CAPITAL UNIVERSITY OF SCIENCE AND TECHNOLOGY, ISLAMABAD

Analyzing Causes and Effect Mechanism for Escalation Provisions in the Construction Industry of Pakistan

by

Muhammad Usman Khan

A thesis submitted in partial fulfillment for the degree of Master of Science

in the

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This work is dedicated to all my valuable treasures in life, to my:

Respected Family

Which is my love and strength:

Thank you for always helping me through every difficult time of my life and for Encouraging me to move forward. You have been always a sign of love and Happiness for me.

CERTIFICATE OF APPROVAL

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(Muhammad Usman Khan)

Abstract

The construction industry grapples with a significant challenge as the prices of building materials, labor, and fuel continually fluctuate, leading to unforeseen cost escalations and surpassing the initially planned project budgets. To handle this uncertainty, contracts often include clauses that adjust prices based on these changes. These price adjustment clauses are meant to let both contractors and clients benefit from price increases or decreases, and they also encourage fair competition in bidding for projects. Different methods are used to adjust prices in construction contracts.

This research looks into the reasons behind these price changes, how they affect construction projects, and the formulae used to adjust prices. The study focuses on construction contracts in Pakistan and gathered information through a survey of construction professionals in various cities. The data collected was analyzed using the Statistical Package for the Social Sciences (SPSS).Results demonstrate that the knowledge among the stakeholders, regarding the phenomenon of price escalation/de-escalation resulting from the fluctuation in prices of construction inputs, is satisfactory. Very lower percentage of respondents of the survey shows the interest of dealing with actual base price adjustment formula in construction contracts. The price compensation system that is currently in place is limited to very few construction inputs. Loss in profits and project delays were found to be the major effects of the price fluctuation and inflation. As far as the introduction of factor based price adjustment formula by PEC is concerned, majority of the stakeholders have shown their agreement and trust over this method as this formula provides equal opportunities and fair grounds to every stakeholder in a construction contract. However, the lack of awareness, practical knowledge and experience of using the subject formula in construction contracts was found among the stakeholders of the CI. The comparison between previously implied methods for the calculation of adjusted prices and the price adjustment formula is also the part of this study. Based on the analysis of the results, recommendations for the stakeholders have been proposed for the betterment of the construction industry

against the adverse effects of the price escalation/de-escalation. The study recommends the electricity rates should be included in the list of items on which escalation is admissible, and the requirement of establishing a comprehensive and reliable price database, with the joint efforts of all the stakeholders. The proposed database should be updated within short intervals. Finally, this study may be useful for clients, consultants, contractors and other stakeholders who desire to improve the price adjustment process in Pakistan.

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Abbreviations and Symbols

BP	Basic price of item
CP	Current price
CI	Construction Industry
CPI	Consumer Price Index
CDA	Capital Development Authority
C&W	Communication and Work
FIDIC	International federation of consulting engineers
GDP	Gross domestic product
GOP	Government of Pakistan
HSD	High-Speed Diesel
IPC	Interim Payment Certificates
MMT	Modern Monetary Theory
NHA	National Highway Authority
PEC	Pakistan Engineering Council
PPI	Producer Price Index
POL	Petroleum, Oil, and Lubricants
Pn	Price adjustment factor
SPSS	Statistical Package for the Social Sciences
WBS	Work Breakdown Structure
VOW	Value of work

Chapter 1

Introduction

1.1 Background

The Construction Industry (CI) and associated engineering services are recognized as foundational drivers of economic and societal advancement. Their pivotal role lies in fostering economic growth through the development of a country's infrastructure. The CI serves as a significant source for generating employment opportunities across a spectrum of skill levels, encompassing unskilled, semi-skilled, and skilled personnel. Furthermore, it plays a crucial role in contributing to revenue generation in both the public and private sectors of the economy. Additionally, the CI contributes to foreign exchange earnings through the export of construction materials and the provision of related services [1].

Pakistan, classified as a developing nation, necessitates extensive developmental initiatives to propel its economic growth. Among the pivotal determinants for achieving the requisite levels of economic advancement in a developing context such as Pakistan, the construction industry emerges as a prominent frontline participant. In this era, the world has become a global village and keeping in view the economic competition, no country can only rely on its traditional export items. If properly encouraged the Construction Industry could serve as a base for the development of the country. The construction industry is one of the important

economic sectors of a country. However, in Pakistan the CI has shown the lowest growth rate of 0.8% in the decade in the fiscal year 2010-11 [2].

Besides all its importance, unfortunately CI can be counted in one of the most ignored sectors in Pakistan. The construction sector is universally acknowledged as a high-risk enterprise for all stakeholders involved [3]. Stakeholders, including project owners, contractors, consultants, financiers, suppliers, and service providers, harbor individual concerns regarding the inherent risks in this business domain. Within the construction industry, effective risk management constitutes a pivotal element in the decision-making process [4]. Despite the paramount importance of risk analysis in construction activities, scant attention has been directed toward the methodologies employed for risk management within the construction industry of Pakistan, along with the corresponding responses from Construction Industry (CI) entities [5]. There exists an imperative necessity to investigate the perspectives of the construction industry concerning risk associated with construction, as well as the utilization and efficacy of risk analysis and management techniques by the CI.

