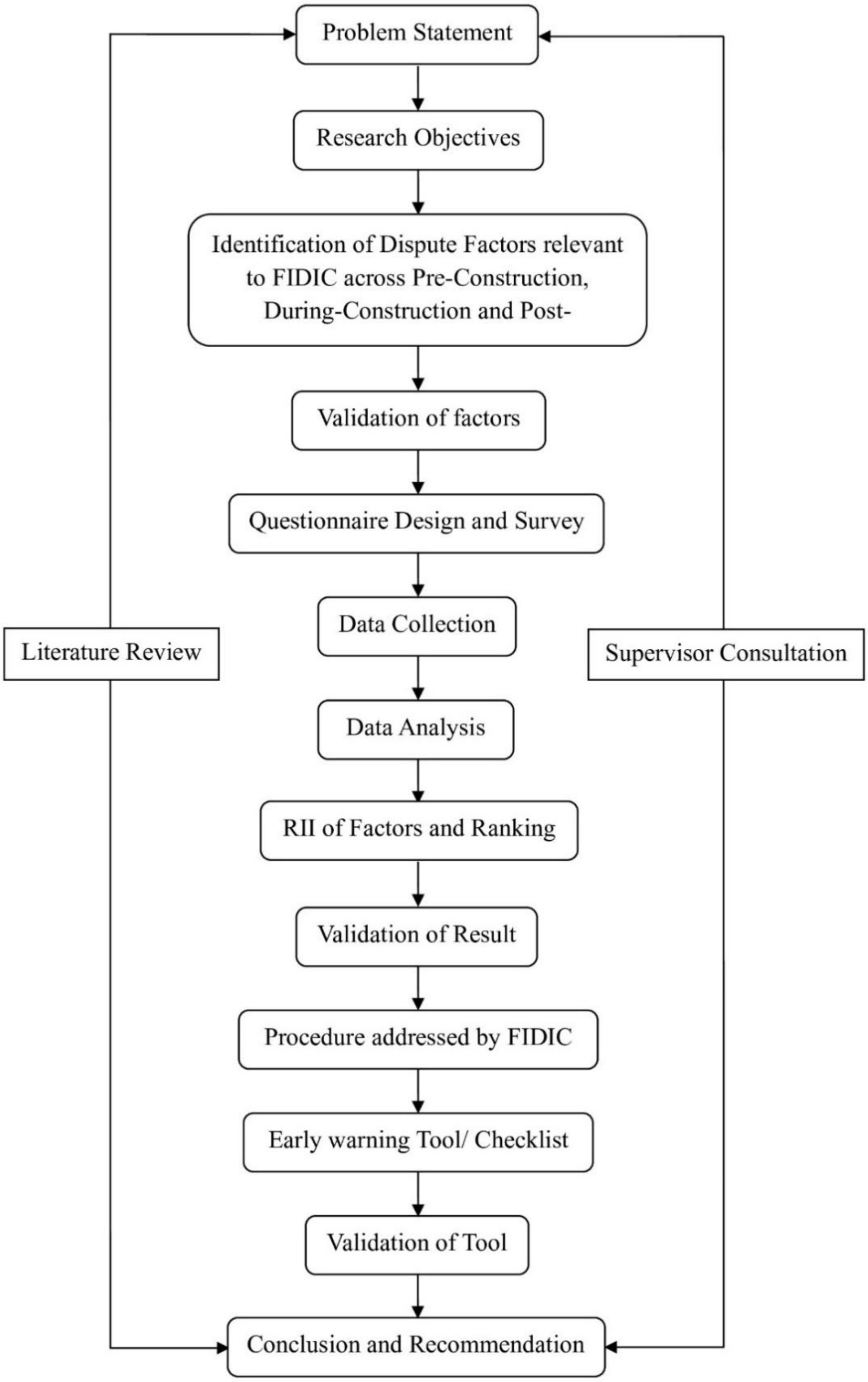

Figure 3-2: Research Design

3.1.3 Research Framework

A research framework is a structured plan that guides a study by showing the ideas, concepts, and relationships that the research is based on. It is done to give the study clear direction, ensure that the research problem is approached systematically, and help the researcher stay focused on what needs to be examined. It involves developing the theoretical framework, identifying the key variables of the study to build a conceptual framework, defining the target population, and selecting suitable sampling methods to collect relevant data.

3.1.3.1 Theoretical Framework

The theoretical framework links the researcher to existing knowledge by providing an understanding of relevant concepts, their definitions, and the theories related to the current research interest. It serves as the foundation for the study by showing how the research is grounded in established scholarly work. Figure 3-3 visually illustrates the theoretical framework adopted in this study.

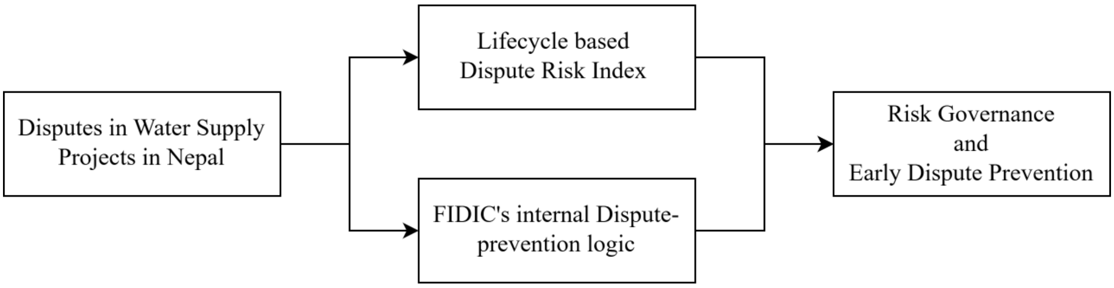

Figure 3-3: Theoretical Framework

The theoretical framework above explains how this study understands and addresses disputes in water supply projects in Nepal. It begins with the recognition that disputes are a recurring problem in these projects and treats them as the main issue requiring analysis. From this starting point, the framework applies two complementary perspectives. The first is the lifecycle-based Dispute Risk Index, which helps examine how dispute risks emerge and change across the pre-construction, construction, and post-construction stages. The second is FIDIC's internal dispute-prevention logic, which provides the contractual and procedural basis for identifying problems early and responding to them before they intensify. Together, these two elements guide the study toward the final outcome of stronger risk governance and early dispute prevention. In simple terms, the framework shows that disputes should not only be reacted to after they occur, but should be tracked across the project life cycle and managed proactively through appropriate contractual mechanisms.

3.1.3.2 Conceptual Framework

A conceptual framework is a diagrammatic presentation of the way the main variables in a study are expected to relate to one another. After the variables have been identified, it helps the researcher examine their possible cause and effect connections and shows how the major elements of the study work together to produce coherent findings. It also reflects the central objectives of the research by organizing them into a logical structure. For this reason, the conceptual framework is usually developed before data collection, since it serves as a guide for determining the type of information the researcher needs in order to achieve the intended results. Figure 3-4 presents the conceptual framework adopted for this study.

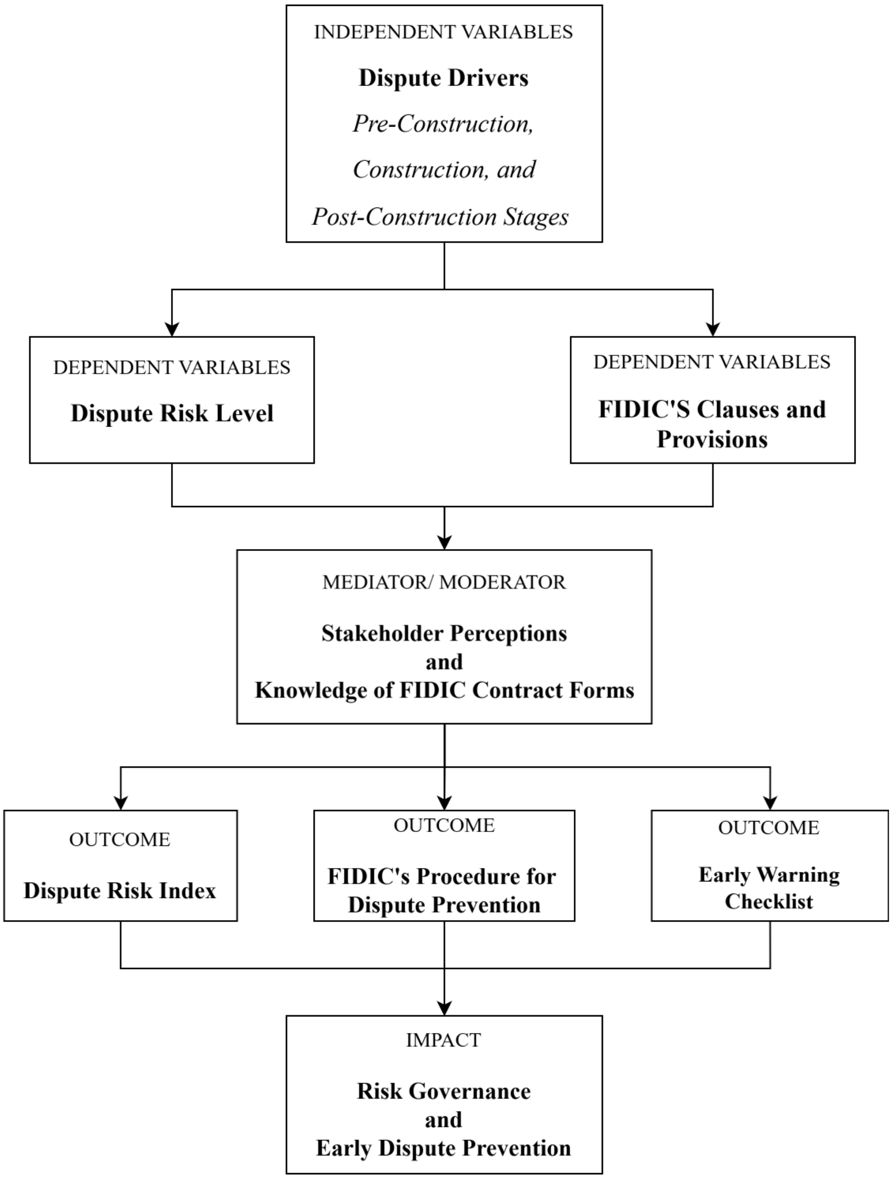

Figure 3-4: Conceptual Framework

The conceptual framework outlines the key variables of the study and the relationships among them in explaining dispute risk in water supply projects in Nepal. It shows that dispute drivers across the pre-construction, construction, and post-construction stages influences dispute risk levels, while stakeholder perceptions and FIDIC-related knowledge shape how those risks are interpreted and managed. The framework further outlines how these interactions lead to the development of the Dispute Risk Index (DRI) and the early warning checklist as practical tools for early dispute prevention.

The following steps addressed the objectives of this research. At the level of the independent variables, the framework identified dispute drivers arising across the pre-construction, construction, and post-construction stages, which addressed Objective 1 of this research. These elements influenced the level of dispute risk within a project. Their effect was further shaped by factors related to stakeholder perceptions and FIDIC, including knowledge of FIDIC MDB Harmonised contract forms, relevant clauses and procedures, and the contract's built-in dispute prevention process. The combined interaction of these variables addressed Objective 2 and produced the main outcome of the study, namely the Dispute Risk Index (DRI), which served as an output for indicating dispute potential and supporting the preparation of an early warning checklist for early dispute prevention, thereby addressing Objective 3.

3.2 Study Area

The study area for this research was Nepal, with particular emphasis on water supply projects implemented within the country. Nepal was selected because the water supply sector is not only essential to public health, service delivery, and national development, but also remains a major area of ongoing investment and future project activity. The sector continues to attract substantial development financing, with the Asian Development Bank showing a strong water and urban portfolio presence and additional water-related projects in its pipeline, while the World Bank portfolio also indicates ongoing commitments and a number of upcoming water-related procurement packages. This continuing investment made water supply projects a highly relevant field of study, since improvements in dispute prevention could contribute not only to current project performance but also to the more effective delivery of future projects planned in Nepal. The sector was further considered appropriate because water supply projects involve multiple stakeholders, complex contractual relationships, and implementation challenges that extend across the pre-construction, construction, and post-construction stages, making them suitable for examining dispute drivers and developing a practical dispute risk framework.

Within this broader national setting, the Melamchi Water Supply Project was used as the principal case study. It was selected because of its national significance, large scale, long implementation history, and the complexity of issues that arose during its delivery, all of which made it a strong reference point for understanding dispute risk in Nepal's water supply sector. To strengthen the contextual basis of the study, several other water supply projects in Nepal were also considered as relevant examples of dispute-prone or conflict-affected project environments. These included the Kavre Valley Integrated Water Supply Project, the Urban Water Supply and Sanitation (Sector) Project, the Kathmandu Valley Water Supply Improvement Project, the Salu-Sunarpani Lift Water Supply Project in Ramechhap, and the Pathivara Drinking Water Project in Taplejung. Across these projects, disputes were commonly linked to contractor-related delays, non-compliance with technical specifications, land acquisition disagreements, design and implementation shortcomings, and broader institutional and coordination challenges. Their inclusion helped situate the Melamchi case within a wider sectoral context and reinforced the relevance of the study to water supply projects in Nepal more generally.

3.3 Study Population, Sampling and Sample Size

The study population comprised stakeholders involved in Nepal's water supply sector as client, contractor, or consultant representatives, since these groups are directly engaged in project planning, contract administration, supervision, and implementation. Different sampling approaches were applied at different stages of the study. For the expert validation of the preliminary list of dispute drivers, purposive sampling was used to select a panel of five senior professionals with extensive experience in the relevant field. This step helped ensure that the initially identified dispute drivers were relevant, practical, and appropriate to the context of water supply projects in Nepal.

For the questionnaire survey, a non-probability purposive sampling method was adopted using a snowball sampling approach. This method was considered suitable because the study targeted specialized professionals in the water supply sector who were not easily accessible through a complete sampling frame. Initial respondents were therefore requested to refer other qualified participants from their professional networks. However, snowball sampling may introduce homophily bias, as respondents often refer individuals with similar professional backgrounds or perspectives. For this reason, the findings of the study were interpreted as indicative of the sectoral situation rather than fully generalizable to the entire population.

The minimum required sample size for the survey was determined using Cochran's formula for a large population:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where,

- n_0 = represents the minimum required sample size,
- z is the z-score corresponding to the selected confidence level,
- p is the estimated population proportion,
- q = 1 - p,
- e is the allowable margin of error.

For this study, a 90% confidence level was adopted because of resource limitations and the exploratory nature of the research.

Accordingly, the values used were:

z = 1.645, p = 0.5, q = 0.5, and e = 0.1.

Substituting these values into Cochran's formula gave:

$$n_0 = \frac{(1.645)^2 \times 0.5 \times 0.5}{(0.1)^2}$$

$$= 67.65$$

$$\approx 68$$

Thus, the minimum sample size required for the questionnaire survey was 68 respondents.

Following the questionnaire survey and data analysis, an additional qualitative phase was carried out through in-depth interviews. For this stage, purposive sampling was again employed to select another panel of six professionals with more than 40 years of experience in the relevant field. These interviews were conducted to provide deeper interpretation of the survey findings, examine the likelihood of occurrence of the identified factors in water supply projects, validate the major dispute drivers that emerged from the analysis, and identify any additional factors that may substantially contribute to disputes.

3.4 Methods of Data Collection

3.4.1 Primary Data Collection

Primary data refers to information collected directly by the researcher from original sources for the specific purpose of the study. For this study, these data were obtained through three main methods: expert validation, a questionnaire survey, and in-depth interviews. First, the preliminary list of dispute drivers was reviewed and validated by experts who had more than 30 years of experience in the sector. This step helped ensure that the identified factors were relevant and appropriate to the context of water supply projects in Nepal. The questionnaire was then developed using the online platform KoboToolbox and was organized into four sections. Section 1 gathered background information about the respondents, including their professional role and experience in the water sector, while Sections 2, 3, and 4 focused on factors related to the pre-construction, construction, and post-construction stages, respectively, asking respondents to assess the extent to which each factor contributed to the occurrence of disputes.

The responses in these sections were measured using a five-point Likert scale, where 1 indicated no impact, 2 minor impact, 3 moderate impact, 4 major impact, and 5 critical impacts. The questionnaire was administered online, and respondents were reached through a snowball sampling approach in order to obtain the required sample size. Before the main survey was launched, a pilot test was conducted with five respondents to check the clarity, relevance, and suitability of the questionnaire items. Based on their feedback, necessary revisions were made before the final survey was distributed. In total, 68 valid responses were collected.

After the questionnaire survey and initial data analysis were completed, the findings were shared with six professionals who each had more than 40 years of experience in the water supply sector. In-depth interviews were then conducted to assess the likelihood of occurrence of each factor in water supply projects, to further examine the major dispute drivers identified from the quantitative analysis, and to identify any additional important factors that could contribute to disputes.

3.4.2 Secondary Data Collection

Secondary data refers to information that has already been gathered and documented by other researchers or institutions rather than being collected directly by the researcher. Such data are obtained from existing sources, including journal articles, conference papers, reports, theses, websites, magazines, and official records. In this study, secondary data were mainly drawn from journal articles, conference proceedings, reports, and both national and international theses.

3.5 Data Analysis

3.5.1 Relative Importance Index (RII)

Survey data were processed in Microsoft Excel. Internal consistency was checked using Cronbach's alpha, and the Relative Importance Index (RII) was used to rank the dispute drivers.

The Relative Importance Index (RII) was computed using the following equation.

$$RII_i = \frac{\sum W_i}{A \times N}$$

In this equation,

- W_i denotes the Likert score ranging from 1 to 5,
- A represents the maximum possible score, which is 5, and
- N is the total number of respondents, which is 68.

In count form, the same expression can be written as:

$$RII_i = \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{5N}$$

Where, n_1, n_2, n_3, n_4 and n_5 represent the number of responses at each scale point. The RII values obtained from the questionnaire represented the relative impact of each dispute driver.

For interpretation, factors with RII > 0.7 were considered to have high impact, those with RII between 0.5 and 0.7 were considered to have moderate impact, and those with RII < 0.5 were considered to have low impact (Kometa et al., 1995). The ranked results were then reviewed through in-depth interviews with six professionals who each had more than 40 years of experience in the water-supply sector.

The Spearman rank order correlation coefficient was applied to examine the degree of agreement between the individual stakeholder group and the overall composite ranking of dispute drivers at each project lifecycle stage. The formula used is:

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2 - 1)}$$

Where,

- ρ is the Spearman correlation coefficient,
- d_i is the rank difference between the stakeholder group ranking and the overall ranking for each dispute driver, and
- n is the total number of dispute drivers assessed at that stage.

It is interpreted based on the strength of correlation as follows (Akoglu, 2018):

- -1 = a perfect negative correlation between ranks
- 0 = no correlation between ranks
- 0 to 0.19 = very weak
- 0.2 to 0.39 = weak
- 0.4 to 0.59 = moderate
- 0.6 to 0.79 = strong
- 0.8 to 1.0 = very strong
- +1 = a perfect positive correlation between ranks

3.5.2 Dispute Risk Index (DRI)

The analysis for the Dispute Risk Index (DRI) was carried out in a stepwise manner to combine the perceived impact of each dispute driver with its likelihood of occurrence in water supply projects.

The impact values i.e RII_i was converted into proportional weights for index construction, the RII of each factor was normalized by dividing it by the sum of the RII values for all 36 factors. The normalized impact weight for factor i was therefore calculated as:

$$NRII_i = \frac{RII_i}{\sum_{j=1}^{36} RII_j}$$

This normalization ensured that the total weight across all factors summed to 1.0 and allowed each factor to contribute proportionally to the final index according to its relative importance.

The second stage of analysis focused on the likelihood of occurrence of each dispute driver. For this purpose, the results from the questionnaire were shared with six highly experienced professionals, and their judgments were used to assess how frequently each factor was likely to occur in water supply projects. These likelihood ratings were also analyzed on a five-point scale and converted into an index using the same RII approach. Thus, the frequency or likelihood score for factor i was calculated as:

$$f_i = \frac{\sum L_i}{A \times n}$$

Where,

- L_i is the total likelihood score assigned to factor i,
- $A = 5$ is the maximum possible score, and
- $n = 6$ is the number of expert respondents.