One of the predominant risks and challenges confronted by the construction industry pertains to the phenomenon wherein project completion costs significantly surpass the original contract prices [6]. This issue is characterized as Cost Escalation, denoting the increase in material prices leading to a decline in the purchasing power of the nation. When the annual percentage of escalation remains within a reasonable range, it is indicative of normal economic growth; however, exceeding a certain threshold is termed an inflation crisis within the country [7]. Escalation is also delineated as a depreciation in the real value of money, carrying potential adverse effects on the economy. Notably, uncertainty regarding future escalation may dissuade both investment and saving. Elevated levels of escalation can trigger consumer hoarding, anticipating future price rises. A consensus perspective posits that prolonged escalation is often a result of the money supply outpacing economic growth rates [8].The responsibility of maintaining a low and stable inflation rate typically falls under the purview of monetary authorities, commonly embodied by

central banks. These entities regulate the money supply by determining interest rates, conducting open market operations, and establishing banking reserve requirements [9].

Most of the construction projects in Pakistan faced the challenge of increase in project deliver cost that results in unpredictable change of economic environment [10]. The recent times, notable escalation in prices has been observed, extending beyond basic construction materials to encompass labor and fuel costs. This phenomenon introduces considerable uncertainty among stakeholders in construction projects. Consequently, it becomes imperative for project owners and contractors to implement strategies for quantifying and managing cost escalation. This is essential to ensure the availability of adequate funds for achieving project objectives within designated budgets and timelines [11]. In response to the challenges posed by price fluctuations, various methods and contractual clauses have been developed to address this uncertainty. Price adjustment clauses serve as a mechanism allowing contractors and clients to reap the advantages of price increases or decreases [12]. Moreover, these clauses foster a climate of competitive bidding. Diverse methods and techniques are employed in the incorporation of price adjustment mechanisms within construction contracts.

In this research, the International federation of consulting engineers (FIDIC) price adjustment formulae has been studied in comparison to the previous method of calculation for price adjustments resulted from the price fluctuations in the market. Conclusions and recommendations in relation to the advantages and disadvantages of the formula have been drawn based on statistical analysis of the data.

1.2 Research Motivation and Problem Statement

Price fluctuations have become a noticeable pattern in the global economy, and this trend is particularly significant in developing countries like Pakistan, given their dependence on external factors. The economic and political instability, along with poor security conditions in the country over the past decade, has led to

unpredictable and abnormal fluctuations in the prices of construction materials, labor, and equipment. Consequently, following is the problem statement:

"Cost escalation is causing dispute between the client and contractor which ultimately cause in the delay of the project. It is desire to explore the factors, which cause escalation problems, to draw comparison between the escalation formulae and recommendations for controlling cost escalation. The main purpose for the comparison of formula is to resolve the disputes among the Client and Contractors regarding the measurement of escalation caused during the Project."

1.3 Overall Objective of the Research Program and Specific Aim of this MS Thesis

The overall aim of this study is to analyze methods in measuring escalation to improve the price escalation system of construction projects in Pakistan and to identify the method of escalation normally used in Pakistan and whether the Contractor or the Employer has fully been compensated.
Following objectives were set forth for this research:

- To study the different factors causing escalation, effect of escalation and methods of price adjustment being used in construction industry.
- To make a comparison of different price adjustment techniques.
- To analyze the responses of the construction project participants regarding the price adjustment formulae in construction contracts and suggest improvements.

This MS research aims to identify and analyze the primary factors contributing to cost escalation in construction projects in Pakistan. It seeks to recommend strategies to mitigate these factors while exploring the most accurate measurement method for assessing cost escalation.

1.4 Scope of Work and Study Limitations

The scope of this study is to examine the concept of escalation within the guidelines of the International Federation of Consulting Engineers (FIDIC) and the Pakistan Engineering Council (PEC). The focus is on the construction industry in Pakistan, with a specific emphasis on understanding the perspectives of key stakeholders such as clients, consultants, and contractors/subcontractors regarding the price adjustment formulae. To carry out this study, data was gathered through a questionnaire-based survey. Due to time and resource constraints, some experts and projects were visited in person for data collection, while the remaining data from various locations was obtained through mail/email.

1.5 Thesis Outline

The thesis has been organized in five chapters, as shown in Figure 1-1. Details of the chapters are listed below:

Chapter 1: It elaborate presentation is made, commencing with the introduction section. This pivotal segment encapsulates the research's motivational underpinnings, articulates the precise problem statement, elucidates the overarching objective steering the inquiry, and delineates the specific aims that guide the investigative pursuits. Furthermore, a detailed exposition on the chosen research methodology is provided, offering insights into the strategic approach employed to glean pertinent data. The chapter culminates with a comprehensive outline of the thesis, offering readers a roadmap that navigates through the subsequent chapters.