In this way, f_i ranged from 0 to 1, with higher values indicating greater likelihood of occurrence.

After obtaining both the normalized impact weight and the likelihood score, the factor-level Dispute Risk Index was calculated by multiplying the two components:

$$DRI_i = NRII_i \times f_i$$

This formula shows that the dispute risk contribution of each factor depended on both its relative impact and its probability of occurrence. A factor received a higher DRI contribution when it was judged to be both highly influential in causing disputes and more likely to occur in practice.

The overall Dispute Risk Index for the study was then obtained by summing the factor-level DRI values for all 36 dispute drivers:

$$DRI = \sum_{i=1}^{36} (NRII_i \times f_i)$$

To express the result in percentage form for easier interpretation, the final value was multiplied by 100:

$$DRI(\%) = \left[\sum_{i=1}^{36} (NRII_i \times f_i)\right] \times 100$$

Accordingly, the DRI ranged from 0 to 100, where a higher value indicated greater overall dispute potential across the project lifecycle. In addition to calculating the aggregate index, the individual DRI_ivalues were also used to rank the dispute drivers from highest to lowest priority. This ranking provided a practical basis for identifying the most critical factors requiring early monitoring and preventive intervention.

3.5.3 FIDIC Procedure and Checklist

A detailed analysis was carried out of the clauses in the FIDIC MDB Harmonised Conditions of Contract for Construction (June 2010 edition) that were relevant to the highest-ranked dispute drivers identified through the earlier stages of analysis. The purpose of this stage was not only to identify the contractual provisions associated with the major dispute drivers, but also to understand how those provisions could be used in practice to reduce the likelihood of disputes escalating.

Each top-ranked factor was therefore systematically mapped against the relevant FIDIC clauses, with particular attention to the contractual causes of dispute, the actions required from the parties, and the likely consequences of non-compliance. This helped establish a clear procedural link between dispute-prone project conditions and the contractual mechanisms available for their management.

The analysis went beyond simple clause identification by examining how the relevant FIDIC provisions operate as a process of risk governance and early dispute prevention. This was important because disputes in water supply projects often do not arise suddenly; rather, they develop from unmanaged issues that are not addressed at the appropriate stage of the project. By mapping the major dispute drivers to the corresponding contractual responses, the study created a more practical understanding of how FIDIC procedures can support early intervention before disagreements harden into formal disputes.

Based on this clause-mapping exercise, a stage-wise yes/no checklist was developed for the pre-construction, construction, and post-construction phases of water supply projects. The checklist was designed as a practical tool to help project stakeholders monitor whether the key procedural and contractual actions required under the FIDIC MDB Harmonised Book had been addressed at the right time. Each checklist item was derived from the top ranked dispute drivers and the related FIDIC procedures, so that the final tool directly reflected both the empirical findings of the study and the contractual framework governing project delivery. After the preparation, the checklist was validated by three senior professionals from the relevant sector. Few changes were made after the comments and feedback. In this way, the checklist served as an operational early warning tool that could support project teams in improving compliance, strengthening contract administration, and promoting proactive dispute prevention throughout the project lifecycle.

3.6 Reliability of the Data

To check the internal consistency of the ratings, Cronbach's Alpha was also calculated for both the questionnaire data and the expert likelihood ratings. The reliability coefficient was determined using:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_T^2}\right)$$

Where,

- k is the number of items,
- σ_i^2 is the variance of each item, and
- σ_T^2 is the variance of the total score.

This step was important to confirm that the set of dispute drivers used in the analysis showed acceptable internal consistency before constructing the final DRI.

Table 3-1: Cronbach's Alpha Value

Cronbach's alpha (α)	**Internal Consistency**
0.9 -1	Excellent
0.8 – 0.89	Good
0.7 – 0.79	Acceptable
0.6 – 0.69	Questionable
0.5 – 0.59	Poor
A < 0.49	Unacceptable

Source: Adopted from Contractor's Performance Appraisal System in the Malaysian Construction Industry: Current Practice, Perception and Understanding by Zahreen, K., Arof, M., Ismail, S., & Saleh, A. L. (2018). In International Journal of Engineering & Technology (Vol. 7, Issue 3). (Zahreen et al., 2018)

Questionnaire reliability was tested through Cronbach's alpha, a common measure of internal consistency. The resulting coefficient was 0.962, which indicates excellent reliability. In practical terms, the items showed a high level of consistency in measuring the intended constructs.

3.7 Research Matrix

The research matrix, shown below in Table 3-2, summarizes the whole research analysis process:

Table 3-2: Research Matrix

S.N.	Objective	Research Question	Data Required	Sources of Data	Data Analysis	Expected Outcome
1.	To identify and rank the dispute drivers arising across the pre-construction, construction, and post-construction phases of water supply projects in Nepal, based on their perceived impact on dispute occurrence	What are the major dispute drivers arising across the pre-construction, construction, and post-construction phases of water supply projects in Nepal, and what is their relative level of impact on dispute occurrence?	List of dispute drivers, phase-wise classification of dispute causes, stakeholder ratings on dispute impact	Literature review, Expert review, questionnaire surveys	Expert validation, Likert scale analysis, Relative Importance Index (RII), ranking by stage and by overall project lifecycle, Spearman's rank correlation	Ranked dispute drivers under pre-construction, construction, and post-construction stages and as a whole
2.	To develop a Dispute Risk Index (DRI) that integrates the impact and likelihood of each dispute driver into a composite	How can the identified dispute drivers be quantified by integrating their perceived impact and likelihood of occurrence into a	Impact ratings of dispute drivers, frequency of each factor, priority	Questionnaire survey, in-depth interview, findings from Objective 1	RII, normalization of weights, likelihood scoring, weighted index calculation for DRI	Developed Dispute Risk Index (DRI) showing the significance and

S.N.	Objective	Research Question	Data Required	Sources of Data	Data Analysis	Expected Outcome
	measure of dispute exposure across the project lifecycle.	Dispute Risk Index (DRI) for water supply projects?	drivers identified from Objective 1			dispute potential of identified drivers
3.	To examine the FIDIC MDB Harmonised Contract provisions associated with the highest-ranked dispute drivers and to formulate it into a practical, stage-wise checklist as a proactive tool for early dispute prevention	Which provisions of the FIDIC MDB Harmonised Contract are associated with the highest-ranked dispute drivers, and how can these provisions be translated into a practical, stage-wise checklist as a proactive tool for early dispute prevention?	Top-ranked dispute drivers, relevant FIDIC clauses and procedures, expert inputs for preventive actions	Objective 1, FIDIC MDB Harmonised Contract Form, expert validation	Content analysis, clause mapping, expert validation	Mapped FIDIC provisions linked to key dispute drivers and a checklist/tool for early dispute prevention

CHAPTER 4: RESULTS AND DISCUSSION

This chapter presents the findings generated from the questionnaire survey and interprets them in light of the study objectives. A total of 68 valid responses were collected from key stakeholders across the water supply sector, including client, contractor, and consultant representatives. The respondent group brought substantial professional depth to the study, with nearly all participants having direct sector experience and a large proportion having more than a decade of practical involvement in water supply projects. The data were analyzed using the methods set out in the previous chapter, and the results were further strengthened through expert validation and comparison with case-study evidence from actual projects. Taken together, this provides both empirical and practical grounding for the findings presented in this chapter.

4.1 Ranked Dispute Drivers across the Life cycle of Water Supply Projects

The dispute drivers identified were ranked using the Relative Importance Index (RII) to determine the extent to which respondents perceived each factor to contribute to disputes in water supply projects. In this analysis, a higher RII value indicates a stronger perceived influence of a factor on dispute occurrence. The results showed that dispute risk was not confined to one project phase; rather, it extended across the pre-construction, construction, and post-construction stages. This confirms that disputes in water supply projects should be understood as a lifecycle issue, not as an isolated contractual event arising only after work on site has begun.

4.1.1 Pre-construction Stage

Table 4-1 shows that the most significant dispute driver at the pre-construction stage was delayed site handover / land acquisition / resettlement / compensation disagreement (RII = 0.779). This finding is highly important because it shows that disputes in Nepal's water supply projects often begin before productive work starts. Site access, land acquisition, and compensation are not merely administrative preliminaries; they directly shape whether a contractor can mobilize, sequence works, and perform in accordance with the contract. When these issues remain unresolved, delay, frustration, and contractual tension are almost inevitable.

The second-ranked factor was contractor's capacity (RII = 0.753). This indicates that dispute exposure at the pre-construction stage is also strongly influenced by whether the selected contractor has the technical, managerial, and organizational ability to undertake the works effectively. In practice, limited contractor capacity can create early stress in the project through slow mobilization, weak planning, poor resource deployment, and delayed performance, all of which later feed into disputes over time, quality, and responsibility.

The third-ranked factor, ambiguous or contradictory contract documents (RII = 0.735), shows that disputes are often embedded in the contract itself before construction begins. When drawings, specifications, BoQs, and other contract documents are unclear or inconsistent, disagreement arises not because one party has necessarily acted improperly, but because the contractual basis for performance is itself uncertain. This makes document clarity a central preventive issue, not simply a drafting concern.

Two factors shared the next highest position: inadequate process and milestone design and unclear financing structure and institutional responsibility (both RII = 0.729). These findings show that pre-construction dispute risk is driven not only by technical preparation, but also by governance and organizational readiness. Weak milestone planning creates unrealistic expectations from the start, while unclear financing arrangements and institutional responsibilities make decision-making slower, less coordinated, and more vulnerable to conflict. In other words, disputes are often seeded when projects begin without a fully stable administrative foundation.

Table 4-1: Ranking of dispute drivers during Pre-Construction Stage based on RII

Rank	Dispute Driver	RII
1	Delayed site handover / land acquisition / resettlement / Compensation Disagreement	0.779
2	Contractor's Capacity	0.753
3	Ambiguous or contradictory contract documents	0.735
4	Inadequate process and milestone design	0.729
5	Unclear financing structure and institutional responsibility	0.729
6	Unclear Engineer authority / slow Employer decision-making	0.715
7	Inadequate geotechnical/topographic/site investigation	0.706

Rank	Dispute Driver	RII
8	Environmental/social approvals not ready	0.703
9	Incomplete/late design drawings & specifications	0.700
10	BoQ/quantity errors and measurement baseline weakness	0.676
11	Unrealistic baseline programme	0.653
12	Poor mapping of existing utilities and assets	0.632

The pre-construction findings provide compelling evidence that dispute risk in Nepal's water supply projects is fundamentally a function of project readiness rather than construction-phase complexity. The concentration of high-ranked dispute drivers at this stage, spanning land availability, contract clarity, site investigation quality, regulatory approvals, financing certainty, and institutional decision-making, collectively points to a systemic pattern in which projects are mobilized before the foundational conditions for conflict-free execution have been adequately secured.

This pattern is not incidental. In the context of Nepal's water supply sector, pre-construction weaknesses are structurally embedded in how projects are prepared and sanctioned. Land acquisition disputes, for instance, frequently arise because right-of-way clearances are treated as administrative formalities rather than critical path activities, resulting in contractor mobilization onto sites where access remains legally or physically contested. Similarly, ambiguities in contract documentation, scope gaps, undefined responsibilities, and poorly specified technical standards, create interpretive conflicts that surface during execution but originate entirely in the pre-tender phase. These findings are consistent with broader infrastructure literature, which identifies front-end loading and preparation quality as among the strongest predictors of project dispute frequency (Semple et al., 1994).

The Spearman correlation analysis reveals significant perceptual differences among stakeholder groups in recognizing pre-construction dispute risks. As shown in Table 4-2, twelve dispute drivers were ranked by three stakeholder groups, yielding correlation coefficients of $\rho = 0.94$ (consultant), $\rho = 0.81$ (client), and $\rho = 0.23$ (contractor). The consultant's near-perfect alignment reflects their central role in design, specifications, and pre-tender documentation, while the client's strong correlation is consistent with their authority over site handover, approvals, and financing. The contractor's weak correlation, however, indicates a tendency to underweight pre-construction governance risks, as their formal engagement begins only after key design and procurement decisions have been made.

This perceptual divergence constitutes a governance concern in its own right. When contractors do not share the same early-warning sensitivity as clients and consultants, they are less likely to flag documentation ambiguities during tender review or raise concerns before contract award inadvertently reinforcing the preconditions for dispute escalation. Closing this gap through structured pre-construction risk briefings, joint readiness assessments, and early contractor involvement in design review represents an underutilized yet practical dispute prevention mechanism.

Taken together, the pre-construction findings establish a clear and actionable conclusion: the most upstream and therefore most cost-effective opportunity for dispute prevention in Nepal's water supply projects lies in strengthening project readiness before mobilization. Interventions targeting earlier land resolution, more rigorous feasibility and site investigations, unambiguous contract documentation, secured regulatory approvals, and coordinated institutional decision-making would collectively address the root conditions from which the majority of pre-construction disputes emerge. These are not novel recommendations in the abstract, but the RII analysis grounds them specifically in the Nepali water supply context, providing an evidence base for prioritizing governance reforms at the project preparation stage.

Table 4-2: Spearman's Rank Correlation Analysis of Stakeholder Rankings for Pre-Construction Stage Dispute Drivers

Description	**Client**		**Consultant**		**Contractor**		**Overall**		**Rank diff.**	**d1²**	**Rank diff.**	**d2²**	**Rank diff.**	**d3²**
	RII Score	**Rank A**	**RII Score**	**Rank B**	**RII Score**	**Rank C**	**RII Score**	**Rank Y**	**Y-A**	**$(Y-A)^2$**	**Y-B**	**$(Y-B)^2$**	**Y-C**	**$(Y-C)^2$**
Incomplete/late design drawings & specifications	0.124	7	0.515	9	0.062	2	0.700	9	2	4	0	0	7	49
Ambiguous or contradictory contract documents	0.126	5	0.544	3	0.065	1	0.735	3	-2	4	0	0	2	4
BoQ/quantity errors and measurement baseline weakness	0.115	9	0.503	10	0.059	3	0.676	10	1	1	0	0	7	49
Inadequate process and milestone design	0.126	6	0.544	4	0.059	4	0.729	4	-2	4	0	0	0	0
Inadequate geotechnical/topographic/site investigation	0.115	10	0.538	5	0.053	7	0.706	7	-3	9	2	4	0	0
Poor mapping of existing utilities and assets	0.115	11	0.474	12	0.044	12	0.632	12	1	1	0	0	0	0
Delayed site handover/ land	0.135	4	0.594	1	0.050	10	0.779	1	-3	9	0	0	-9	81

Description	**Client**		**Consultant**		**Contractor**		**Overall**		**Rank diff.**	**d1²**	**Rank diff.**	**d2²**	**Rank diff.**	**d3²**
	RII Score	**Rank A**	**RII Score**	**Rank B**	**RII Score**	**Rank C**	**RII Score**	**Rank Y**	**Y-A**	**$(Y\text{-}A)^2$**	**Y-B**	**$(Y\text{-}B)^2$**	**Y-C**	**$(Y\text{-}C)^2$**
acquisition/ resettlement/ Compensation Disagreement														
Environmental/social approvals not ready	0.118	8	0.535	6	0.050	11	0.703	8	0	0	2	4	-3	9
Unrealistic baseline programme	0.115	12	0.485	11	0.053	8	0.653	11	-1	1	0	0	3	9
Contractor's Capacity	0.141	1	0.553	2	0.059	5	0.753	2	1	1	0	0	-3	9
Unclear Engineer authority / slow Employer decision-making	0.138	2	0.524	8	0.053	9	0.715	6	4	16	-2	4	-3	9
Unclear financing structure and institutional responsibility	0.138	3	0.532	7	0.059	6	0.729	5	2	4	-2	4	-1	1
									$\sum d1^2$	**54**	**$\sum d2^2$**	**16**	**$\sum d3^2$**	**220**

4.1.2 Construction Stage

Table 4-3 shows that the most significant dispute driver during construction was high volume of variations / change orders (scope growth) (RII = 0.776). This finding suggests that once work begins, dispute risk becomes highly sensitive to scope instability. Variations may arise from design development, site realities, stakeholder demands, or weak pre-construction preparation, but in all cases, they create pressure on time, cost, sequencing, and valuation. A high number of variations is therefore not only a sign of design or scope change; it is also a direct indicator of heightened dispute exposure.

The second-ranked factor was delays caused by authorities (RII = 0.744). This shows that many major dispute triggers remain outside the immediate control of the core contract parties. Road authorities, utility agencies, local government bodies, environmental regulators, and similar institutions can delay access, approvals, and execution. This makes construction-stage disputes in water supply projects partly an issue of external coordination, not only contract administration between Employer, Engineer, and Contractor.

The third-ranked factor, EOT, concurrent delay, and acceleration disagreements (RII = 0.735), confirms that time-related entitlement remains one of the central areas of dispute during implementation. This is especially significant because delay in construction is rarely linear or attributable to a single cause. Where multiple delays overlap, and where responsibility is contested, disagreement over EOT entitlement becomes highly likely. The ranking of this factor shows that time management in water supply projects is not just an operational issue; it is one of the main pathways through which disputes escalate.

The next two factors, delayed payment, IPC certification and cash flow stress (RII = 0.726) and quality non-conformities and failed tests (RII = 0.724), highlight the dual commercial and technical character of dispute risk during construction. Payment delays create direct financial strain on contractors and often worsen already difficult project relationships. Quality failures, on the other hand, raise questions of performance, compliance, remedial work, and liability. Their high ranking shows that disputes are shaped both by whether work is paid for properly and by whether it meets required standards.

Table 4-3: Ranking of dispute drivers during Construction Stage based on RII

Rank	Dispute Driver	RII
1	High volume of Variations/change orders (scope growth)	0.776
2	Delays caused by Authorities	0.744
3	EOT, concurrent delay, and acceleration disagreements	0.735
4	Delayed payment, IPC Certification and Cash flow Stress	0.726
5	Quality non-conformities and failed tests	0.724
6	Late instructions/drawings/clarifications during construction	0.709
7	Utility relocation delays and third-party interface failures	0.700
8	Delayed Engineer approvals	0.694
9	Late notices, weak records, and claims administration failures	0.694
10	Unforeseeable physical conditions	0.653
11	Disputes over valuation	0.653
12	MDB audit/integrity compliance issues	0.650
13	Supply chain and customs delays	0.624

The during-construction stage emerges as the most active and operationally intense phase of dispute formation in Nepal's water supply projects. This is the stage where weaknesses embedded in project preparation are no longer latent- they become visible, contractually consequential, and increasingly difficult to contain. Scope instability, approval delays, time entitlement disputes, payment failures, quality non-compliance, and administrative gaps all converge during implementation, collectively making construction the most dispute-prone phase across the entire project lifecycle.

As shown in Table 4-4, thirteen dispute drivers were assessed, yielding Spearman correlation coefficients of $\rho = 0.962$ (consultant), $\rho = 0.797$ (client), and $\rho = 0.154$ (contractor). The consultant's coefficient reached its highest value across all three stages, reflecting their broadest situational awareness in the Engineer's role spanning variation management, EOT adjudication, IPC certification, and claims administration. The client's strong and consistent correlation reinforces their sustained stake in payment flows and approval authorities throughout construction.

The contractor's markedly weak correlation reveals a fundamentally different frame of reference rather than a lack of awareness. Contractors ranked high-variation volumes and delayed IPC payments significantly above the overall consensus, as these directly threaten cash flow and site operations. This financially driven prioritization means contractors tend to focus on immediate operational symptoms rather than the broader contractual and governance risks that anchor the composite ranking.

Effective dispute prevention at the construction stage requires proactive, disciplined, and consistent application of FIDIC's notice, determination, and claims administration provisions as an embedded daily practice- not as a reactive measure deployed only after disputes have already crystallized. When these provisions are treated as procedural formalities rather than active risk management tools, the contractual conditions for dispute escalation are inadvertently preserved. The findings therefore suggest that governance interventions at this stage should focus not only on improving documentation and variation control systems, but also on building a shared understanding among all three parties of how FIDIC's procedural framework functions as a dispute prevention mechanism in practice. Without this procedural discipline and alignment, construction-stage drivers will continue converting pre-construction weaknesses into formal contractual conflict, sustaining the dispute-intensive conditions that characterize Nepal's water supply sector.

Table 4-4: Spearman's Rank Correlation Analysis of Stakeholder Rankings for During-Construction Stage Dispute Drivers

Description	**Client**		**Consultant**		**Contractor**		**Overall**		**Rank diff.**	**d1^2**	**Rank diff.**	**d2^2**	**Rank diff.**	**d3^2**
	RII Score	**Rank A**	**RII Score**	**Rank B**	**RII Score**	**Rank C**	**RII Score**	**Rank Y**	**Y-A**	**(Y-A)^2**	**Y-B**	**(Y-B)^2**	**Y-C**	**(Y-C)^2**
Unforeseeable physical conditions	0.106	11	0.494	10	0.053	9	0.653	10	-1	1	0	0	1	1
Utility relocation delays and third-party interface failures	0.118	8	0.526	8	0.056	4	0.700	7	-1	1	-1	1	3	9
Delayed Engineer approvals	0.124	4	0.515	9	0.056	5	0.694	8	4	16	-1	1	3	9
Late instructions/drawings /clarifications during construction	0.121	7	0.529	7	0.059	2	0.709	6	-1	1	-1	1	4	16
High volume of Variations/change orders (scope growth)	0.138	1	0.585	1	0.053	10	0.776	1	0	0	0	0	-9	81
Delays caused by authorities	0.124	5	0.565	2	0.056	6	0.744	2	-3	9	0	0	-4	16
Supply chain and customs delays	0.115	9	0.459	13	0.050	13	0.624	13	4	16	0	0	0	0

Description	Client		Consultant		Contractor		Overall		Rank diff.	$d1^2$	Rank diff.	$d2^2$	Rank diff.	$d3^2$
	RII Score	Rank A	RII Score	Rank B	RII Score	Rank C	RII Score	Rank Y	Y-A	$(Y\text{-}A)^2$	Y-B	$(Y\text{-}B)^2$	Y-C	$(Y\text{-}C)^2$
Delayed payment, IPC Certification and Cash flow Stress	0.126	3	0.547	4	0.053	11	0.726	4	1	1	0	0	-7	49
Disputes over valuation	0.109	10	0.491	12	0.053	12	0.653	11	1	1	-1	1	-1	1
EOT, concurrent delay, and acceleration disagreements	0.124	6	0.559	3	0.053	8	0.735	3	-3	9	0	0	-5	25
Quality non-conformities and failed tests	0.129	2	0.532	5	0.062	1	0.724	5	3	9	0	0	4	16
MDB audit/integrity compliance issues	0.097	13	0.494	11	0.059	3	0.650	12	-1	1	1	1	9	81
Late notices, weak records, and claims administration failures	0.106	12	0.532	6	0.056	7	0.694	9	-3	9	3	9	2	4
									$\sum d1^2$	**74**	$\sum d2^2$	**14**	$\sum d3^2$	**308**

4.1.3 Post-construction Stage

Table 4-5 shows that the highest-ranked dispute driver at the post-construction stage was post-commissioning drinking-water quality non-compliance (RII = 0.688). This is a particularly important finding because it highlights the service-sensitive nature of water supply projects. Unlike many other forms of infrastructure, a water supply system is not considered successful simply because construction is finished. It must also perform operationally and meet required water quality standards. When that does not happen, disputes continue beyond physical completion.

The second-ranked factor was defects during the Defects Notification Period (RII = 0.671). This indicates that the completion of construction does not bring dispute risk to an end. Defects discovered after handover can reopen questions of workmanship, responsibility, rectification, time, and cost. In practical terms, this finding shows that post-construction dispute prevention depends not only on closing the contract properly, but also on managing post-completion obligations actively and fairly.

The third-ranked factor, ineffective use of Dispute Board / amicable settlement (RII = 0.659), is especially significant because it points to a governance failure rather than a technical or commercial problem. It shows that when the available dispute-avoidance and early-resolution mechanisms are not used effectively, tensions that might otherwise have been resolved can remain unresolved for longer and become more difficult to settle later. This gives strong support to the study's wider emphasis on proactive dispute governance.

The next factors, disputes over commissioning and performance test criteria (RII = 0.647) and as-built drawings, asset data, and O&M manuals incomplete or rejected (RII = 0.647), show that the handover stage is not merely administrative. It is a technically and contractually sensitive stage in which operational readiness, test standards, documentation quality, and transfer obligations must all align. Where they do not, disputes can persist even after the physical works are substantially complete.

Table 4-5: Ranking of dispute drivers during Post- Construction Stage based on RII

Rank	Dispute Driver	RII
1	Post-commissioning drinking-water quality non-compliance	0.688
2	Defects during Defects Notification Period	0.671
3	Ineffective use of Dispute Board/amicable settlement	0.659
4	Disputes over commissioning and performance test criteria	0.647
5	As-built drawings, asset data, and O&M manuals incomplete or rejected	0.647
6	Final measurement, final statement and close-out disputes	0.641
7	Delayed Taking-Over due to incomplete punch list/ tests/ documentation	0.635
8	Supplier warranty and interface disputes	0.632
9	Operator training/operational readiness gaps	0.629
10	Extension of DNP and delayed Performance Certificate	0.615
11	Restricted access/coordination for defect rectification	0.603

The post-construction findings establish that dispute exposure in Nepal's water supply projects does not conclude with the completion of physical works. While dispute risk at this stage is comparatively lower than in earlier phases, it remains significant challenging the common assumption that dispute exposure naturally diminishes once construction is complete. The ranking pattern indicates that disputes remain active when system performance, defect correction, documentation, and close-out obligations are inadequately managed, underscoring that the transition from construction to operation represents a distinctly vulnerable governance moment.

As shown in Table 4-6, eleven dispute drivers were evaluated, yielding Spearman correlation coefficients of $\rho = 0.791$ (client), $\rho = 0.755$ (consultant), and $\rho = 0.200$ (contractor). A notable shift occurs at this stage: the consultant's correlation drops relative to the client's, and the gap between the two narrows considerably compared to earlier stages. This realignment is consistent with the nature of post-construction activities, taking-over, final measurement, and O&M handover, which engage client-side and employer institutional actors more directly than the Engineer. The consultant's slightly lower alignment likely reflects ambiguity over the boundaries of their post-construction authority under FIDIC, particularly concerning performance certificates and final statements. The contractor's weak correlation, consistent across all three stages, reflects their tendency to prioritize defect liability exposure and warranty disputes over the institutional and documentation-related concerns that dominate the overall ranking.

These findings carry a clear practical implication. Dispute prevention at the post-construction stage depends not only on satisfying technical and contractual obligations at Taking-Over, but on the proactive application of FIDIC's dispute-avoidance provisions specifically designed for this period. Without such procedural discipline, accumulated tensions from earlier stages persist and intensify, ultimately compromising the operational performance and service-delivery outcomes that these projects are built to achieve.

Table 4-6: Spearman's Rank Correlation Analysis of Stakeholder Rankings for Post-Construction Stage Dispute Drivers

Description	**Client**		**Consultant**		**Contractor**		**Overall**		**Rank diff.**	**d1^2**	**Rank diff.**	**d2^2**	**Rank diff.**	**d3^2**
	RII Score	**Rank A**	**RII Score**	**Rank B**	**RII Score**	**Rank C**	**RII Score**	**Rank Y**	**Y-A**	**(Y-A)^2**	**Y-B**	**(Y-B)^2**	**Y-C**	**(Y-C)^2**
Delayed Taking-Over due to incomplete punch list/ tests/ documentation	0.112	7	0.468	9	0.056	1	0.635	7	0	0	-2	4	6	36
Disputes over commissioning and performance test criteria	0.118	1	0.474	7	0.056	2	0.647	4	3	9	-3	9	2	4
Defects during Defects Notification Period	0.118	2	0.500	2	0.053	4	0.671	2	0	0	0	0	-2	4
Restricted access/coordination for defect rectification	0.094	11	0.459	11	0.050	5	0.603	11	0	0	0	0	6	36
Extension of DNP and delayed Performance Certificate	0.100	9	0.465	10	0.050	6	0.615	10	1	1	0	0	4	16

Description	Client		Consultant		Contractor		Overall		Rank diff.	$d1^2$	Rank diff.	$d2^2$	Rank diff.	$d3^2$
	RII Score	**Rank A**	**RII Score**	**Rank B**	**RII Score**	**Rank C**	**RII Score**	**Rank Y**	**Y-A**	$(Y-A)^2$	**Y-B**	$(Y-B)^2$	**Y-C**	$(Y-C)^2$
Final measurement, final statement and close-out disagreement	0.118	3	0.474	8	0.050	7	0.641	6	3	9	-2	4	-1	1
As-built drawings, asset data, and O&M manuals incomplete or rejected	0.115	4	0.488	3	0.044	10	0.647	5	1	1	2	4	-5	25
Post-commissioning drinking-water quality non-compliance	0.115	5	0.524	1	0.050	8	0.688	1	-4	16	0	0	-7	49
Operator training/ operational readiness gaps	0.097	10	0.488	4	0.044	11	0.629	9	-1	1	5	25	-2	4
Supplier warranty and interface disputes	0.103	8	0.479	6	0.050	9	0.632	8	0	0	2	4	-1	1
Ineffective use of Dispute Board/ amicable settlement	0.115	6	0.488	5	0.056	3	0.659	3	-3	9	-2	4	0	0
									$\sum d1^2$	**46**	$\sum d2^2$	**54**	$\sum d3^2$	**176**

4.1.4 Overall Project Life cycle

The 15 most critical dispute drivers were identified through a two-stage process. The first ten were drawn from the highest-ranked factors produced by RII analysis across all three project stages considered together, while the remaining five were brought forward during expert validation by senior professionals who considered them too important to be omitted. The resulting list therefore reflects both the wider stakeholder view captured through the survey and the seasoned judgement of experienced practitioners.

Taken together, the final list of major drivers included:

1) Delayed site handover / land acquisition / resettlement / compensation disagreement
2) High volume of variations/change orders (scope growth)
3) Contractor's capacity
4) Delays caused by authorities
5) Ambiguous or contradictory contract documents
6) EOT, concurrent delay, and acceleration disagreements
7) Inadequate process and milestone design
8) Unclear financing structure and institutional responsibility
9) Delayed payment, IPC certification and cash flow stress
10) Quality non-conformities and failed tests
11) Late instructions/drawings/clarifications during construction
12) Environmental/social approvals not ready
13) Utility relocation delays and third-party interface failures
14) Post-commissioning drinking-water quality non-compliance
15) BoQ/ quantity errors and measurement baseline weakness

Taken together, the findings across the three stages reveal a clear pattern. The dispute profile changes as the project moves forward, but it does not reset. Instead, weaknesses in one stage tend to carry into the next. Pre-construction is dominated by readiness problems such as land access, contract ambiguity, incomplete investigation, weak planning, and unclear institutional responsibility. Construction is dominated by operational and contractual pressure points such as variations, approvals, delay entitlement, payment, quality, and records. Post-construction is dominated by performance, defects, documentation, and close-out. What this means is that dispute risk evolves across the lifecycle, but it remains connected throughout.

This is perhaps the most important overall finding of the RII analysis. Readiness failures at the beginning of the project do not remain confined to the pre-construction stage. They later reappear as variations, EOT claims, authority delays, payment tension, and quality disputes during construction. In turn, unresolved technical and administrative issues during construction continue into post-construction through failed tests, defects, documentation gaps, and commissioning disputes. The results therefore show that disputes in Nepal's water supply projects are cumulative in nature. They develop through a chain of unresolved issues rather than through one isolated event.

The overall findings also justify the selection of the priority drivers for analysis. RII rankings reflects the fact that RII directly captured the collective judgement of a broad stakeholder sample regarding how strongly each factor contributes to dispute occurrence, making it the most appropriate basis for identifying the conditions that most warrant attention across the study as a whole.

4.1.5 Validation of Ranked Dispute Drivers against Case Study Evidence

To test whether the dispute drivers emerging from the RII analysis reflected real-world conditions rather than perception alone, six water supply projects in Nepal were selected for case-based validation. A criterion-based purposive sampling approach was adopted, as this method is best suited to qualitative case-based research where cases are chosen for their information richness and relevance to the study objectives rather than for statistical representativeness (Seawnght & Gerring, 2008). Case selection followed established validity principles requiring that selection criteria be defined in advance and that external validity be achieved through analytical, rather than statistical, generalization (Quintão et al., 2020).

The six projects, the Melamchi Water Supply Project, Kavre Valley Integrated Water Supply Project, Urban Water Supply and Sanitation (Sector) Project, Kathmandu Valley Water Supply Improvement Project, Salu-Sunarpani Lift Water Supply Project (Ramechhap), and Pathivara Drinking Water Project (Taplejung), were deliberately selected to offer variation across scale, geography, institutional arrangement, and implementation complexity, while remaining comparable in their contractual and funding context. Most were donor-financed through the Asian Development Bank or similar multilateral partners and administered under the FIDIC MDB Harmonised Conditions of Contract, providing a broadly consistent institutional baseline against which dispute patterns could be meaningfully compared.

The Melamchi Water Supply Project, a large-scale inter-basin transfer scheme involving complex infrastructure and multiple contract packages, most comprehensively validates the ranked dispute drivers across all project stages. Land acquisition delays, contractor performance failures, high variation order volumes, authority-related stoppages, payment certification disputes, and post-commissioning water quality and documentation issues each correspond directly to the top-ranked drivers in their respective project phases.

The Kavre Valley Integrated Water Supply Project, a peri-urban scheme characterized by challenging subsurface conditions and multi-agency coordination requirements, corroborates pre-construction and construction-stage rankings, with disputes arising from inadequate geotechnical investigations, ambiguous contract documents, BoQ errors, and delayed Engineer approvals for submittals and method statements.

The Urban Water Supply and Sanitation (Sector) Project, a geographically dispersed multi-town programme implemented across numerous municipalities with varying institutional capacities, and the Kathmandu Valley Water Supply Improvement Project, an urban rehabilitation scheme executed within a densely built environment with complex utility interfaces and resettlement obligations, both reflect dispute patterns linked to land acquisition, social safeguard compliance, inter-agency coordination failures, urban construction disruptions, and post-commissioning technical performance issues consistent with the corresponding ranked drivers.

The Salu-Sunarpani Lift Water Supply Project in Ramechhap, a remote mid-hill scheme requiring lift infrastructure across difficult terrain, and the Pathivara Drinking Water Project in Taplejung, a high-altitude gravity scheme implemented in an ecologically sensitive corridor subject to forest clearance requirements, further validate environmental and social approval delays, third-party utility relocation failures, and post-commissioning water quality non-compliance as significant dispute sources, reinforcing their respective positions in the pre-construction, construction, and post-construction rankings.

The case validation matrix in Table 4-7 confirmed strong correspondence between the top-ranked dispute drivers and documented project experience. Issues including land acquisition difficulties, contractor capacity gaps, variation and scope-change disputes, authority-related delays, payment and certification problems, quality non-conformities, and post-commissioning failures recurred consistently across projects of differing scale, location, and institutional complexity. This recurrence confirms that the ranked drivers are grounded in actual dispute-generating conditions observed in Nepalese water supply projects, not merely in survey perceptions - an approach consistent with (Maemura et al., 2018), who similarly used multiple project cases to verify whether analytically identified causal factors were observable in practice.

Taken together, the case validation strengthens the credibility and applied relevance of the empirical findings, and provides a reliable foundation for constructing the Dispute Risk Index, mapping FIDIC clause-level responses, and developing the stage-wise early-warning checklist.

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Table 4-7: Case Validation Matrix

S.N.	Priority Dispute Driver	Relevant project(s) showing comparable evidence	Nature of validation from case evidence
1	Delayed site handover/ land acquisition/ resettlement/ compensation disagreement	Melamchi Water Supply Project; Urban Water Supply and Sanitation (Sector) Project (Development Bank, 2024); Kathmandu Valley Water Supply Improvement Project (KUKL, 2017)	Land acquisition, compensation, resettlement, and site-availability problems were repeatedly associated with implementation delays and dispute-prone conditions.
2	High volume of variations/ change orders (scope growth)	Melamchi Water Supply Project	Scope changes, design revisions, and access-related adjustments generated repeated variation-related contention.
3	Contractor's capacity	Melamchi Water Supply Project; Urban Water Supply and Sanitation (Sector) Project	Contractor performance weaknesses, slow progress, and broader implementation difficulties reflected capacity-related dispute exposure.
4	Delays caused by authorities	Melamchi Water Supply Project; Kathmandu Valley Water Supply Improvement Project	Approval delays, road access constraints, traffic management requirements, restoration obligations, and agency-related stoppages created execution-stage disputes.
5	Ambiguous or contradictory contract documents	Kavre Valley Integrated Water Supply Project	Ambiguities in contract documents and unclear documentation created disagreement over obligations and technical interpretation.
6	EOT, concurrent delay, and acceleration disagreements	Melamchi Water Supply Project	Authority-related and access-related delays translated into extension-of-time and concurrent-delay disputes.

S.N.	Priority Dispute Driver	Relevant project(s) showing comparable evidence	Nature of validation from case evidence
7	Inadequate process and milestone design	Urban Water Supply and Sanitation (Sector) Project; Kathmandu Valley Water Supply Improvement Project	Design and implementation shortcomings, together with performance and sequencing issues, reflected weaknesses in process and milestone planning.
8	Unclear financing structure and institutional responsibility	Urban Water Supply and Sanitation (Sector) Project	Multi-town, institutionally complex implementation conditions and inter-agency coordination weaknesses supported this factor.
9	Delayed payment, IPC certification, and cash flow stress	Melamchi Water Supply Project	Payment delays, certification issues, and cash-flow related tension were explicitly observed.
10	Quality non-conformities and failed tests	Melamchi Water Supply Project; Urban Water Supply and Sanitation (Sector) Project; Kathmandu Valley Water Supply Improvement Project	Technical non-compliance, commissioning/ performance concerns, leakage, breakage, and testing-related issues corresponded to this driver.
11	Late instructions/ drawings/ clarifications during construction	Melamchi Water Supply Project; Kathmandu Valley Water Supply Improvement Project	Design revisions, changed access conditions, and execution-stage disruptions supported the presence of late clarification and instruction-related tension.
12	Environmental/ social approvals not ready	Salu-Sunarpani Lift Water Supply Project; Pathivara Drinking Water Project; Urban Water Supply and Sanitation (Sector) Project; Kathmandu Valley Water Supply Improvement Project	Forest clearance, safeguard compliance, consultation processes, and delayed environmental/social approvals created start-up and sequencing problems.

S.N.	Priority Dispute Driver	Relevant project(s) showing comparable evidence	Nature of validation from case evidence
13	Utility relocation delays and third-party interface failures	Melamchi Water Supply Project; Kathmandu Valley Water Supply Improvement Project; Salu-Sunarpani Lift Water Supply Project; Pathivara Drinking Water Project	Utility relocation and third-party coordination failures caused stoppages and implementation disruption.
14	Post-commissioning drinking-water quality non-compliance	Melamchi Water Supply Project; Salu-Sunarpani Lift Water Supply Project; Pathivara Drinking Water Project; Kathmandu Valley Water Supply Improvement Project	Water-quality and post-commissioning performance concerns were evident and remained dispute-sensitive after physical completion.
15	BoQ / quantity errors and measurement baseline weakness	Kavre Valley Integrated Water Supply Project	Unclear measurement baselines and related document ambiguity directly supported this factor.

4.2 Development of Dispute Risk Index (DRI)

The Dispute Risk Index was constructed by combining two dimensions of dispute exposure: the perceived importance of each risk factor, captured through the RII, and its likelihood of occurrence, derived from expert judgement. This dual-component structure moves the analysis beyond simple ranking, producing instead a composite measure of dispute exposure across the full project lifecycle. The DRI was calculated for all 36 dispute risk factors identified across the study, for the priority dispute drivers determined on the basis of their overall lifecycle RII rankings, and across the three project lifecycle stages- pre-construction, during-construction, and post-construction. All dispute risk factors spanning three stages were assessed using a five-point Likert scale, where higher scores reflect greater severity or more frequent occurrence. This scaling approach enables qualitative expert judgement to be systematically converted into quantitative values suitable for weighted index construction.