Chapter 2: This chapter include the meticulous exploration into the existing body of knowledge is undertaken through an exhaustive literature review. This section not only encapsulates a detailed introduction to the phenomenon of price escalation but also delves into the intricacies of its causative factors. Furthermore, a comprehensive examination of escalation clauses is presented, providing an in-depth understanding of their nature and application. A substantial focus is

also devoted to unraveling the background and practical application of the price adjustment formula, with a nuanced analysis of its various parameters, enriching the reader's comprehension of this critical aspect of the research.

Chapter 3: This chapter serves as the methodological cornerstone of the thesis, elucidating the systematic processes employed in executing the research. This encompasses a detailed exposition on the intricacies of survey design and the meticulous development of a questionnaire tailored for the collection of pertinent data. The chapter meticulously details the procedural steps undertaken to ensure the robustness and efficacy of the chosen methodology.

Chapter 4: This chapter is a pivotal segment dedicated to presenting and analyzing the results derived from the research endeavors. The analysis is intricately woven to align with the predefined research objectives, offering a structured and data-driven exploration that enhances the depth of understanding and contributes to the fulfillment of the overarching research goals.

Chapter 5: The conclusive Chapter 5 encapsulates the culmination of the research journey, presenting a cogent summary of findings, drawing well-founded conclusions based on the results and insights gleaned. Additionally, this section proffers meaningful recommendations arising from the research, providing a valuable guide for future considerations and further inquiries in the domain

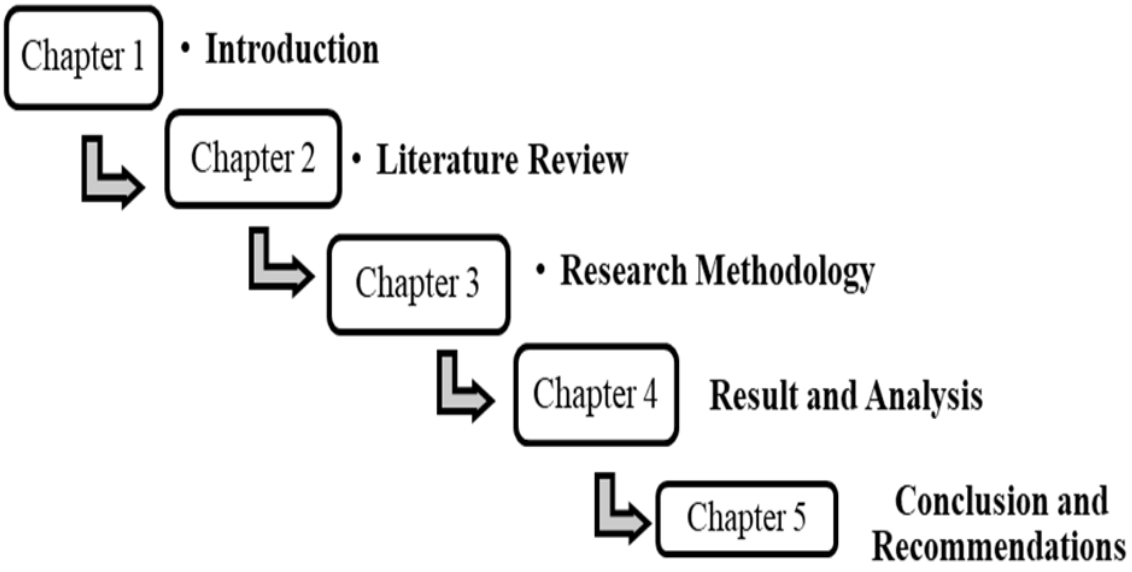

FIGURE 1.1: Graphical presentation of outline of thesis

1.6 Summary

This section provides a concise introduction to the significance of addressing price fluctuations in construction materials and services. The theoretical foundation for this study is derived from an in-depth literature review, as discussed in Chapter 2. The chapter outlines the research's importance, defines its scope and limitations, and offers an overview of the thesis.

Chapter 2

Literature Review

2.1 Background

A project is defined as a strategic mechanism for realizing an organization's strategic plan. Typically, projects within the realm of civil engineering construction are characterized as unique, temporary endeavors, often constituting components of broader programs [13]. These projects adhere to predetermined costs, completion timelines, and quality specifications. The execution of civil engineering projects follows distinct stages, namely initiation, planning, execution, monitoring and control, and project closure. Each stage involves numerous activities [14].Key participants in these projects include Owners/Clients, financers, consultants, designers, contractors, suppliers, and end-users. These stakeholders, with minor variations, collectively contribute to the completion of civil engineering works. The nature of interactions among these parties, whether direct or indirect, depends on the specific project requirements. The construction industry, characterized by substantial investments and turnovers, serves as a significant economic indicator for a country [15]. In developing nations, the construction sector is strategically employed as a means of poverty alleviation through revenue generation and employment creation. Among the entities involved in civil engineering projects, contractors and consultants are distinctly business organizations primarily driven by profit motives

for their services, while other stakeholders may or may not align with commercial enterprises [16].