After computing the RII for each factor, the values were normalized to ensure proportional contribution across all 36 dispute risk factors. This was done by dividing each factor's RII by the combined total RII of all 36 factors, yielding a normalized weight for each factor. As a result, all weights collectively summed to 1, meaning that factors carrying higher relative importance exerted a correspondingly greater influence on the final index rather than being treated on equal footing.

A separate frequency assessment was then conducted to capture the likelihood dimension of dispute exposure. Six expert respondents rated each of the 36 factors in terms of how frequently they were expected to generate disputes in practice. Applying the same RII calculation logic to these frequency responses produced a frequency index value between 0 and 1 for each factor, where a higher value indicates a greater perceived likelihood of that factor contributing to disputes.

The Dispute Risk Index was then derived by multiplying each factor's normalized importance weight by its corresponding frequency index, summing these products across all 36 factors by using the formula:

$$DRI = \sum_{i=1}^{36} (NRII_i \times f_i)$$

Where, $NRII_i$ is the normalized importance weight of factor i and f_i is its frequency index.

The final result was then multiplied by 100 to express the DRI as a percentage. This computation ensured that the index reflected both the severity and the likelihood of each dispute risk factor simultaneously, giving greater combined weight to factors that were rated as both highly important and frequently occurring, rather than assigning uniform influence to all factors regardless of their perceived significance.

Applying this to all 36 dispute risk factors yielded an overall DRI of 61.03%.

Stage-wise and priority-driver DRI values were similarly computed and are presented in Table 4-8.

Table 4-8: DRI values under the different calculation bases

Basis of Calculation	No. of Factors Used	DRI (%)
All dispute drivers across the lifecycle	36	61.03
Priority dispute drivers	15	62.43
Pre-construction stage	12	64.41
Construction stage	13	59.93
Post-construction stage	11	58.38

The results showed that, when all 36 dispute drivers were analyzed together, the overall Dispute Risk Index (DRI) was found to be 61.03%. This shows that water supply projects in Nepal face a considerable level of dispute risk throughout the entire project lifecycle. It also suggests that the project management and contract administration practices currently followed in the sector create conditions in which disputes are quite likely to arise. Because the index was developed by combining both impact and likelihood, the result indicates that dispute risk in Nepal's water supply projects does not come from only a few isolated problems. Instead, it is created by the combined effect of many recurring issues spread across different project stages. This supports the study's central argument that disputes in water supply projects develop across the lifecycle and therefore need a preventive approach rather than a purely reactive one.

The DRI calculated using only the 15 priority drivers was 62.43%, slightly higher than the DRI for all 36 factors. This finding is important because it shows that dispute exposure is concentrated within a relatively smaller group of dominant drivers. In practical terms, this means that not all dispute drivers demand the same level of management attention. A limited number of recurring issues accounts for a disproportionately large share of dispute exposure. This supports the logic of prioritization and justifies focusing preventive effort on the most critical drivers.

The stage-wise DRI results provide a clearer understanding of how dispute risk is distributed across the project lifecycle. The pre-construction stage recorded the highest DRI at 64.41%, followed by the construction stage at 59.93%, and the post-construction stage at 58.38%. These values should be understood as separate stage-based indicators. Viewed in this way, the findings show that the pre-construction stage carried the greatest concentration of dispute vulnerability.

This is one of the most important findings of the study. The RII results showed that construction is the stage where dispute pressures become most visible and active. However, the DRI results show that pre-construction is the stage where dispute risk is most deeply embedded. In other words, construction may be the most dispute-active stage, but pre-construction is the most dispute-vulnerable stage. This distinction is analytically important. It means that many disputes that become visible during construction actually originate earlier, in unresolved access issues, weak investigations, incomplete designs, poor measurement baselines, unclear responsibilities, and weak front-end planning.

The construction-stage DRI of 59.93% showed that dispute exposure remained high during project implementation, although it was slightly lower than the pre-construction result. The main contributors at this stage were factors such as a high number of variation orders, disagreements over extension of time and concurrent delays, weak notice and record management, payment and certification problems, and delays caused by authorities. These findings suggest that the construction stage is where earlier weaknesses begin to turn into active contractual and operational tensions.

The post-construction DRI of 58.38%, although the lowest among the three stages, remains high enough to show that dispute exposure continues after substantial completion. This is a significant result because it challenges the common assumption that dispute risk decreases sharply once construction work is finished. In the post-construction stage, the main contributors included ineffective use of dispute resolution mechanisms, defects during the Defects Notification Period, post-commissioning water quality non-compliance, and incomplete or rejected as-built drawings, asset records, and operation and maintenance manuals. This pattern shows that dispute risk does not end with physical completion, but continues into handover, commissioning, defect correction, and early operation. It also indicates that post-construction dispute exposure is not entirely new in nature; rather, it is often the cumulative result of dispute drivers that have occurred during the earlier stages of the project and remained unresolved. In this sense, many post-construction disputes represent the delayed effects or continuing form of problems originating in pre-construction and construction, now surfacing through commissioning failures, defects, documentation gaps, and operational performance issues.

Another important finding was that the initial ranking of dispute drivers shifted to some extent when likelihood of occurrence was combined with impact in the DRI calculation. This means that a factor may appear very important in terms of impact, but it will not necessarily create the greatest overall risk unless it is also likely to happen repeatedly in practice. This shows the added value of the DRI, as it provides a more balanced understanding of dispute risk than impact ranking alone.

Overall, the DRI analysis produced three key findings. First, dispute exposure in Nepal's water supply projects was substantial across the full project lifecycle, with the overall DRI remaining above 60%. Second, the risk was more concentrated within a smaller group of dominant drivers, as shown by the slightly higher DRI for the top 15 factors. Third, the pre-construction stage emerged as the most critical stage in terms of dispute vulnerability, suggesting that weak preparation, inadequate technical investigation, uncertainty in measurement, and delays in decision-making create conditions that later develop into disputes. At the same time, the construction and post-construction results showed that dispute risk does not disappear after mobilization or completion. Instead, it continues in different forms through contract administration, payments, testing, project close-out, and operational performance.

Together, these findings reinforce the need for early warning, prioritization, and stage-specific prevention rather than a narrow focus on resolving disputes only after they have fully escalated.

4.3 Analysis of FIDIC Provisions and Development of Checklist

4.3.1 Analysis of FIDIC Provisions

The top 15 dispute drivers identified through RII were selected for the FIDIC clause mapping. This was appropriate because RII showed how strongly each factor was perceived to contribute to disputes, making it a direct and practical basis for linking major dispute triggers with the relevant contract provisions. Using the RII-based ranking also helped keep the analysis consistent with stakeholder views, the study objectives, and the development of the checklist for early dispute prevention.

The findings showed that the relevant provisions of the FIDIC MDB Harmonised Conditions of Contract address these dispute drivers through a connected set of procedures rather than through single, isolated clauses. In other words, the contract dealt with dispute-prone issues through an interrelated system of notices, decisions, approvals, claims, testing, payment procedures, and corrective actions. However, the analysis also showed that these procedures work as preventive tools only when they are applied early, consistently, and with adequate records. In practice, disputes often arise not because the contract has no relevant clause, but because the available procedures are activated too late, applied inconsistently, or supported by weak documentation.

The FIDIC MDB Harmonised Conditions of Contract (2010) contains comprehensive procedural provisions that can serve as preventive governance mechanisms against the top-ranked dispute drivers. However, a systematic review against the five highest-priority empirical drivers revealed a recurring pattern: while the contract addresses the legal consequences of dispute-triggering events with reasonable thoroughness, it lacks sufficient procedural specificity to guide parties through the conditions that routinely generate conflict in Nepal's water supply sector. This section presents the principal findings on these contractual gaps and their implications for dispute prevention.

A closer review of the five highest-priority drivers revealed a more specific pattern. For delayed site handover, land acquisition, and compensation disagreement, FIDIC provides entitlement pathways after delay has occurred, but it does not provide a sufficiently detailed pre-commencement mechanism for verifying site readiness, coordinating possession by work front, or escalating multi-agency land and compensation problems. This means that the contract responds to the consequences of access failure more clearly than it prevents the access failure itself.

For high volume of variations and scope growth, FIDIC provides the Engineer's authority to instruct variations and a procedure for dealing with them, but it does not contain a practical control mechanism for cumulative variation build-up, real-time cost impact review, or backlog management. In projects where scope change becomes frequent, this leaves too much room for unresolved time and cost tension to accumulate.

For contractor's capacity, the contract establishes general obligations, performance security, and remedies for serious default, but these mechanisms are mainly reactive. They become effective after underperformance is already visible. The contract does not provide a strong early-warning framework for monitoring emerging capacity problems before they become major performance disputes.

For EOT, concurrent delay, and acceleration disagreements, the contract provides a framework for programme management, delay damages, and extension of time. However, it does not prescribe a sufficiently clear methodology for undertaking structured delay analysis in complex cases. This creates room for competing interpretations and makes time-related disputes particularly difficult to resolve.

For post-commissioning drinking-water quality non-compliance, the contract contains testing and defects provisions, but it does not embed a sufficiently specific governance framework for water quality standards, sampling protocols, frequency of testing, or attribution of operational responsibility in the context of water supply systems. As a result, a sector-specific performance problem is addressed through more generic contractual mechanisms than the situation may require.

Taken together, these findings show that the FIDIC MDB Harmonised Book contains relevant preventive mechanisms, but that it does not always provide enough procedural specificity to deal with the recurring governance conditions found in Nepal's water supply sector. The contract provides rights, remedies, and administrative pathways, but several critical preventive details are left unspecified or are assumed to be managed elsewhere. This means that effective dispute prevention in Nepal's water supply projects requires both disciplined use of existing FIDIC procedures and targeted strengthening through appropriate Particular Conditions and project-specific administration practices.

A selection of the analyzed results is presented below for illustrative purposes. The full analytical outcomes are documented in Appendix 1.

1) Delayed Site handover/ Land Acquisition/ Resettlement and Compensation Disagreement

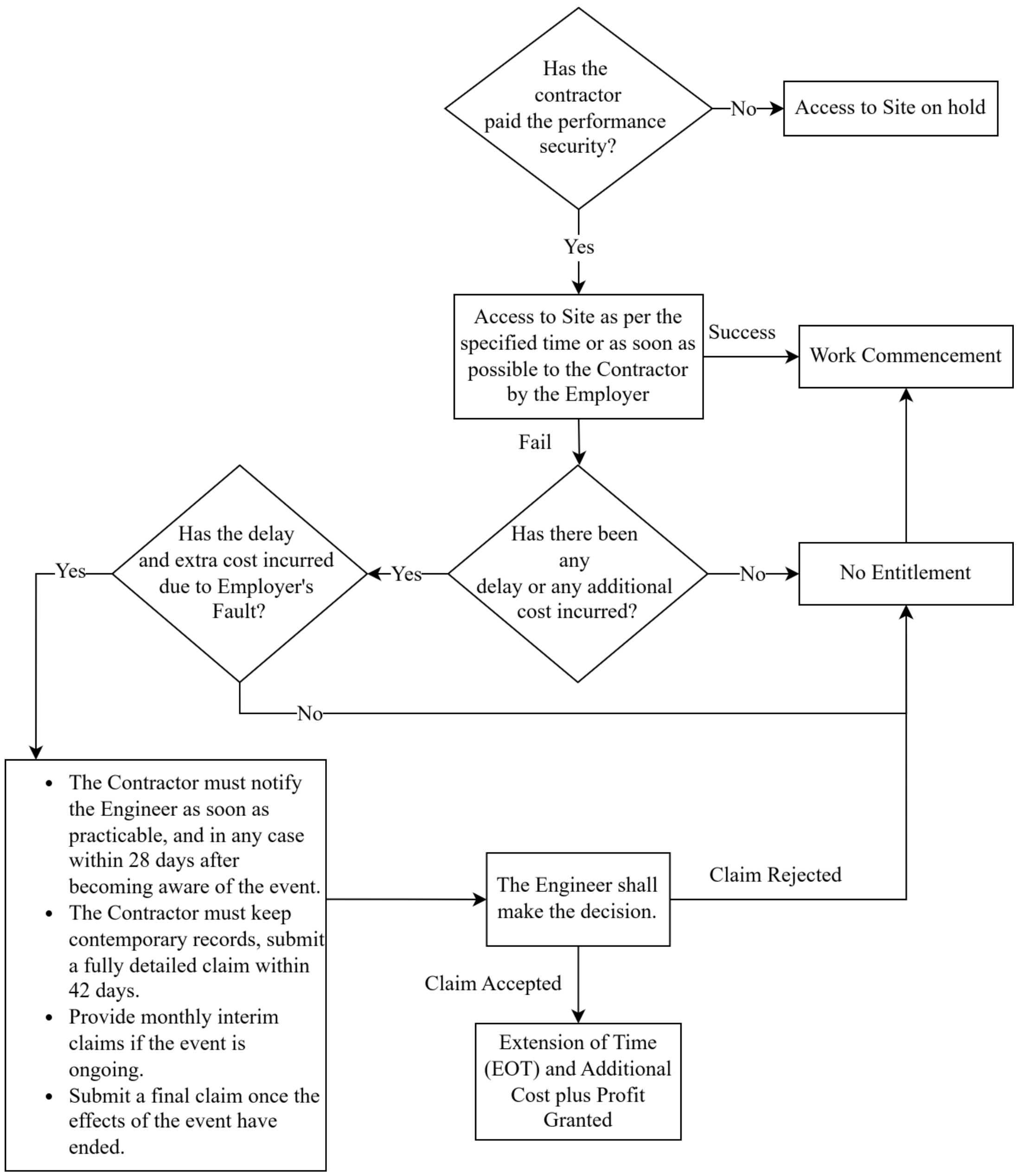
FIDIC Clauses:

2.1 Right of Access to the Site

8.4 Extension of Time for Completion

20.1 Contractor's Claims

Procedure:



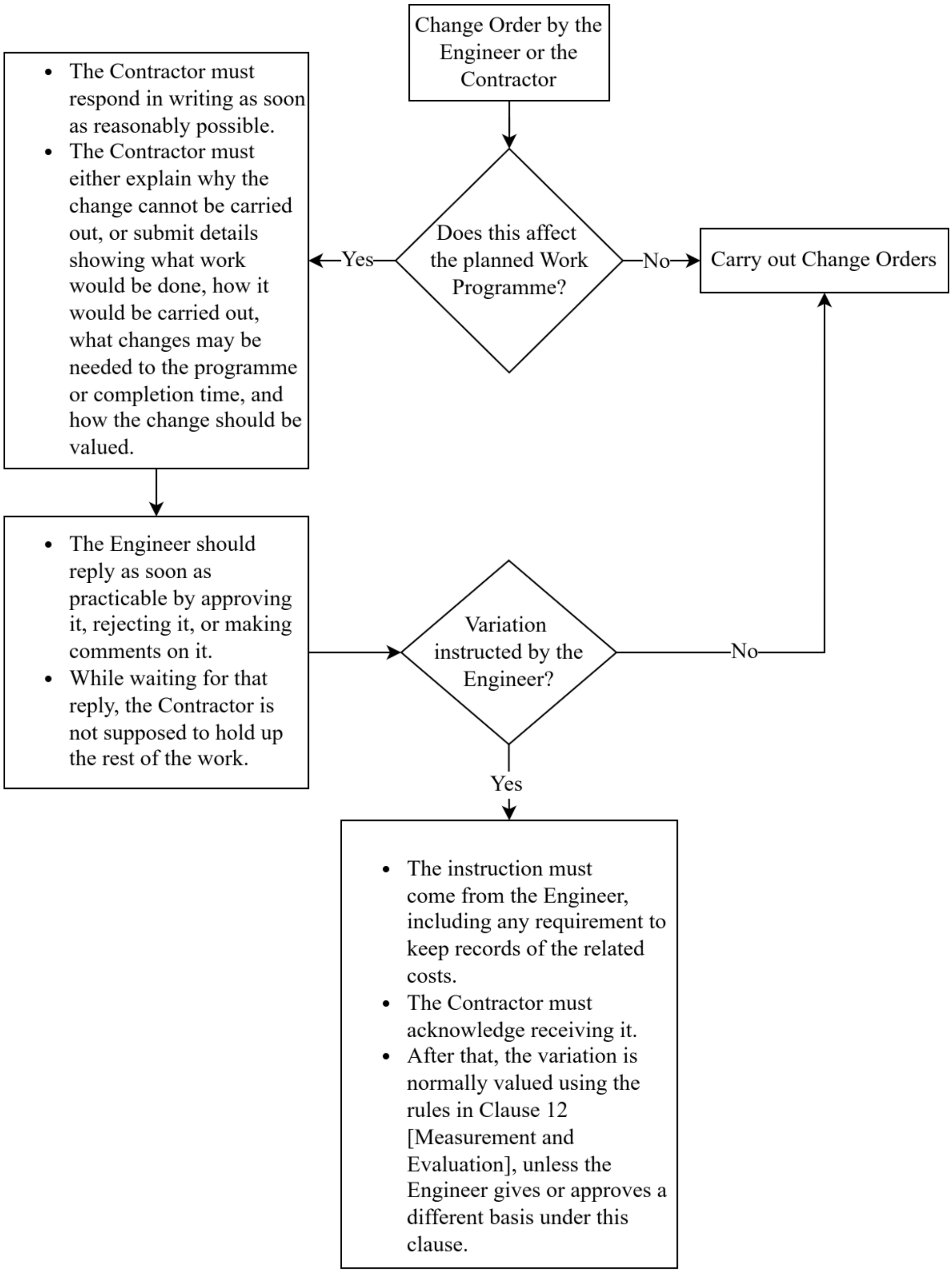
2) High Volume of Variations/ Change Orders/ Scope Growth

FIDIC Clauses:

13.1 Right to Vary

13.3 Variation Procedure

Procedure:



Source: FIDIC Multilateral Development Bank Harmonised Edition June 2010

4.3.2 Development of the Checklist

Based on the analysis of the FIDIC provisions, a stage-wise yes/no checklist was developed as the main practical output of the study. The checklist translated the contractual logic of the FIDIC provisions into simple operational questions that could be reviewed by project teams during project implementation. It was structured around the three major project stages: pre-construction, construction, and post-construction/commissioning. In total, the checklist comprised 33 questions, including 10 for the pre-construction stage, 17 for the construction stage, and 6 for the post-construction/commissioning stage. Each item also included a recommended review frequency, together with fields for status, responsible owner, due date, immediate action required, and remarks. This structure made the checklist useful not only for monitoring compliance, but also for assigning responsibility and ensuring timely follow-up action.

At the pre-construction stage, the checklist focuses on readiness. It addresses work-front access, land and compensation issues, safeguard and authority approvals, utility relocation preparedness, document ambiguity, institutional and financing clarity, contractor mobilization, programme realism, measurement baselines, and community interface concerns. This is significant because it turns the study's main pre-construction findings into concrete monitoring actions that can be used before those issues grow into delay claims or formal disputes.

At the construction stage, the checklist addresses the active management of dispute-sensitive conditions. It covers change orders, aged variations, resources, programme reliability, authority delays, late instructions, document conflicts, decision follow-up, payment-cycle performance, QA/QC controls, environmental and social compliance, utility coordination, and quantity verification. This shows that the checklist is not limited to legal compliance alone. It brings together commercial, technical, contractual, and coordination issues in a single monitoring tool.

At the post-construction and commissioning stage, the checklist addresses testing, water quality performance, defect logging and rectification, unresolved commissioning issues, final measurement and close-out, and the release of final payments and retention. This is especially important for water supply projects because project success depends on operational performance after construction, not only on physical completion.

A key strength of the checklist is that it converts complex contractual procedures into a practical, reviewable format. Rather than waiting for a claim or dispute to crystallize, it encourages regular checking of the conditions that usually lead to conflict. The yes/no format allows project teams to identify gaps quickly, while the review frequency and action fields make it easier to assign responsibility and act in time.

Taken together, the findings under Objective 3 show that the highest-ranked dispute drivers can be addressed more effectively when FIDIC procedures are used proactively rather than reactively. The clause analysis identifies the relevant contractual pathways, and the checklist converts those pathways into a usable project-management tool. This moves the study beyond diagnosis and toward application by offering a practical mechanism for early warning, improved contract administration, and more timely dispute prevention in Nepal's water supply projects.