Contractors are primarily engaged in multifaceted activities with a direct susceptibility to prevailing market conditions. Market-driven price fluctuations significantly impact contractors, given their frontline role in the construction sector. They bear the responsibility for procuring and ensuring the timely delivery of labor, materials, and equipment, depending on the contractual arrangements, essential for project completion. Contractors maintain direct connections with suppliers, subcontractors, and labor [17]. It is noteworthy, however, that contractors are not inherently obligated to endure and absorb the enduring impacts of market price fluctuations. The onus of managing such fluctuations lies with project owners or clients, who hold ownership and responsibility for the project.

The construction industry in Pakistan is confronted with the intricate challenge of escalation, necessitating a comprehensive exploration of its multifaceted dimensions. In the pursuit of unraveling the complexities, the chapter commences with an examination of cost escalation, a pervasive issue marked by fluctuations in material prices, labor costs, and other inputs influencing project expenses. Simultaneously, an investigation into the factors causing inflation within the Pakistani context is initiated, encompassing the pivotal roles played by money supply, exchange rates, and distinct mechanisms such as cost-push and demand-pull inflation. The interplay of these factors within the construction landscape is critical for understanding escalation dynamics. Delving into specifics, the discussion on money supply unfolds to scrutinize how shifts in monetary dynamics impact construction costs. Likewise, the exploration of exchange rates sheds light on the industry's susceptibility to currency fluctuations. Further scrutiny involves dissecting cost-push and demand-pull inflation mechanisms, providing insights into their contributions to escalation. Subsequently, a pivotal segment unfolds, focusing on the consequential effects of escalation on the construction industry. This examination elucidates the far-reaching impacts on project timelines, financial viability, and overall industry sustainability, offering foundational insights for devising effective escalation management strategies. Transitioning to a solutions-oriented approach, the chapter progresses to explore various techniques employed in the

construction industry for measuring and managing escalation. Subsections encompass an exploration of escalation clauses in contracts, diverse measurement formulae, the general structure of price adjustment formulas, and specific features defining these methodologies. Culminating the chapter, the summary encapsulates key insights, providing a cohesive overview of the factors, techniques, and implications associated with escalation in the Pakistani construction industry. This serves as a robust foundation for subsequent in-depth analyses and discussions.

2.2 Factors of Escalation in Construction Industry of Pakistan

In the construction industry of Pakistan, identified factors contributing to cost escalation prominently include financial issues, delayed payments, and inflation, with clients positioned to mitigate the impact of financial challenges the literature on factors contributing to escalation in construction projects provides valuable insights into the multifaceted challenges faced by the industry. Economic factors, particularly the depreciation of local currency, substantial impact on project costs due to increased expenses for imported materials and equipment. Social and labor-related factors, such as strikes, represent significant threats to project timelines and costs. Effective labor management strategies are emphasized to mitigate these risks. [18]. Primary drivers of escalation are recognized as material price fluctuations and variations In terms of project management and contractual issues, the subletting of projects and the challenges associated with subcontractor management, including coordination issues and potential delays, leading to cost escalation. Disputes, emerge as critical factors contributing to project escalation. Effective dispute resolution mechanisms and robust contract administration are identified as crucial components in avoiding delays and cost overruns. [19]. The construction sector is acknowledged as a pivotal contributor to economic growth and development, with construction activity preceding GDP, rather than the reverse Uncertainties inherent in construction projects, pose continual challenges. Factors such as design changes, unforeseen site conditions, and regulatory issues

contribute to cost escalation if not adequately managed. Inadequate contract management, further exacerbates the problem. Poorly defined contracts, ambiguous clauses, and a lack of effective monitoring mechanisms can lead to disputes and increased project costs. [20].The principal driver of escalation is attributed to change orders in the project scope that were not encompassed by the original contract. Increased complexity, as indicated by factors such as contract size, duration, and urban location, elevates both the risk and magnitude of cost overruns. Notably, poor cost predictability and the rightward skew of the distribution of final costs pose concerns for project managers and owners, potentially resulting in project cost overruns unless the contingency budget is sufficiently robust to accommodate uncertainties. Consensus among experts identifies inadequate supervision, irregular payment schedules, and design errors as the most commonly agreed-upon factors responsible for project cost escalation external environmental factors, including natural disasters, need for comprehensive risk assessments and contingency planning to mitigate the impact of unforeseen events on construction projects. The interplay of economic, social, and managerial factors in causing escalation in construction projects. Currency depreciation, labor strikes, subletting challenges, disputes, uncertainties, and inadequate contract management are identified as critical aspects demanding meticulous attention in project planning and execution. [21].

The construction industry in Pakistan is confronted with a myriad of factors that contribute to cost escalation, necessitating a comprehensive exploration of these influences. Economic conditions play a pivotal role. They underscore the impact of inflation rates and currency devaluation on construction costs, advocating for a proactive approach to manage economic uncertainties within project planning. The political and regulatory environment is another critical dimension, who delves into the implications of political instability, bureaucratic hurdles, and inconsistent regulatory policies on project timelines and costs. Effective strategies to address these challenges are deemed vital for successful project delivery. Supply chain disruptions, underscore the vulnerability of the construction industry in Pakistan to raw material shortages and skilled labor unavailability. Robust supply chain

management practices are identified as imperative to mitigate these risks and ensure seamless project execution. Technological changes are also scrutinized in the literature, the effects of technology-driven advancements on construction project costs. Adapting to new technologies while effectively managing associated costs emerges as a critical consideration for stakeholders in the industry [22].