A few selected checklist items for each stage are presented below for illustrative purposes. The complete checklist is documented in Appendix 2.

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
PRE-CONSTRUCTION							
1	Are all critical work fronts handed over, free from unresolved land, resettlement, compensation, or access constraints, and recorded section-wise before planned start?	Before commencement of each section and weekly until full access is achieved					
DURING CONSTRUCTION							
11	Is section-wise access status maintained during execution, with no critical front lagging more than 7 days without recorded recovery action?	Weekly and at each progress meeting					
POST-CONSTRUCTION / COMMISSIONING							
28	Are completion and commissioning tests current, with failed or repeat critical tests investigated and accepted retests documented before handover steps continue?	At each test or commissioning cycle					

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study was carried out to develop a Dispute Risk Index (DRI) and a proactive tool for early dispute prevention in water supply projects in Nepal. It was motivated by a clear sectoral problem: although water supply projects are strategically important public investments, dispute risks in Nepal are often recognized too late, by which time they have already affected time, cost, quality, institutional relationships, and ultimately service delivery. The central conclusion of this thesis is that disputes in Nepal's water supply projects are not isolated legal events. They are structurally predictable outcomes of accumulated weaknesses across project preparation, implementation, and close-out - weaknesses that are identifiable in advance, quantifiable in terms of their risk contribution, and manageable through the disciplined application of contractual governance mechanisms that already exist within the FIDIC MDB Harmonised Conditions of Contract. For this reason, dispute prevention must be treated as a lifecycle governance issue, not merely as a mechanism for resolving conflict after it has escalated.

With respect to the first objective, the study identified and ranked dispute drivers across the pre-construction, construction, and post-construction stages of water supply projects. The findings showed that the dispute profile changes across the lifecycle, but remains interconnected throughout. At the pre-construction stage, the dominant drivers-delayed site handover and land acquisition, contractor capacity limitations, ambiguous contract documents, and weak institutional readiness reflected deficiencies in project preparation that take root before a contractor is even mobilized. During construction, the highest-ranked drivers- high variation volumes, authority-related delays, EOT and concurrent delay disagreements, payment and certification problems, and quality non-conformities marked this as the stage at which pre-construction weaknesses convert into active contractual and operational conflict. In the post-construction stage, the leading drivers included post-commissioning water quality non-compliance, defects during the Defects Notification Period, and ineffective use of dispute avoidance mechanisms which collectively confirmed that dispute exposure persists after physical completion through performance, documentation, and close-out failures. Spearman rank correlation analysis confirmed that consultant and client perceptions align closely with the overall composite rankings, while contractor perceptions diverge consistently toward financial and operational priorities. Case-based validation against six actual water supply projects in Nepal confirmed that all priority dispute drivers identified through the RII analysis have documented parallels in real project experience, substantially strengthening the external validity of the empirical findings. Overall, the dispute risk in Nepal’s water supply projects is lifecycle-wide, cumulative, and rooted in a recurring set of governance, institutional, technical, and contractual vulnerabilities that are identifiable well in advance of their eventual escalation into formal disputes.

With respect to the second objective, the Dispute Risk Index was developed by combining the perceived impact of each dispute driver with its likelihood of occurrence. This provided a more complete measure of dispute exposure than ranking alone. The overall DRI of 61.03% indicates that water supply projects in Nepal face a considerable level of dispute risk across the full lifecycle. The DRI for the priority drivers was slightly higher, showing that a smaller group of dominant factors accounts for a large share of the overall dispute burden. Most importantly, the stage-wise results showed that the pre-construction stage had the highest DRI (64.41%), followed by the construction stage (59.93%) and the post-construction stage (58.38%). This is one of the most important findings of the thesis. It shows that although disputes become most visible during construction, they are often seeded much earlier, in weak project preparation, incomplete investigations, unclear measurement baselines, delayed decisions, and unresolved access and approval issues. At the same time, the post-construction result confirms that dispute exposure does not disappear after substantial completion; rather, it continues in the form of commissioning problems, defects, operational non-performance, documentation deficiencies, and final account disputes, many of which represent the cumulative outcome of issues that were not resolved earlier in the project lifecycle.

With respect to the third objective, the study examined the relevant provisions of the FIDIC MDB Harmonised Conditions of Contract and translated them into a practical early-warning tool. The findings showed that the contract already contains important preventive mechanisms through notices, approvals, Engineer’s determinations, claims procedures, payment rules, testing requirements, and related administrative actions. However, the study also found that these provisions are often retrospective in operation. In other words, they provide remedies after conflict has already emerged, but are not always sufficiently specific to prevent routine dispute-generating conditions in Nepal's water supply context. In particular, the absence of clear procedures on site readiness verification, cumulative variation thresholds, early contractor-performance monitoring, delay-analysis methodology, and sector-specific water quality benchmarking creates governance gaps that recurring project conditions can easily expose. The study therefore concludes that effective dispute prevention in Nepal requires both the disciplined and timely use of existing FIDIC procedures and the careful supplementation of those procedures through context-appropriate Particular Conditions. On this basis, the study developed a 33-question stage-wise checklist for pre-construction, construction, and post-construction/commissioning, designed to convert FIDIC's contractual logic into a practical tool for early warning, accountability, and timely intervention.

Overall, the major contribution of this study lies in bringing together empirical dispute-driver identification, dispute-risk quantification, and FIDIC-based contract administration within one practical framework. The DRI provides a structured way of understanding where dispute risks are most concentrated, while the checklist converts that understanding into a usable governance tool for project teams. The thesis therefore contributes not only to academic knowledge on dispute prevention, but also to practice by offering a context-specific foundation for improving contract management, reducing escalation, and enhancing project performance in terms of time, cost, quality, and service delivery in Nepal's water supply sector.

5.2 Recommendations from Study

Based on the findings of this study, the following recommendations are proposed to strengthen dispute prevention and improve project governance in Nepal's water supply sector.

1) Adopt a lifecycle-based dispute prevention approach, covering the pre-construction, construction, and post-construction stages, instead of relying only on dispute resolution after escalation.
2) Strengthen front-end project readiness through timely site access, completion of approvals, better design documentation, realistic process and milestone planning, and clear institutional responsibilities.

3) Apply the FIDIC-based checklist regularly to detect risks early and take corrective action.
4) Provide capacity-building and training on FIDIC procedures for clients, contractors, and consultants.
5) Integrate early dispute prevention tools into project monitoring systems, procurement practice, and contract administration guidelines across the water supply sector.
6) Supplement FIDIC MDB Particular Conditions with explicit provisions addressing multi-agency coordination timelines, concurrent delay assessment methodology, contractor-capacity pre-qualification, and post-commissioning water quality benchmarking closing contractual gaps that the General Conditions alone leave inadequately covered.
7) Activate the Dispute Board mechanism under Clause 20.4 of the FIDIC MDB Harmonised Book in its genuinely preventive mode.

5.2.1 Recommendations for Further Study

The recommendations for further study are presented below:

1) Future research should use a larger sample size and more representative sampling methods so that the findings can be generalized more confidently across the wider population of stakeholders in Nepal's water supply sector.
2) Similar research could be conducted in other infrastructure sectors such as roads, irrigation, buildings, and hydropower to compare whether the main dispute drivers and risk patterns differ across sectors.
3) Comparative studies between Nepal and other countries would be useful for understanding which dispute drivers are context-specific and which are common across developing-country infrastructure projects.
4) Additional studies could examine the application of the framework under other FIDIC forms or newer editions, especially to compare how dispute prevention differs between the MDB Harmonised Book and later FIDIC contracts.
5) Researchers may also expand the present work by developing a digital dashboard or project monitoring system based on the DRI so that dispute warning signs can be tracked more continuously during implementation.

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APPENDIX 1: ANALYZED FIDIC PROCEDURES

Source: FIDIC Multilateral Development Bank Harmonised Edition June 2010

1) Delayed Site handover/ Land Acquisition/ Resettlement and Compensation Disagreement

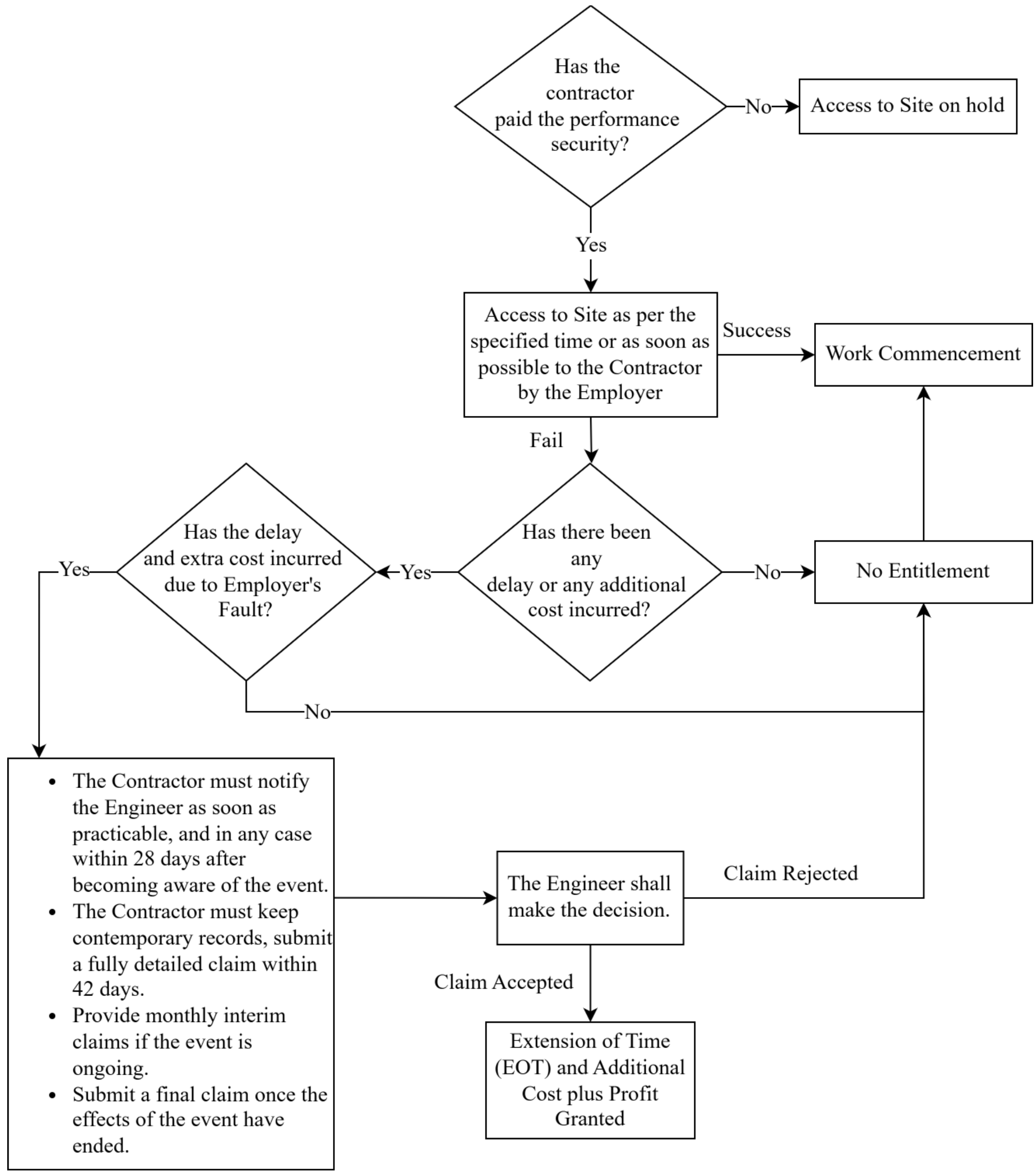
FIDIC Clauses:

2.1 Right of Access to the Site

8.4 Extension of Time for Completion

20.1 Contractor's Claims

Procedure:



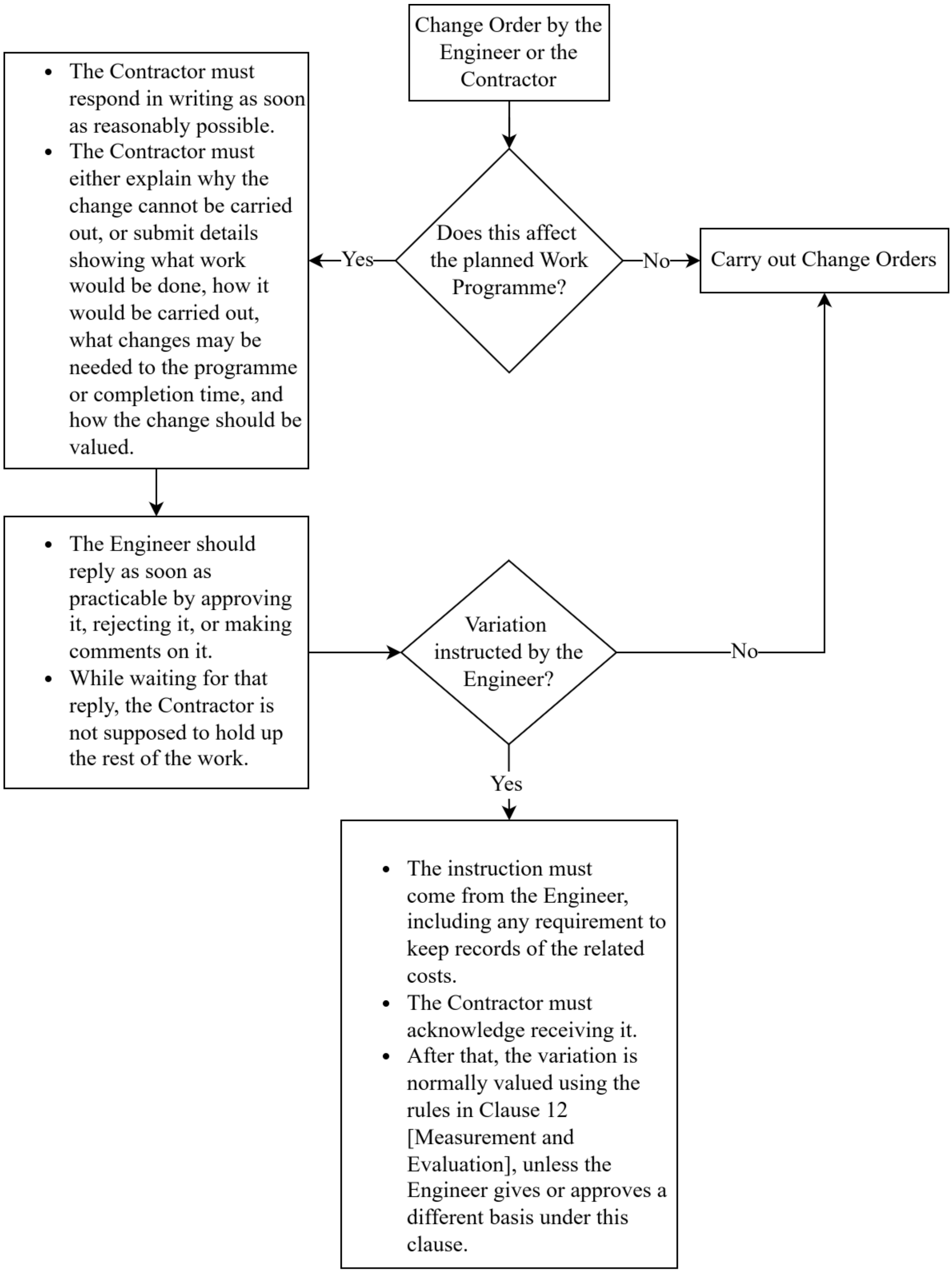
2) High Volume of Variations/ Change Orders/ Scope Growth

FIDIC Clauses:

13.1 Right to Vary

13.3 Variation Procedure

Procedure:



3) Contractor's Capacity

FIDIC Clauses:

4.1 Contractor's General Obligations

4.2 Performance Security

8.3 Programme

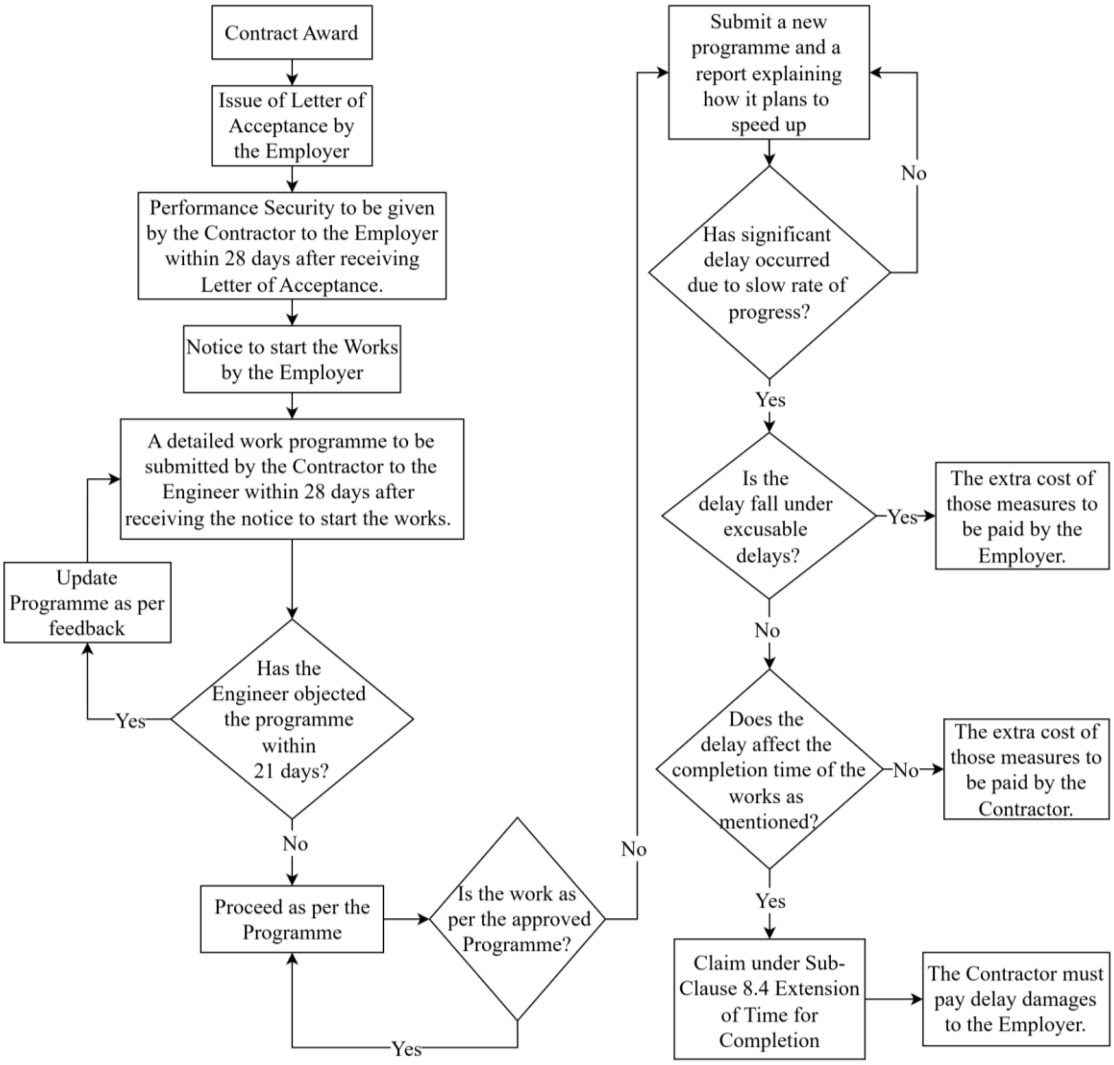
8.6 Rate of Progress

8.7 Delay Damages

15.2 Termination by Employer

2.5 Employer's Claims

Procedure:



FIDIC Clause	FIDIC Procedure
4.1 Contractor’s General Obligations	The contractor must carry out any design work assigned under the contract, build and finish the works properly, follow the contract and the Engineer’s instructions, and fix any defects that appear. The contractor must also provide everything needed for the job, such as plant, contractor’s documents, labour, materials, equipment, consumables, services, and any temporary or permanent items required to complete the works. Materials, equipment, and services used in the works must come from a source country that is eligible under the Bank’s rules. The contractor is also fully responsible for how the works are carried out on site. This includes making sure the construction methods are suitable, stable, and safe. Unless the contract says otherwise, the contractor is responsible for its own documents, temporary works, and any design needed for plant and materials so that they meet the contract requirements. However, the contractor is not generally responsible for the overall design or specification of the permanent works unless that duty is specifically given in the contract. If the Engineer asks, the contractor must explain the methods and arrangements it plans to use for carrying out the works. The contractor is also not allowed to make any major change to those methods or arrangements without first notifying the Engineer. If the contractor is responsible for designing part of the permanent works, it must submit the design documents, ensure they match the specification and drawings, make sure that part is fit for its intended purpose, and provide as-built drawings and operation and maintenance manuals before that part can be treated as complete for taking over.
2.5 Employer’s Claims	If the Employer believes it has a right to receive money from the Contractor under the contract, or wants the Defects Notification Period to be extended, the Employer or the Engineer must give the Contractor notice with details of that claim. However, this notice is not required for charges that are already due under Sub-Clause 4.19, Sub-Clause 4.20, or for other services requested by the Contractor. That notice must be given as soon as reasonably possible and no later than 28 days after the Employer became aware, or should have become aware, of the event or situation causing the claim. If the claim is for extending the Defects Notification Period, the notice must be given before that period expires.