Environmental and sustainability factors are gaining prominence, the financial implications of integrating eco-friendly practices and compliance with environmental regulations into construction projects. Striking a balance between sustainability goals and cost considerations is pivotal for achieving long-term project viability. Changes in project scope, underscore the challenges posed by variations in project requirements. Robust change management processes are identified as crucial in minimizing cost escalation resulting from scope changes [23].

Labor productivity and availability are consistently highlighted in the literature. The significance of addressing fluctuations in labor productivity and wage inflation for cost-effective project execution. Infrastructure and logistics, emerge as critical factors influencing construction costs. Improving transportation networks and logistics infrastructure is deemed crucial in reducing delays and associated costs.

Financial risks and funding challenges, underscore the importance of robust financial planning and risk mitigation strategies in the construction industry. Finally, security concerns, the impact of security issues and geopolitical tensions on project timelines, necessitating the incorporation of security measures into comprehensive project planning.

2.2.1 Cost Escalation and Construction Industry

The literature reveals a wealth of insights into the multifaceted nature of cost escalation within the construction sector. Numerous studies have investigated the various dimensions and contributing factors, shedding light on the challenges faced by industry stakeholders. Cost escalation is a prevalent concern within the construction industry, the need for a comprehensive understanding of the factors driving cost increases to develop effective strategies for cost control and project

management. The construction industry's susceptibility to economic conditions is underscored, where fluctuations in inflation rates and currency devaluation are identified as key contributors to escalating costs. Inflation constitutes a crucial phenomenon within the construction industry (CI) context, given the inherent volatility in the purchasing power of money across global economies. The constant flux in the amount of materials and services obtainable with a fixed monetary unit underscores the dynamic nature of inflation [24]. Inflation, essentially, erodes the currency's purchasing power, signifying that an identical sum of money can procure fewer goods and services as prices escalate. Consequently, inflation imparts diminished value to future currency relative to its present worth [24].Conversely, deflation, though rare in the contemporary world, results in an augmented purchasing power for the same amount of money in subsequent years compared to its current value [23]. An elevated inflation rate invariably correlates with heightened price volatility, exerting ramifications on the future prospects of investment projects. This, in turn, diminishes investor interest and hampers economic growth. Furthermore, inflation intertwines with a country's tax system to disrupt borrowing and lending decisions, compelling firms to allocate additional resources to manage inflationary effects [25].

2.2.2 Factors Causing Inflation

Economists don't always agree on where inflation comes from, but they generally believe that inflation is affected by various factors, either on their own or working together.

Money Supply:

The quantity of currency circulating within the national economy is believed to exert influence on its purchasing power. An excess of money relative to the available goods and services tends to devalue the currency, while a scarcity of currency enhances its value. The Federal Reserve, by managing the money supply, endeavors to align the expansion of currency with the concurrent growth rate of the economy the relationship between money supply and inflation has been extensively explored in the literature. The Quantity Theory of Money, discussed by various researchers,

establishes a foundational framework, asserting that an increase in the money supply, assuming constant velocity and output, results in a proportional increase in the price level. Empirical studies, contribute by employing econometric models to analyze this relationship in different economic contexts, often using time-series data to estimate the impact of changes in money supply on inflation rates. The effective management of money supply and inflation hinges on the strategic implementation of central bank policies. These inquiries explore the utilization of monetary policy tools by central banks, including interest rates and open market operations, to regulate money supply and impact inflationary patterns. Additionally, the investigations delve into monetary transmission mechanisms, scrutinizing channels such as interest rates, exchange rates, and asset prices to gain a deeper understanding of the intricate interactions within the broader economic system [26].

Global perspectives on the money supply-inflation relationship are considered, The studies explore cross-country variations, institutional differences, and the impact of global economic trends on the effectiveness of monetary policy in controlling inflation through adjustments in money supply. In recent years, the Modern Monetary Theory (MMT) has introduced new perspectives on fiscal and monetary policy coordination in the context of money supply and inflation. Moreover, the literature also considers the role of inflation expectations in shaping the money supply-inflation nexus. The studies emphasize the psychological and anticipatory aspects of inflation, considering how expectations influence individuals' behavior and economic outcomes.

Exchange Rates:

The global standing of the U.S. dollar carries consequences for the profitability of international firms engaged in those markets. To counteract the fluctuating strength or weakness of the dollar globally, adjustments in price rates may be introduced. When exchange rates diminish or erode corporate profits in particular markets, compensatory actions might necessitate raising prices in alternative markets. The literature examining the nexus between exchange rates and inflation provides a nuanced understanding of the complex dynamics shaping economic