FIDIC Clause	FIDIC Procedure
	The claim details must identify the contractual basis for the claim and explain the amount or extension being sought. After receiving the claim, the Engineer must act under Sub-Clause 3.5 to agree or determine whether the Employer is entitled to any payment from the Contractor and/or any extension of the Defects Notification Period. Any amount decided under this process may be deducted from the Contract Price or from Payment Certificates. The Employer is only allowed to make deductions from certified payments or bring a claim against the Contractor by following this clause.
15.2 Termination by Employer	The Employer has the right to end the contract if the Contractor commits serious default. This includes situations such as failing to provide the required performance security, ignoring a notice to correct, abandoning the works, failing without good reason to continue the works properly, failing to obey rejection or remedial work notices within the allowed time, subcontracting the whole works or assigning the contract without approval, becoming insolvent, or offering bribes or improper benefits in connection with the contract. In most of these cases, the Employer must give 14 days' notice before termination takes effect, but for insolvency or bribery-related events the Employer may terminate immediately by notice. Once the contract is terminated, the Employer may remove the Contractor from the Site. The Contractor must leave the Site and hand over the required Goods, Contractor's Documents, and other design documents to the Engineer. Even after termination, the Contractor must still try to follow reasonable instructions in the notice, especially if they relate to assigning subcontracts or protecting life, property, or the works themselves. After termination, the Employer may finish the works himself or through others, and may use the Contractor's Goods and documents for that purpose. The Contractor must promptly remove its equipment and temporary works at its own risk and cost once they are released. If the Contractor still owes money to the Employer, those items may be sold and the proceeds used to recover the amount due, with any remaining balance paid back to the Contractor.

4) Delays Caused by Authorities

FIDIC Clauses:

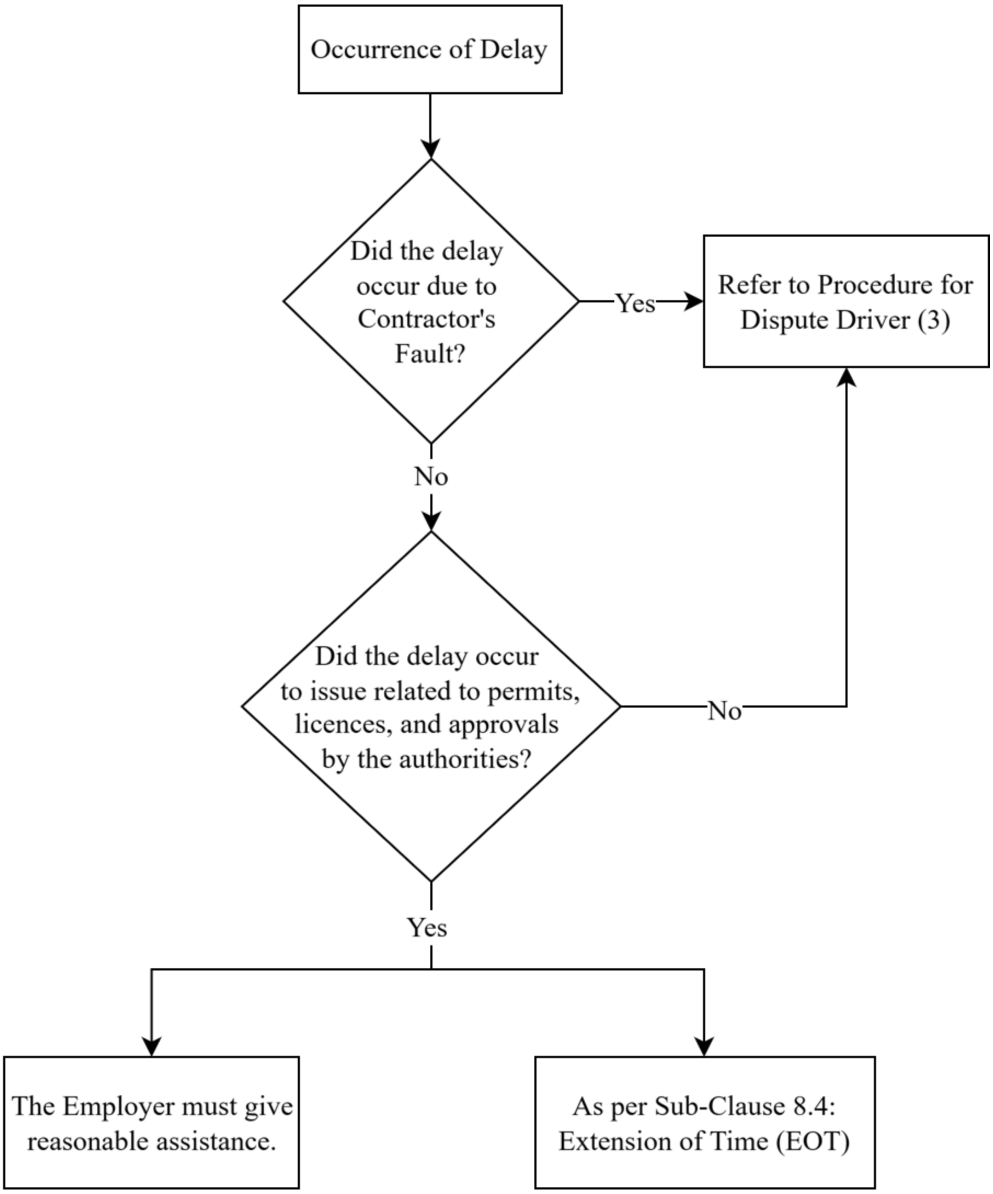
8.5 Delays Caused by Authorities

1.13 Compliance with Laws

2.2 Permits, Licences or Approvals

8.4 Extension of Time for Completion

Procedure:



5) Ambiguous or Contradictory Contract Documents

FIDIC Clause	FIDIC Procedure
1.5 Priority of Documents	All the contract documents should be read together and used to explain one another. But if there is any conflict, inconsistency, or uncertainty between them, they do not all have the same importance. The contract sets an order of priority, meaning the document higher on the list will prevail over one lower down. The order starts with the Contract Agreement, then the Letter of Acceptance, the Letter of Tender, Particular Conditions Part A, Particular Conditions Part B, the General Conditions, the Specification, the Drawings, and finally the Schedules and any other contract documents. If there is still any doubt or mismatch between the documents, the Engineer must issue the clarification or instruction needed to resolve it.

6) EOT, concurrent delay, and acceleration disagreements

FIDIC Clause	FIDIC Procedure
8.3 Programme	The contractor must prepare and submit a detailed work programme to the Engineer within 28 days after receiving the notice to start the works. This programme must be updated whenever the earlier version no longer matches the actual progress of the project or the contractor's duties under the contract. The programme should clearly show how the contractor plans to carry out the overall works. It must also include the same information for nominated subcontractors and a supporting report explaining the contractor's proposed methods, major stages, and the expected labour and equipment needed at each stage. If the Engineer does not object within 21 days after receiving the programme, the contractor is expected to proceed in line with it, while still meeting all other contract obligations. The contractor must also quickly inform the Engineer about any likely future event or situation that may slow the work, increase cost, or delay completion. The Engineer may then ask for an estimate of the likely impact or request a proposal under the variation procedure. If the Engineer later says that the programme does not comply with the contract or no longer reflects actual progress or the contractor's stated plans, the contractor must submit a revised programme.
8.4 Extension of Time for Completion	If the contractor is delayed for certain accepted reasons, the contractor may get extra time to finish the works. This extra time is only allowed to the extent that the delay actually affects completion. One of the main accepted reasons is: delays caused by the employer. To receive that extension, the contractor must notify the engineer under the claims procedure in Sub-Clause 20.1 [Contractor's Claims]. When deciding the extension, the engineer can review earlier decisions and increase the total extra time if justified, but cannot reduce time that was already granted. The clause says that if the contractor properly followed the procedures of public authorities, but those authorities still caused an unforeseen delay or disruption, that situation can also count as a valid reason for an extension of time.
8.6 Rate of Progress	If the work is moving too slowly to finish on time, or if it is falling behind the approved programme for reasons that are not covered by the extension-of-time clause, the Engineer can require the Contractor to submit a new programme and a

FIDIC Clause	FIDIC Procedure
	report explaining how it plans to speed things up and still finish within the allowed time. Unless the Engineer says otherwise, the Contractor must then use those revised methods. This may mean working longer hours, using more labour, or bringing in more equipment or materials, and normally the Contractor must bear that risk and cost. If the Employer suffers extra cost because of those revised methods, the Contractor may also have to pay those costs, on top of any delay damages that apply. However, if the acceleration or revised methods are required to deal with delays that fall under Sub-Clause 8.4 such as excusable delay, then the extra cost of those measures is to be paid by the Employer. Even then, the Contractor does not get any further additional payment benefit beyond those costs.
8.7 Delay Damages	If the Contractor does not finish the works within the time allowed under the contract, the Contractor must pay delay damages to the Employer, provided the Employer follows the claims procedure. The amount is the daily rate stated in the Contract Data, and it is payable for each day from the end of the Time for Completion up to the date stated in the Taking-Over Certificate. However, the total amount payable cannot go beyond the maximum limit stated in the Contract Data. This clause also makes clear that these delay damages are the Employer's main financial remedy for late completion, except where the Employer terminates the contract before completion under Sub-Clause 15.2. Even if delay damages are payable, the Contractor must still finish the works and remain responsible for all other duties under the contract.

7) Inadequate Process and Milestone Design

FIDIC Clause	FIDIC Procedure
8.1 Commencement of Works	Under Clause 8.1, unless the Particular Conditions state otherwise, the Commencement Date is the date when all required preconditions have been satisfied and the Contractor receives the Engineer’s notice confirming that both parties agree those conditions have been met and directing the Contractor to begin the Works. These preconditions are that the Contract Agreement has been signed by both parties and, where necessary, approved by the relevant authorities of the country; the Contractor has been given reasonable evidence of the Employer’s financial arrangements under Sub-Clause 2.4; unless the Contract Data provides otherwise, the Contractor has been given effective access to and possession of the Site together with any permissions required under Sub-Clause 1.13 for starting the Works; and the Contractor has received the advance payment under Sub-Clause 14.2, provided the required bank guarantee has already been submitted. If the Engineer’s instruction to commence is not received within 180 days from the Contractor’s receipt of the Letter of Acceptance, the Contractor is entitled to terminate the Contract under Sub-Clause 16.2.
8.2 Time for Completion	Clause 8.2 states that the Contractor must finish the entire Works, as well as any individual Section if the Contract divides the Works that way, within the agreed Time for Completion stated for the Works or for that Section. Finishing on time does not only mean physically ending the construction activities; it also requires the Contractor to successfully complete and pass the Tests on Completion and to finish any other tasks that the Contract says must be done before the Works or a Section can be treated as complete for taking-over under Sub-Clause 10.1.
8.3 Programme	The contractor must prepare and submit a detailed work programme to the Engineer within 28 days after receiving the notice to start the works. This programme must be updated whenever the earlier version no longer matches the actual progress of the project or the contractor’s duties under the contract. The programme should clearly show how the contractor plans to carry out the overall works. It must also include the same information for nominated subcontractors and a supporting report explaining the contractor’s proposed

FIDIC Clause	FIDIC Procedure
	methods, major stages, and the expected labour and equipment needed at each stage. If the Engineer does not object within 21 days after receiving the programme, the contractor is expected to proceed in line with it, while still meeting all other contract obligations. The contractor must also quickly inform the Engineer about any likely future event or situation that may slow the work, increase cost, or delay completion. The Engineer may then ask for an estimate of the likely impact or request a proposal under the variation procedure. If the Engineer later says that the programme does not comply with the contract or no longer reflects actual progress or the contractor's stated plans, the contractor must submit a revised programme.

8) Unclear Financing Structure and Institutional Responsibility

FIDIC Clause	FIDIC Procedure
2.4 Employer's Financial Arrangements	Clause 2.4 requires the Employer to show, before the Commencement Date and again within 28 days whenever the Contractor asks, reasonable proof that proper financial arrangements exist and are being kept in place so the Contract Price can be paid on time in accordance with Clause 14, based on the amount expected to be payable at that stage. If the Employer makes any significant change to those financial arrangements, the Employer must promptly notify the Contractor and give full details. The clause also adds a special rule for bank-funded projects: if the Bank informs the Borrower that loan disbursements for the Works have been suspended, and that loan finances all or part of the Works, the Employer must notify the Contractor within 7 days after the Borrower receives that notice, give detailed particulars including the date of the Bank's notification, and send a copy to the Engineer. If the Employer will still have alternative funds available in the proper currencies to keep paying the Contractor after a date 60 days from the Bank's suspension notice, the Employer must also provide reasonable evidence showing how far those funds will cover continuing payments.
3.1 Engineer's Duties and Authority	Clause 3.1 states that the Employer must appoint the Engineer, who is to perform the duties assigned under the Contract, with support from suitably qualified engineers and other competent professionals. The Engineer has no power to change the Contract itself, but may exercise the authority given to the Engineer expressly or by necessary implication under the Contract. Where the Engineer must first obtain the Employer's approval before using a particular power, that requirement must be set out in the Particular Conditions, and the Employer must promptly inform the Contractor of any change to the Engineer's authority. If the Engineer uses a power that requires the Employer's approval, the Employer is treated as having given that approval for Contract purposes. Except where the Contract says otherwise, the Engineer acts on behalf of the Employer when carrying out duties or exercising authority, but cannot release either party from its contractual obligations, and any approval, inspection, instruction, certificate, consent, notice, test, or similar act by the Engineer does not remove the Contractor's

FIDIC Clause	FIDIC Procedure
	responsibility for its work, including errors, omissions, discrepancies, or non-compliance. In addition, unless the Contract provides otherwise, when the Engineer responds to a Contractor's request, that response must be given in writing within 28 days of receiving the request.
8.1 Commencement of Works	Under Clause 8.1, unless the Particular Conditions state otherwise, the Commencement Date is the date when all required preconditions have been satisfied and the Contractor receives the Engineer's notice confirming that both parties agree those conditions have been met and directing the Contractor to begin the Works. These preconditions are that the Contract Agreement has been signed by both parties and, where necessary, approved by the relevant authorities of the country; the Contractor has been given reasonable evidence of the Employer's financial arrangements under Sub-Clause 2.4; unless the Contract Data provides otherwise, the Contractor has been given effective access to and possession of the Site together with any permissions required under Sub-Clause 1.13 for starting the Works; and the Contractor has received the advance payment under Sub-Clause 14.2, provided the required bank guarantee has already been submitted. If the Engineer's instruction to commence is not received within 180 days from the Contractor's receipt of the Letter of Acceptance, the Contractor is entitled to terminate the Contract under Sub-Clause 16.2.
14.2 Advance Payment	Clause 14.2 provides that the Employer must pay the Contractor an advance payment, treated as an interest-free loan to help with mobilization and cash flow, once the Contractor submits the required advance payment guarantee. The amount of that advance, how many instalments it will be paid in, when those instalments will be made, and the currencies and proportions to be used must all be stated in the Contract Data. This clause does not operate unless the Employer has received the guarantee and the Contract Data actually specifies the total advance payment. After the Contractor submits a Statement and the Employer has received both the Performance Security and a guarantee equal in amount and currency to the advance payment, the Engineer must issue an Interim Payment Certificate for the advance payment or its first instalment. The Contractor must keep that guarantee valid and enforceable until the advance

FIDIC Clause	FIDIC Procedure
	has been fully repaid, although its value should reduce gradually as repayment is made through the Payment Certificates, and if the guarantee is close to expiring before full repayment, the Contractor must extend it. Unless the Contract Data says otherwise, the advance is recovered by percentage deductions from interim payments, starting with the next Interim Payment Certificate after certified interim payments exceed 30% of the Accepted Contract Amount less Provisional Sums, and continuing at the amortization rate stated in the Contract Data until the full advance has been recovered, with full repayment required before 90% of the Accepted Contract Amount less Provisional Sums has been certified. If any part of the advance remains unpaid when the Taking-Over Certificate is issued, or before termination under the clauses specified in the contract, the entire outstanding balance becomes immediately due, and in certain cases of termination by the Employer, that balance must be paid by the Contractor to the Employer.
16.2 Termination by Contractor	Clause 16.2 allows the Contractor to terminate the Contract if any of several serious events occur: the Employer does not provide the financial evidence required under Sub-Clause 2.4 within 42 days after the Contractor's notice under Sub-Clause 16.1; the Engineer fails to issue the relevant Payment Certificate within 56 days after receiving the Contractor's Statement and supporting documents; the Contractor is not paid an amount due under an Interim Payment Certificate within 42 days after the payment deadline under Sub-Clause 14.7, except where deductions are made under Sub-Clause 2.5; the Employer seriously fails to perform its obligations in a way that materially and adversely affects the economic balance of the Contract or the Contractor's ability to perform; the Employer fails to comply with Sub-Clause 1.6 or 1.7; a prolonged suspension affects the whole of the Works under Sub-Clause 8.11; the Employer becomes bankrupt, insolvent, or subject to equivalent legal proceedings; or the Contractor does not receive the Engineer's instruction confirming fulfilment of the conditions for commencement under Sub-Clause 8.1. In those situations, the Contractor may terminate by giving the Employer 14 days' notice, except in the cases of prolonged suspension or insolvency, where termination may be made immediately by notice. The clause further

FIDIC Clause	FIDIC Procedure
	provides that, if the Bank suspends the loan or credit funding all or part of the Works and the Contractor still has not received the sums due under Interim Payment Certificates after the extra 14 days mentioned in Sub-Clause 14.7, the Contractor may either suspend or reduce the rate of work under Sub-Clause 16.1 or terminate the Contract by notice to the Employer, copied to the Engineer, with the termination taking effect 14 days after that notice. Choosing termination under this clause does not take away any other rights the Contractor may have under the Contract or otherwise.