outcomes. The exchange rate movements should, over the long run, reflect relative inflation rates between two countries, influencing the purchasing power of their respective currencies. Building on this, the concept of exchange rate pass-through, investigating how changes in exchange rates transmit to domestic prices and emphasizing the importance of considering these pass-through mechanisms in inflation analyses. [27]. additionally, the literature explores the interplay between global commodity prices and exchange rates, as investigated by researcher. These studies shed light on how fluctuations in exchange rates impact the prices of internationally traded commodities, thereby influencing domestic inflation rates. Further insights into the relationship between exchange rates and inflation emerge from studies investigating the role of different exchange rate regimes. The literature considers the challenges faced by emerging markets, how exchange rate volatility in these markets can contribute to inflationary pressures, considering factors such as external debt, capital flows, and economic stability. Moreover, the literature delves into the responses of central banks and their impact on inflation expectations. The studies explore how monetary authorities' actions in response to exchange rate movements and inflationary pressures influence public expectations and, consequently, inflation outcomes. In conclusion, the comprehensive literature on exchange rates and inflation provides a multifaceted understanding of the intricate relationship between these variables, incorporating theoretical frameworks, empirical analyses, and considerations of global and emerging market perspectives.

Cost-Push Inflation:

Supply-side inflation refers to a scenario wherein producers of goods and services proactively transfer their escalating operating costs to customers by implementing higher prices. These operating costs encompass various components such as fabrication/manufacturing, marketing, and sales, among others. The literature on cost-push inflation provides a comprehensive understanding of the economic phenomena wherein rising production costs exert upward pressure on overall price levels. The factors contributing to cost-push inflation. One prominent factor is the increase in the cost of production inputs, expenses for raw materials, labor, or energy directly translate into elevated production costs for businesses. The impact

of external shocks, such as geopolitical events or disruptions in the global supply chain, on production costs and subsequent inflationary pressures. [28].

Labor-related factors are also crucial contributors to cost-push inflation. The studies highlight the impact of wage increases or changes in labor market conditions on overall production costs, emphasizing the role of labor as a key determinant in the inflationary process. Additionally, the influence of regulatory changes and compliance costs on production expenses, shedding light on how shifts in government policies can contribute to cost-push inflationary trends. The literature also recognizes the role of technological advancements and innovation in influencing production costs, as discussed. While technological progress may enhance efficiency, it can also lead to increased costs associated with adopting new technologies, impacting overall production expenses.

Demand-Pull Inflation:

This relates to inflation driven by demand, wherein consumers engage in unchecked spending on goods and services, typically at the expense of saving. The surge in demand for particular goods and services results in a proportional rise in their prices, as the demand outstrips the existing supply. The literature on demand-pull inflation offers a comprehensive examination of the economic phenomenon where an increase in aggregate demand outpaces the economy's ability to produce goods and services, leading to upward pressure on overall price levels. Studies by researchers delve into the key drivers of demand-pull inflation. One central aspect is consumer spending. Whereby robust consumer demand, often fueled by factors like low interest rates or increased consumer confidence, stimulates aggregate demand, contributing to inflationary pressures. [29].

The study explores the role of investment spending in driving demand-pull inflation. Increased business investments, whether in capital goods or expansion projects, can augment aggregate demand, creating a scenario where demand outstrips supply and induces inflation. Additionally, studies emphasize the impact of government spending on inflationary trends. Heightened government expenditures, particularly in situations of fiscal stimulus or increased public infrastructure

projects, can significantly contribute to the overall demand-pull dynamic. The literature also considers the role of exports and imports in influencing aggregate demand. Research investigates how changes in net exports, driven by shifts in international trade dynamics, can impact domestic demand and contribute to inflationary pressures. Moreover, studies delve into the impact of speculative activities and financial market dynamics on demand-pull inflation, highlighting the intricate relationship between financial markets and overall economic demand.

The literature on demand-pull inflation provides a nuanced understanding of the factors driving this economic phenomenon. From consumer spending and investment to government expenditures, international trade dynamics, and financial market influences, researchers have contributed valuable insights into the complexities surrounding demand-pull inflation.

2.3 Effects of Escalation on Construction Industry

Building prices exhibit significant annual fluctuations, encompassing variations in the costs of building materials, human resources, and other essential construction inputs. These fluctuations pose challenges to accurately estimating construction costs for housing projects. Inherent challenges are omnipresent in every construction endeavor, with the nature and impact of these challenges varying across projects and regions. The literature on the effects of escalation in the construction industry encompasses a diverse range of perspectives, highlighting the multifaceted impact of cost increases on various project dimensions. Research emphasizes the pervasive challenge of cost overruns, indicating that escalation significantly contributes to exceeding initial project budgets. This effect is compounded by delays, which underscore the interdependence of cost and time in construction projects. Delays often result from financial constraints induced by escalation, leading to disruptions in project schedules [30]. Key challenges include resource allocation, time management, cost control, quality assurance, safety protocols, project complexity, and changes in project scope, uncertainties, and communication issues.

Statistical analysis underscores that all investigated challenges are characterized as high-risk factors. Among these, time, cost, and quality emerge as the most critical challenges, with the potential to jeopardize the success of a construction project Contractual disputes, a prevalent consequence of escalation, are a central focus in the literature. Study delve into the intricacies of disputes arising from cost escalation, emphasizing the importance of clear and well-defined contracts to mitigate conflicts. These disputes, often centered on the allocation of increased costs, introduce legal complexities and can strain relationships among project stakeholders [31].