9) Delayed Payment, IPC Certification and Cash flow Stress

FIDIC Clause	FIDIC Procedure
14.3 Application for Interim Payment Certificates	Clause 14.3 requires the Contractor, after the end of each month, to submit six copies of a Statement to the Engineer in the approved form, supported by documents including that month's progress report, setting out in detail the amounts the Contractor believes are due under the Contract. The Statement must show the figures in the currencies in which the Contract Price is payable and must include, where relevant, the estimated value of the work carried out and Contractor's Documents produced up to the end of the month, any additions or deductions arising from changes in legislation or cost, the deduction for retention up to the contractual limit, any amounts to be added for advance payment instalments and deducted for repayment of the advance, any additions or deductions relating to Plant and Materials, any other sums that have become payable or deductible under the Contract or otherwise, including matters under Clause 20, and finally the deduction of all amounts already certified in previous Payment Certificates.
14.4 Schedule of Payments	Clause 14.4 explains how payments are handled depending on whether the Contract contains a schedule of payments. If such a schedule is included, then, unless the schedule says otherwise, the listed instalments are treated as the estimated contract values for the purpose of Sub-Clause 14.3, Sub-Clause 14.5 does not apply, and if actual progress turns out to be ahead of or behind the progress assumed when the schedule was prepared, the Engineer may, under Sub-Clause 3.5, agree or determine revised instalments to reflect that difference. If the Contract does not include a schedule of payments, the Contractor must submit non-binding estimates of the payments expected to fall due in each quarterly period, with the first estimate due within 42 days after the Commencement Date and revised estimates to be submitted every quarter until the Taking-Over Certificate for the Works is issued.
14.5 Plant and Materials Intended for the Works	Clause 14.5 allows the Contractor to receive interim payment for certain Plant and Materials that are intended to become part of the Permanent Works before they are finally incorporated, but only if this clause applies and the required lists are included in the Schedules. To qualify, the Contractor must keep proper records of the orders, receipts, costs and use of those items, make those records available for inspection,

FIDIC Clause	FIDIC Procedure
	and submit a supported statement showing the cost of obtaining and bringing them to Site. Payment may be certified either for items listed for payment when shipped, provided they have been shipped to the country in accordance with the Contract and are supported by shipping documents, proof of freight and insurance payment, any other reasonably required documents, and a bank guarantee for the same amount and currencies, or for items listed for payment when delivered to Site, provided they have actually arrived, are properly stored, protected from loss, damage or deterioration, and appear to comply with the Contract. If those conditions are met, the Engineer may certify an additional amount equal to 80% of the determined cost of those Plant and Materials, including delivery to Site, taking into account both the supporting documents and the contract value of the items. That advance amount is paid in the same currencies in which the contract value will later be paid, and once the value of those items is included in the Works under Sub-Clause 14.3, an equivalent reduction must be made in the same currencies and proportions so that the Contractor is not paid twice for the same items.
14.6 Issue of Interim Payment Certificates	No interim payment can be certified or paid until the Employer has received and approved the Performance Security. After that, once the Engineer receives the Contractor's Statement and the required supporting documents, the Engineer must, within 28 days, issue an Interim Payment Certificate to both the Employer and the Contractor. This certificate must state the amount the Engineer fairly considers payable, and must explain any deduction or withholding. However, before the Taking-Over Certificate for the Works is issued, the Engineer is not required to issue an Interim Payment Certificate if the net amount payable, after retention and other deductions, is less than the minimum interim certificate amount stated in the Contract Data. In that case, the Engineer must notify the Contractor. The Engineer cannot refuse to issue an Interim Payment Certificate for any other reason. Still, money may be withheld in two situations: first, if any goods supplied or work carried out do not comply with the Contract, the estimated cost of correcting or replacing them may be held back until the issue

FIDIC Clause	FIDIC Procedure
	is fixed; second, if the Contractor has failed, or is failing, to perform any required work or obligation under the Contract and has already been notified of that failure by the Engineer, the value of that unperformed work or obligation may be withheld until it is properly carried out. The Engineer may also correct or revise any earlier Payment Certificate in a later one. Issuing a Payment Certificate does not mean that the Engineer has accepted the work, approved it, consented to it, or confirmed satisfaction with it.
14.7 Payment	The Employer must pay the Contractor within the time limits set out in the Contract. The first advance payment instalment must be paid within 42 days after the Letter of Acceptance is issued, or within 21 days after the Employer receives the required Performance Security and advance payment documents, whichever happens later. For each Interim Payment Certificate, the certified amount must be paid within 56 days after the Engineer receives the Contractor's Statement and supporting documents. However, if the Bank loan or credit funding the Works has been suspended, the amount shown in the Contractor's statement must be paid within 14 days after the statement is submitted, and any difference can be corrected in the next payment. The amount stated in the Final Payment Certificate must be paid within 56 days after the Employer receives that certificate. If the Bank funding has been suspended at that stage, the Employer must still pay the undisputed amount in the Final Statement within 56 days from the date the suspension is notified under Sub-Clause 16.2. Any payment due in a particular currency must be transferred to the bank account nominated by the Contractor in the specified payment country for that currency.
14.8 Delayed Payment	If the Employer does not pay on time as required under Clause 14.7, the Contractor has the right to receive financing charges on the overdue amount. These charges are compounded monthly and run for the whole period of delay, starting from the date the payment was due. For interim payments, this start date applies even if the Interim Payment Certificate was issued later. Unless the Particular Conditions say otherwise, the rate is 3% above the central bank discount rate for the currency being paid, or, if that rate is not available, the applicable interbank offered rate. The charges must be paid in the same currency. The Contractor does not need to give a

FIDIC Clause	FIDIC Procedure
	formal notice or obtain certification first, and this right is in addition to any other remedy available under the Contract.
14.9 Payment of Retention Money	Once the Taking-Over Certificate for the whole Works is issued, the Engineer must certify the first half of the Retention Money for payment to the Contractor. If the certificate is issued only for a Section or part of the Works, then only a matching proportion of the Retention Money is to be certified and paid. That proportion is calculated as 50% of the ratio between the estimated value of that Section or part and the estimated final Contract Price. After the Defects Notification Period has ended, the Engineer must promptly certify the remaining balance of the Retention Money for payment. If a Taking-Over Certificate was issued for a Section, then the relevant proportion of the second half must be certified and paid promptly after the Defects Notification Period for that Section ends. But if any work under Clause 11 (Defects Liability) is still unfinished, the Engineer may withhold an amount equal to the estimated cost of that remaining work until it is completed. Also, when calculating these proportions, no adjustment is to be made for changes under Sub-Clauses 13.7 and 13.8. Unless the Particular Conditions say otherwise, once the Works have been taken over and the first half of the Retention Money has been certified, the Contractor may replace the second half with a bank or financial institution guarantee in an approved form. That guarantee must match the amount and currencies of the second half of the Retention Money and stay valid until the Contractor has completed the Works and remedied defects. Once the Employer receives that guarantee, the Engineer must certify payment and the Employer must release the second half of the Retention Money. The guarantee then replaces the normal later release of that amount, and the Employer must return the guarantee within 21 days after receiving a copy of the Performance Certificate. If the existing Performance Security is already a demand guarantee covering more than half of the Retention Money, no separate Retention Money guarantee is needed; if it covers less than half, then only the shortfall needs to be guaranteed.

10) Quality non-conformities and failed tests

FIDIC Clauses:

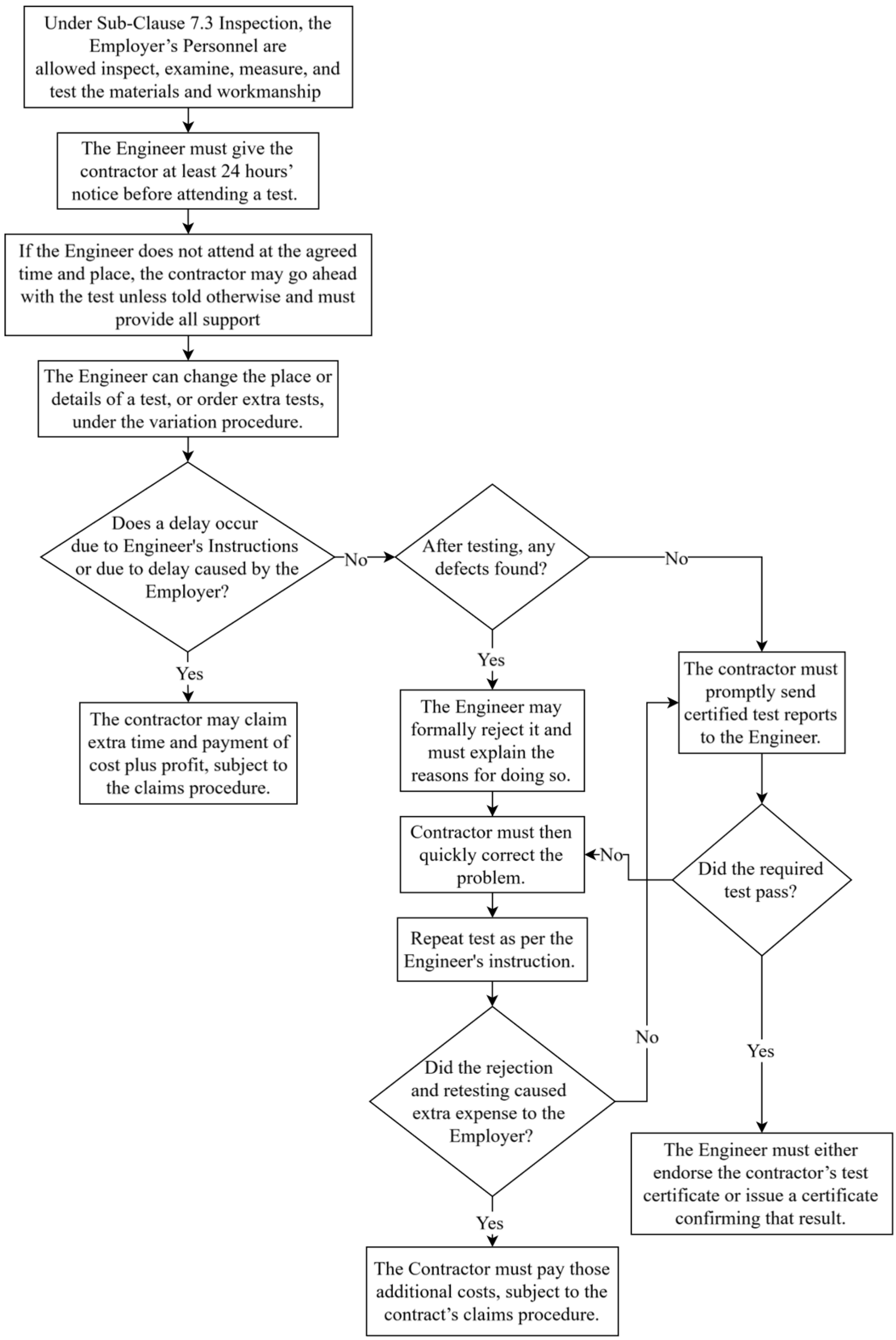
7.3 Inspection

7.4 Testing

7.5 Rejection

Procedure:

(See Next Page)


Under Sub-Clause 7.3 Inspection, the Employer's Personnel are allowed inspect, examine, measure, and test the materials and workmanship
The Engineer must give the contractor at least 24 hours' notice before attending a test.
If the Engineer does not attend at the agreed time and place, the contractor may go ahead with the test unless told otherwise and must provide all support
The Engineer can change the place or details of a test, or order extra tests, under the variation procedure.
Does a delay occur due to Engineer's Instructions or due to delay caused by the Employer?
No
After testing, any defects found?
No
Yes
The contractor may claim extra time and payment of cost plus profit, subject to the claims procedure.
Yes
The Engineer may formally reject it and must explain the reasons for doing so.
The contractor must promptly send certified test reports to the Engineer.
Contractor must then quickly correct the problem.
No
Did the required test pass?
Repeat test as per the Engineer's instruction.
No
Yes
Did the rejection and retesting caused extra expense to the Employer?
The Engineer must either endorse the contractor's test certificate or issue a certificate confirming that result.
Yes
The Contractor must pay those additional costs, subject to the contract's claims procedure.

11) Late Instructions/ Drawings/ Clarifications during Construction

FIDIC Clauses:

1.9 Delayed Drawings or Instruction

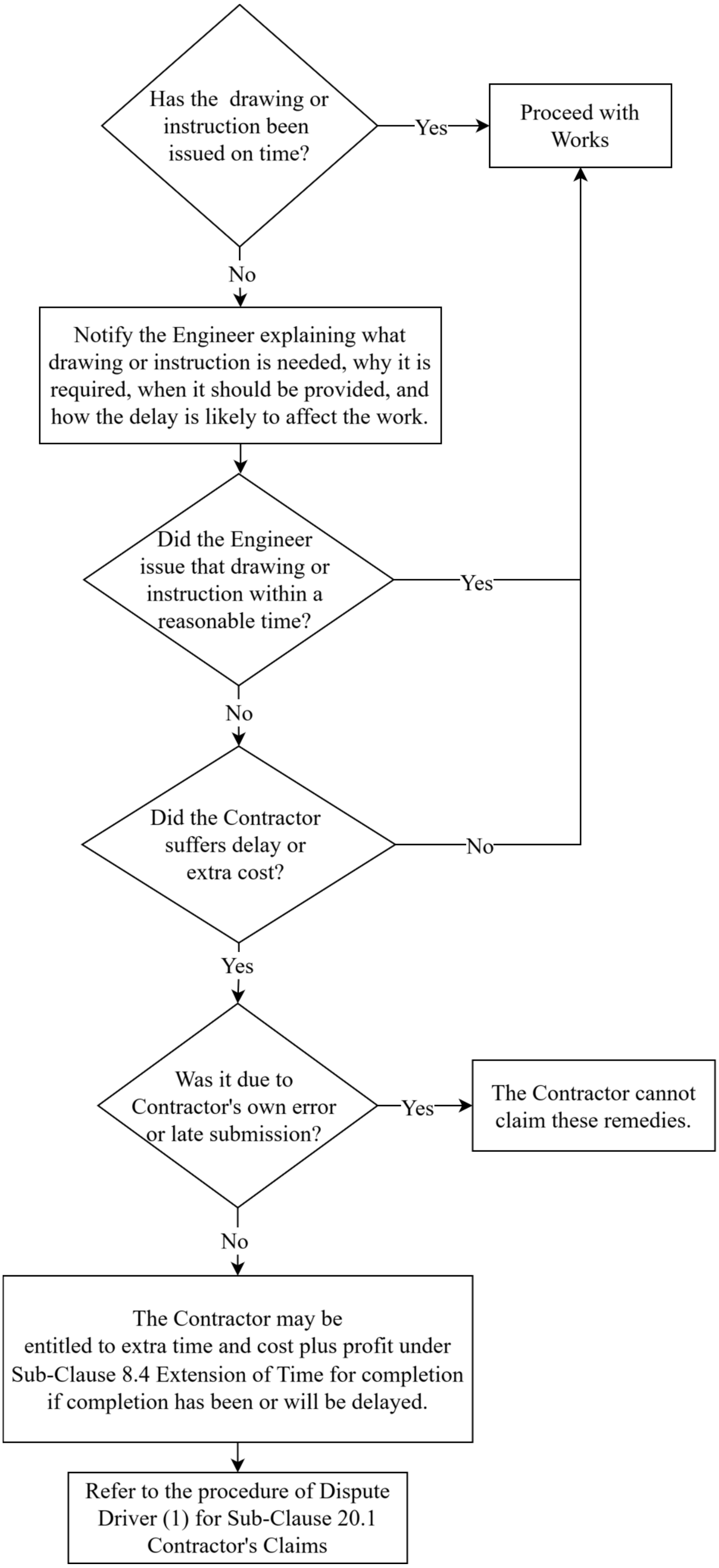
3.3 Instructions of the Engineer

8.4 Extension of Time for Completion

20.1 Contractor's Claims

Procedure:

FIDIC Clause	FIDIC Procedure
3.3 Instructions of the Engineer	The Engineer may issue instructions to the Contractor at any time when those instructions are needed for carrying out the works or fixing defects, and may also issue extra or revised drawings. The Contractor is required to follow instructions that come from the Engineer, or from an assistant who has been properly given that authority. If an instruction changes the works, then the contract rules on variations will apply. As a general rule, instructions should be in writing whenever that is practical. However, an oral instruction can still become binding. If the Engineer or an authorized assistant gives an oral instruction, and the Contractor sends written confirmation of it within 2 working days, that confirmation will count as the written instruction unless the Engineer or assistant responds within the next two working days with a written rejection or a different instruction.


Has the drawing or instruction been issued on time?
Yes
Proceed with Works
No
Notify the Engineer explaining what drawing or instruction is needed, why it is required, when it should be provided, and how the delay is likely to affect the work.
Did the Engineer issue that drawing or instruction within a reasonable time?
Yes
No
Did the Contractor suffers delay or extra cost?
No
Yes
Was it due to Contractor's own error or late submission?
Yes
The Contractor cannot claim these remedies.
No
The Contractor may be entitled to extra time and cost plus profit under Sub-Clause 8.4 Extension of Time for completion if completion has been or will be delayed.
Refer to the procedure of Dispute Driver (1) for Sub-Clause 20.1 Contractor's Claims

12) Environmental/ Social Approvals not ready

FIDIC Clause	FIDIC Procedure
1.13 Compliance with Laws	While carrying out the contract, the Contractor must follow all laws that apply to the works. Unless the Particular Conditions say something different, the Employer is responsible for obtaining the planning permission, zoning approval, building permit, and any other permissions that the Specification says are the Employer's responsibility. If the Employer fails to obtain those, the Employer must protect the Contractor from the consequences of that failure. The Contractor, on the other hand, must give the required notices, pay taxes, duties, and fees, and obtain the permits, licences, and approvals needed under the law for carrying out and completing the works and fixing defects. If the Contractor fails to do this, the Contractor must protect the Employer from the consequences, unless the Contractor was prevented from doing so and can show that it acted diligently.
2.2 Permits, Licences or Approvals	If the Contractor asks for help, the Employer must give reasonable assistance so the Contractor can properly obtain certain legal documents and approvals needed for the project. This includes helping the Contractor get copies of relevant laws that are not easy to obtain, as well as permits, licences, and approvals required by the laws of the country. This assistance covers three main things: approvals that the Contractor is responsible for obtaining under Clause 1.13, approvals needed to bring goods into the country and clear them through customs, and approvals required to export the Contractor's equipment when it is taken away from the Site. The clause does not transfer the Contractor's legal responsibility to the Employer, but it does require the Employer to provide reasonable support when asked.
4.18 Protection of the Environment	The Contractor must take reasonable measures to protect the environment both on and off the Site. This means carrying out the works in a way that reduces harm, inconvenience, and disturbance to people and property, including problems caused by pollution, noise, and similar effects of construction activities. The Contractor must also ensure that emissions, discharges, and wastewater resulting from its operations stay within the limits set by the contract documents or by the laws that apply to the project.

13) Utility relocation delays and third-party interface failures

FIDIC Clause	FIDIC Procedure
4.6 Co-operation	The Contractor must allow reasonable opportunities for certain other people to carry out their work on or near the Site whenever the contract requires it or the Engineer instructs it. This includes the Employer's Personnel, other contractors hired by the Employer, and staff of public authorities who are working in connection with matters not covered by the Contractor's own contract. If giving this access or assistance causes the Contractor delay or creates extra cost that could not reasonably have been foreseen, the instruction may be treated as a Variation to that extent. The assistance may include letting those persons use the Contractor's equipment, temporary works, or site access arrangements where these are under the Contractor's responsibility. Where the Employer is supposed to hand over a foundation, structure, plant, or means of access that depends on the Contractor's Documents, the Contractor must submit those documents to the Engineer in the time and manner required by the Specification.
2.1 Right of Access to the Site	The employer must let the contractor enter and use the site on time, as stated in the contract. If the contract says the employer must hand over certain areas, equipment, or access routes that must also be done in the way and by the time required. However, the employer can refuse access until the contractor has provided the required performance security. If the contract does not state an access date, then the employer must give access early enough for the contractor to carry out the works without interrupting the approved programme. If the employer fails to give access on time and this causes delay or extra cost, the contractor can notify the engineer and may be entitled to more time under Sub-Clause 8.4 [Extension of Time for Completion] and payment of the additional cost plus profit. The engineer then decides or agrees the entitlement. But if the delay happened because of the contractor's own mistake or late documents, then the contractor cannot claim those benefits.
2.2 Permits, Licences or Approvals	If the Contractor asks for help, the Employer must give reasonable assistance so the Contractor can properly obtain certain legal documents and approvals needed for the project. This includes helping the Contractor get copies of relevant

FIDIC Clause	FIDIC Procedure
	laws that are not easy to obtain, as well as permits, licences, and approvals required by the laws of the country. This assistance covers three main things: approvals that the Contractor is responsible for obtaining under Clause 1.13, approvals needed to bring goods into the country and clear them through customs, and approvals required to export the Contractor's equipment when it is taken away from the Site. The clause does not transfer the Contractor's legal responsibility to the Employer, but it does require the Employer to provide reasonable support when asked.

14) Post-Commissioning drinking water quality non-compliance

FIDIC Clauses:

9.4 Failure to Pass Tests on Completion

10.1 Taking Over of the Works and Sections

11.1 Completion of Outstanding Work and Remedying Defects

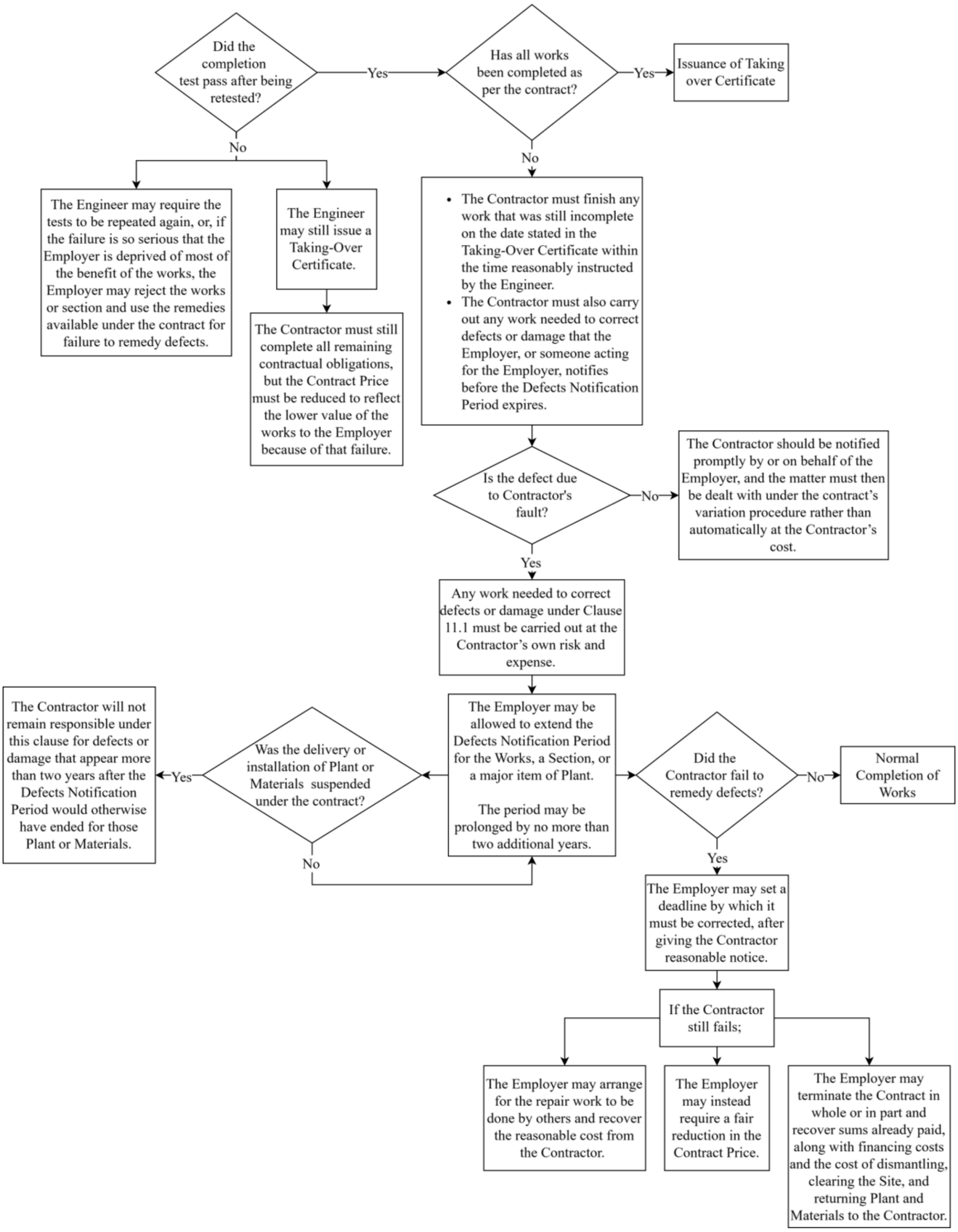
11.2 Cost of Remedying Defects

11.3 Extension of Defects Notification Period

11.4 Failure to Remedy Defects

Procedure:

(See Next Page)


Did the completion test pass after being retested?
Yes
Has all works been completed as per the contract?
Yes
Issuance of Taking over Certificate
No
The Engineer may require the tests to be repeated again, or, if the failure is so serious that the Employer is deprived of most of the benefit of the works, the Employer may reject the works or section and use the remedies available under the contract for failure to remedy defects.
The Engineer may still issue a Taking-Over Certificate.
The Contractor must still complete all remaining contractual obligations, but the Contract Price must be reduced to reflect the lower value of the works to the Employer because of that failure.
No
The Contractor must finish any work that was still incomplete on the date stated in the Taking-Over Certificate within the time reasonably instructed by the Engineer.
The Contractor must also carry out any work needed to correct defects or damage that the Employer, or someone acting for the Employer, notifies before the Defects Notification Period expires.
Is the defect due to Contractor's fault?
No
The Contractor should be notified promptly by or on behalf of the Employer, and the matter must then be dealt with under the contract's variation procedure rather than automatically at the Contractor's cost.
Yes
Any work needed to correct defects or damage under Clause 11.1 must be carried out at the Contractor's own risk and expense.
The Employer may be allowed to extend the Defects Notification Period for the Works, a Section, or a major item of Plant.
The period may be prolonged by no more than two additional years.
Was the delivery or installation of Plant or Materials suspended under the contract?
Yes
The Contractor will not remain responsible under this clause for defects or damage that appear more than two years after the Defects Notification Period would otherwise have ended for those Plant or Materials.
No
Did the Contractor fail to remedy defects?
No
Normal Completion of Works
Yes
The Employer may set a deadline by which it must be corrected, after giving the Contractor reasonable notice.
If the Contractor still fails;
The Employer may arrange for the repair work to be done by others and recover the reasonable cost from the Contractor.
The Employer may instead require a fair reduction in the Contract Price.
The Employer may terminate the Contract in whole or in part and recover sums already paid, along with financing costs and the cost of dismantling, clearing the Site, and returning Plant and Materials to the Contractor.

15) BoQ/ Quantity errors and measurement baseline weakness

FIDIC Clause	FIDIC Procedure
12.1 Works to be Measured	The Works must be measured and valued for payment in accordance with this clause. When the Contractor submits an application for an interim payment, the statement at completion, or the final payment certificate, the Contractor must include the quantities and any other details needed to show the amounts it believes are payable under the contract.
12.2 Method of Measurement	When the Engineer wants any part of the Works to be measured, the Contractor's Representative must be given reasonable notice. The Contractor must then either attend personally, or send a qualified representative, to assist with the measurement and provide any information the Engineer reasonably asks for. If the Contractor does not attend, the Engineer's measurement will be treated as correct. Where the Permanent Works are to be measured from records, the Engineer must prepare those records unless the contract says otherwise. The Contractor must attend when asked, review the records with the Engineer, and sign them once agreed. If the Contractor disagrees or refuses to sign, the Contractor must notify the Engineer of the specific inaccuracies claimed. The Engineer must then review the matter, confirm or revise the records, and certify payment of the undisputed portion. If the Contractor does not object within 14 days after being asked to examine the records, the records will be accepted as accurate. Unless the contract states something different, measurement is based on the actual net quantity of each item of Permanent Works, and the method used must follow the Bill of Quantities or any other applicable schedules.
12.3 Evaluation	The Engineer must determine the Contract Price for each item of work by applying the measured quantities agreed or determined under Clauses 12.1 and 12.2, together with the relevant contract rate or price. Normally, the correct rate is the one already stated in the contract for that item. If there is no exact rate, then a rate for similar work may be used. If an item appears in the Bill of Quantities but no separate rate or price is given for it that item is treated as already covered by other contract rates and will not be paid for separately. A new rate or price may be required in two main situations. First, it may apply where the quantity of an item changes significantly and that change has a material effect on cost, provided the item

FIDIC Clause	FIDIC Procedure
	is not marked in the contract as a fixed-rate item. Second, it may apply where work arises from a Variation and there is no suitable existing rate in the contract because the work is not similar in character or conditions to any priced item already listed. Any new rate should, where possible, be built from existing contract rates with fair adjustments. If that cannot be done, it should be based on the reasonable cost of carrying out the work, plus profit, while taking all relevant circumstances into account. Until the final rate is agreed or determined, the Engineer may set a temporary rate for use in interim payment certificates once the work begins.
12.4 Omissions	If part of the work is omitted through a Variation, and the value of that omission has not already been agreed, the Contractor may still be entitled to recover certain costs. This applies where the Contractor has incurred, or will incur, expense that would have been covered by the original Accepted Contract Amount if the omitted work had remained in the contract, and that expense is not already accounted for in any replacement or substituted work. In that situation, the Contractor must notify the Engineer and provide supporting details. The Engineer must then assess the matter under the contract and either agree or determine the amount of that cost, which is then added into the Contract Price.

APPENDIX 2: CHECKLIST

Date:

How to use: Mark Yes when the control is satisfied and supported by evidence. Mark No when there is a gap, unresolved risk, or action required. Frequency values are pre-filled to show the minimum review timing recommended for each question.

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
PRE-CONSTRUCTION							
1	Are all critical work fronts handed over, free from unresolved land, resettlement, compensation, or access constraints, and recorded section-wise before planned start?	Before commencement of each section and weekly until full access is achieved					
2	Where access or community obstruction risks remain, have recovery actions, escalation steps, and joint resolution records been agreed before mobilization?	Before mobilization and weekly until closure					
3	Are all authority permits, safeguard approvals, and third-party approvals required for planned start identified, current, and not overdue beyond trigger dates?	Before start of each affected activity and weekly thereafter until obtained					

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
4	Are utility relocations, shutdowns, and corridor verifications completed or confirmed in time for the first planned excavations and cutovers?	Before each excavation/cutover front and weekly during readiness period					
5	Have material and contractual ambiguities, contradictions, and document priority issues been logged and clarified, with only the latest approved drawings in circulation?	Before issue for construction and at each new drawing/document release					
6	Are funding evidence, approval routes, and authorized decision-makers clear enough to avoid delayed start-up, instructions, or payment events?	Before contract award and monthly until stabilized					
7	Has the Contractor submitted an acceptable baseline or current programme with practical commencement and milestone definitions?	Before commencement and at each commencement or milestone gate review					
8	Are critical resources, nominated subcontractors, plant, and materials mobilized adequately for commencement?	Before commencement and weekly during mobilization					

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
9	Are BoQ measurement rules, baseline quantities, and recording formats jointly agreed before quantity-based work starts?	Before quantity-based activities and at initial measurement setup					
10	Are community interface arrangements, complaint logging, and responsible focal persons in place before active works begin?	Before mobilization to each work area and weekly during early-stage works					
DURING CONSTRUCTION							
11	Is section-wise access status maintained during execution, with no critical front lagging more than 7 days without recorded recovery action?	Weekly and at each progress meeting					
12	Are community obstructions and complaints being logged, kept below trigger thresholds, and resolved through joint action where repeated or safety-related?	Weekly, and within 48 hours for safety-related matters					
13	Are all variations and change orders recorded, time and cost assessed, and protected from unauthorized site changes?	At each instruction and weekly through the variation review cycle					

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
14	Are pending variations older than 14 days, or variation growth above thresholds, being escalated with contemporaneous cost and time records maintained?	Weekly and at each monthly commercial review					
15	Are actual critical resources at or above 85% of plan, with immediate top-up and recovery measures issued where shortfalls persist?	Weekly					
16	Is the current programme updated and reliable, with progress, critical path slippage, concurrency, and cause ownership formally documented?	Weekly for delay control and monthly for formal programme update					
17	Are authority-dependent activities, delayed permits, and Employer or authority assistance requests actively tracked, evidenced, and mitigated or re-sequenced?	Weekly and before each authority-dependent activity					
18	Are newly arising document conflicts, late drawings, and late instructions formally notified, escalated, and prevented from affecting work without written clarification?	Weekly and immediately when a critical item becomes late					

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
19	Are oral instructions confirmed in writing within 2 working days, with notices preserved where constructive change or delay risk exists?	Daily through correspondence control and weekly review					
20	Are critical approvals, and decision-register items current, with aged decisions escalated within contractual timeframes?	Weekly and at each management review					
21	Is the payment cycle current, with complete Statements, timely IPC certification, timely payment, and overdue certified sums escalated with finance charges or suspension risk assessed?	At each IPC/payment cycle					
22	Are retention deductions and releases managed correctly, with overdue release events escalated promptly?	At each payment event and at each contractual release milestone					
23	Are QA/QC inspections, NCR trends, test failures, retests, and corrective actions under control without repeated critical failure patterns?	Weekly and monthly for trend review					

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
24	Are environmental and social compliance controls current on all active fronts, including approvals, complaints, inspections, repeated findings, and closure records?	Weekly, with immediate action for safety or major compliance issues					
25	Are utility interfaces, relocations, shutdowns, and third-party dependencies tracked and confirmed in time for upcoming works?	Weekly and before each planned shutdown/cutover					
26	Where unexpected utility clashes occur, are similar fronts paused, responsibilities recorded, and mapping or marking methods reverified before resuming?	At each clash event and before restarting similar work					
27	Are actual quantities, BoQ variances, omissions, new-rate triggers, and joint measurement records being reviewed, signed, and evidenced on time?	Weekly and at each measurement or valuation cycle					
POST-CONSTRUCTION / COMMISSIONING							
28	Are completion and commissioning tests current, with failed or repeat critical tests investigated and accepted retests documented before handover steps continue?	At each test or commissioning cycle					

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
29	Are post-commissioning drinking water quality results monitored and stable, with repeated non-compliance or any critical parameter failure immediately escalated and investigated?	Daily during stabilization and weekly until compliance is sustained					
30	Are all commissioning and defect items logged by severity, with no critical defect outstanding at TOC application or beyond rectification deadlines?	Before TOC application and weekly until critical defects are closed					
31	Is the contractual route for unresolved commissioning issues clear, including whether TOC is withheld and whether DNP or rectification periods require adjustment?	Before TOC decision and at each closeout review					
32	Are final measurements, outstanding quantity disagreements, new rates, omissions, and unsigned records resolved with a full audit trail for final account and closeout?	During closeout and before final account agreement					

S.N.	Question	Frequency of Review Required	Status (Y/N)	Owner	Due Date	Immediate Action Required	Remarks
33	Are final payment, retention release, and closeout approvals progressing within contract deadlines after handover and defect-correction milestones?	At each closeout payment milestone and until final release					

Prepared By:

Checked By:

Approved By:

APPENDIX 3: SURVEY QUESTIONNAIRE

Development of a Dispute-Risk Index (DRI) and FIDIC-Based Proactive Tool for Early Dispute Prevention in Water supply Projects in Nepal

Namaste! This survey supports a Master's thesis at IOE, Pulchowk Campus, to develop a Dispute-Risk Index (DRI) and FIDIC-Based Proactive Tool to help prevent disputes in water-supply projects in Nepal. This study compiles a structured list of dispute drivers across different phases: Pre-Construction, During-Construction and Post-Construction (mapped to relevant FIDIC/MDB contract mechanisms) and kindly asks your valuable time and input to prioritize them so they can be converted into a practical risk/dispute prevention tool.

Respondent's Information

Q.1) Name

____

Q.2) Gender

- ◯ Male
- ◯ Female
- ◯ Other

Q.3) Organization Type

- ◯ Government
- ◯ Consultant
- ◯ Contractor

Q.4) Primary Field of Expertise

____

Q.5) Years of Experience

- ◯ 5-10 years
- ◯ 11-20 years
- ◯ 21-30 years
- ◯ 31-40 years
- ◯ more than 40 years

Q.6) Have you worked on water supply projects governed by a FIDIC Contract?

- ◯ Yes
- ◯ No

Please indicate your perceived level of impact for each of the following factors during various stages in contributing to disputes in water supply projects.

» Pre-Construction Stage

Q.7) Please indicate your perceived level of impact for each of the following factors during Pre-Construction stage in contributing to disputes in water supply projects.	No Impact	Minor Impact	Moderate Impact	Major Impact	Critical Impact
Incomplete/late design drawings & specifications	○	○	○	○	○
Ambiguous or contradictory contract documents	○	○	○	○	○
BoQ/quantity errors and measurement baseline weakness	○	○	○	○	○
Inadequate process and milestone design	○	○	○	○	○
Inadequate geotechnical/topographic/site investigation	○	○	○	○	○
Poor mapping of existing utilities and assets	○	○	○	○	○
Delayed site handover/ land acquisition/ resettlement/ Compensation Disagreement	○	○	○	○	○
Environmental/social approvals not ready	○	○	○	○	○
Unrealistic baseline programme	○	○	○	○	○
Contractor's Capacity	○	○	○	○	○
Unclear Engineer authority / slow Employer decision-making	○	○	○	○	○
Unclear financing structure and institutional responsibility	○	○	○	○	○

» During Construction Stage

Q.8) Please indicate your perceived level of impact for each of the following factors during Construction stage in contributing to disputes in water supply projects.	No Impact	Minor Impact	Moderate Impact	Major Impact	Critical Impact
Unforeseeable physical conditions	○	○	○	○	○
Utility relocation delays and third-party interface failures	○	○	○	○	○
Delayed Engineer approvals	○	○	○	○	○
Late instructions/drawings/clarifications during construction	○	○	○	○	○
High volume of Variations/change orders (scope growth)	○	○	○	○	○
Delays caused by authorities	○	○	○	○	○

Supply chain and customs delays					
Delayed payment, IPC Certification and Cashflow Stress					
Disputes over valuation					
EOT, concurrent delay, and acceleration disagreements					
Quality nonconformities and failed tests					
MDB audit/integrity compliance issues					
Late notices, weak records, and claims administration failures					

» Post-Construction Stage

Q.9) Please indicate your perceived level of impact for each of the following factors during Post-Construction stage in contributing to disputes in water supply projects.	No Impact	Minor Impact	Moderate Impact	Major Impact	Critical Impact
Delayed Taking-Over due to incomplete punchlist/tests/documentation					
Disputes over commissioning and performance test criteria					
Defects during Defects Notification Period					
Restricted access/coordination for defect rectification					
Extension of DNP and delayed Performance Certificate					
Final measurement, final statement and close-out disputes					
As-built drawings, asset data, and O&M manuals incomplete or rejected					
Post-commissioning drinking-water quality non-compliance					
Operator training/operational readiness gaps					
Supplier warranty and interface disputes					
Ineffective use of Dispute Board/amicable settlement					

ANNEX I: ACCEPTANCE LETTER FOR 18th IOE GRADUATE CONFERENCE

[IOEGC18] Editor Decision External Inbox

Dr. Pradeep Shrestha 28 Apr

to me, Subash, Nagendra

Ayesha Shrestha, Subash Kumar Bhattarai, Nagendra Bahadur Amatya:

We have reached a decision regarding your submission to 18th IOE Graduate Conference, "Assessment and Prioritization of Key Dispute Drivers throughout the Life Cycle of Water Supply Projects in Nepal".

Our decision is to: Accept Submission

With Warm Regards,
IOEGC-18 Editorial Team

त्रिभुवन विश्वविद्यालय
TRIBHUVAN UNIVERSITY
इन्जिनियरिङ्ग अध्ययन संस्थान
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त्रिभुवन विश्वविद्यालय
इन्जिनियरिङ्ग अध्ययन संस्थान
पुल्चोक क्याम्पस

Date: May 9, 2026

To Whom It May Concern:

This is to certify that the paper titled "*Assessment and Prioritization of Key Dispute Drivers throughout the Life Cycle of Water Supply Projects in Nepal*" (Submission ID #938), with **Ayesha Shrestha** as the first author, was accepted through the peer-review process and has been presented at the 18th IOE Graduate Conference, organized at Pulchowk Campus, Lalitpur, Nepal, from May 7 to 9, 2026.

Please note that inclusion of the accepted manuscript in the conference proceedings is contingent upon timely compliance with any further editorial requirements during the publication process.

Prof. Sangeeta Singh
Convener
18th IOE Graduate Conference

ANNEX II: ORIGINALITY REPORT

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Development of a Dispute-Risk Index (DR I) and FIDIC-Based Proactive Tool for Ear ly Dispute Prevention in Water supply Pro jects in Nepal

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Ayesha Shrestha

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