Delays, defined as extensions beyond the stipulated project completion time, constitute a significant setback for construction projects. Delay occurrences are commonplace in construction and can exert adverse effects on both project timelines and costs. Given the substantial economic impact of construction activities, delays incur significant financial losses, contributing to a decline in the country's GDP [32]. The impact of escalation on profit margins is a consistent theme in studies, shedding light on how increased costs erode the profitability of construction firms. The literature also addresses the challenges of risk management in the face of escalation, emphasizing the need for robust strategies to identify, assess, and mitigate external risks contributing to cost increases.

The rise in market prices for construction materials and labor presents a significant obstacle to the progress of the Construction Industry (CI). Inadequate accessibility and affordability, covering both quantity and quality considerations, can lead to difficulties for project stakeholders in achieving the defined standards for project completion, quality, and timeliness. In the absence of a comprehensive compensation strategy, the primary outcomes of price fluctuations may encompass [33]:

- Delays or cancellation of projects
- Reduced numbers of bidders
- Poor quality
- Loss in profits

- Problems of the cash flow
- Loss of interest of stakeholders in the project

2.4 Techniques Adopted in Construction Industry for Escalation Measurements

Various economic and price dynamics can unfold during the timeline from the initiation of a project to its fruition, impacting the profitability of the victorious bidder. In instances where the winning bidder has not adequately considered the likelihood of price increases, the potential for substantial profit margins diminishes. This scenario may lead to ongoing disputes, claims, and potential litigation during the settlement of accounts, accompanied by delays, substandard work, and attempts to cut costs at the contractor's expense. To mitigate such challenges, contracts with a duration exceeding one year commonly incorporate an escalation/price adjustment clause. An escalation clause is defined as a contractual provision guaranteeing a modification in the contract price when external factors, beyond the control of either party, result in a cost increase or decrease for the contractor [34]. This clause enables the parties to proactively address uncertainty, determining how, by whom, and to what extent additional costs will be absorbed. Consequently, future price increases for significant cost components become the employer's risk, affording the owner not only protection from a contractor hesitant to perform under evolving circumstances but also facilitating competitive and reliable bids. The absence of an adjustment clause could lead bidders to estimate and bid potential future cost increases differently, resulting in unrealistic prices. Furthermore, the inclusion of such a clause ensures that the estimation of future cost increases is neither overly conservative nor excessively high, contributing to more accurate and competitive bids.

2.4.1 Categories of Clauses of Escalation in a Contract

Considering the persistent and unpredictable pattern of price fluctuations in construction materials and labor, the incorporation of price adjustment clauses has

become integral to construction contracts. This inclusion aims to mitigate the uncertainty surrounding prices at the project's outset and allows for a certain level of adaptability. These clauses necessitate meticulous customization and thoughtful drafting, specifically delineating the building materials most susceptible to price variations. The procedure should also stipulate the designated price index for assessing changes in prices and articulate the frequency with which a price adjustment clause may be invoked during the project. Three distinct types of price adjustment methods persistently employed for calculating adjusted prices are as follows [35]:

Invoice method: In this methodology, the contractor submits substantiating documentation, such as invoices, purchase bills, or certifications from suppliers, verifying alterations in the price of procured materials. The documentation must accurately depict the variation in material prices from the contract signing date to the actual purchase date. The contractor is remunerated based on the difference between the rates of the materials on the two specified dates. However, this approach faced limited popularity due to the influx of divergent information regarding increased or decreased rates from both contracting parties.

The invoicing method in accordance with the Pakistan Engineering Council (PEC) guidelines is a critical aspect of engineering and construction projects. Invoices within the realm of engineering projects must adhere to established practices to ensure transparency, adherence to contractual agreements, and compliance with regulatory standards. These invoices typically contain detailed project information, including the project name, location, and a concise description. Reference to the specific contract or agreement under which the services or work are being invoiced is crucial, encompassing contract numbers, dates, and stipulated terms and conditions.

Engineering project invoices often employ a Work Breakdown Structure (WBS) to systematically categorize and outline the various components of work performed, providing a structured breakdown of tasks and associated costs. The inclusion of quantity and unit rates is imperative, offering transparency and clarity regarding the amount of work completed and the corresponding unit costs. Additionally,

adherence to local tax regulations is paramount, with invoices accounting for applicable taxes and duties in compliance with Pakistani tax laws [36].

Index method: In employing the index method within contracts, the adjustment of the contract price is linked to a specific price index guide associated with a particular product. This facilitates the adaptation of the contract price to regional and local fluctuations in essential commodities such as steel, diesel fuel, cement, and asphalt. The index method proves beneficial when a supplier is unable to provide a fixed price until the actual purchase, offering clients oversight by an impartial and independent entity.

As a prominent escalation measurement technique in construction and engineering projects, the index method has been thoroughly examined in the literature. Its foundational principles are grounded in economic indices, including the Consumer Price Index (CPI) and the Producer Price Index (PPI), serving as benchmarks for monitoring changes in the costs of goods and services over time. In the construction industry, the application of the index method is a focal point of investigation in studies that delve into the development and utilization of construction cost indices. These indices play a pivotal role in monitoring fluctuations in the prices of construction-related inputs, labor, and materials [37].

The accuracy and reliability of the index method are central themes in the literature, with studies delving into the challenges and limitations associated with specific indices and proposing methods to enhance accuracy. Considerations of regional variations and the development of specialized indices are addressed in research, recognizing the need for tailored approaches to escalation management based on unique regional economic conditions.

Hybrid Method: This method combines elements from previous approaches and is based on a "certified bid cost." The contractor confirms its estimated cost for a specific material using the current supplier price or an indexed price listing. If these prices change by a set percentage, like 5 percent or 10 percent, either up or down, the contract is adjusted accordingly. The hybrid method, as a nuanced escalation measurement approach, is a focal point in the literature on cost management within construction and engineering projects, explore the integration of

traditional escalation indices with advanced forecasting models to overcome the limitations of individual methods. This hybridization aims to leverage historical data from indices while incorporating predictive elements to enhance the accuracy of projecting future costs.

Well-crafted price adjustment clauses in construction contracts help reduce risks for both the contractor and the owner, minimizing conflicts and promoting cooperation. These clauses are designed with an understanding that material, POL (Petroleum, Oil, and Lubricants), and labor prices can change between contract signing and project completion. Importantly, they provide a way to protect the interests of everyone involved, maintaining good business relationships and ensuring that no one gains unfair advantages.

2.4.2 Escalation Measurement Formulae

Construction projects, whether in the private or public sector, typically span extended durations, ranging from several months to several years. Given the inherent volatility in construction material and labor prices, there exists a significant likelihood that costs will fluctuate unpredictably, to varying degrees, throughout the project's duration. Various project stakeholders adopt strategies to address this risk, employing mitigation, incorporation, or transfer approaches based on their risk tolerance and management capabilities.

Consequently, a provision for price fluctuation in construction contracts is imperative, accompanied by an efficient, accurate, and expeditious method for recovering actual fluctuations. This method should be universally acceptable to all project stakeholders and avoid granting undue advantages to any party involved [38].

In international construction contracts, the practice of incorporating price adjustments is employed to address fluctuations in the costs of materials, labor, and services. Given the high volatility of prices due to various factors, construction experts advocate for computing contract costs based on current prices while allowing flexibility for price adjustments to accommodate probable fluctuations during

the project's duration. The FIDIC 1999 introduces a formula to calculate a significant portion of the escalation risk associated with price hikes. This formula aims to establish a uniform and realistic method for mitigating the adverse effects of price fluctuations, with the intent of being acceptable to all parties under diverse circumstances.

In Pakistan, the Finance Division issues guidelines and formulas for the computation of price adjustments through Office Memorandums, while Pak-PWD periodically generates escalation graphs for standard Civil, Mechanical, and Electrical projects to provide compensation to contractors. The Government of Pakistan (GOP) established a comprehensive formula in 1996 to streamline Price Adjustment calculations. Internationally recognized consultants continue to adhere to FIDIC provisions. However, considering diverse methods and practices, the Pakistan Engineering Council (PEC) formulated the document "Standard Guidelines and Formula for Price Adjustment," primarily based on the rate analysis of various contract elements. Following extensive deliberations, a two-day National Workshop in March 2000, involving contractors, consultants, GOP officials, and financial experts, concluded that adopting the formula method aligned with FIDIC recommendations would be advantageous. Therefore, this document is derived from the recommendations of that workshop [39].

2.4.3 General Form of Price Adjustment Formula

The price adjustment formula introduced by FIDIC in 1999 and adopted by PEC in 2000 [46]. The formula is mentioned below in Equation 2.1.

$$Pn = A + bLn/Lo + cMn/Mo + dEn/Eo + ... \tag{2.1}$$

Where

Pn is the Price adjustment factor for the work carried out in the period "n"

A is a constant or the Non Adjustable portion of the price adjustment

b,c,d are Coefficients or weightages for the each specified element of the adjustment in the contract. The sum of A,b,c,d,etc shall be one.

Lo,Mo,Eo are the Base Date Indices for the specified (adjustable) element
Ln,Mn,En are the current Date indices of the specified element for the period "n"

2.4.4 Features of Price Adjustment Formula

Following are the features of price adjustment formula:

1. Contracts currently in progress at the time of implementing the price adjustment formula will adhere to their existing provisions for price adjustment, unless both parties to the contract sign an amendment with mutual understanding.

2. Price adjustment is applicable only to contracts with an original duration of 12 months or more and a contract value exceeding Rs 25.00 million.

3. Full price adjustment will be granted for the original scheduled completion period, and the contractor must submit the construction schedule as outlined in the contract.

4. If the contract surpasses its initial completion time, no price adjustment will be provided for time beyond the original contract period if the delay is attributable to the contractor. However, if the employer is responsible for the delay, the contractor will receive full compensation for price adjustment. Following is the list of commonly use items on which price adjustment is admissible:

    - Cement
    - Steel
    - POL
    - Labor
    - Bricks
    - Bitumen

5. No compensation for price adjustment will be provided to the contractor for items furnished by the employer, either free of charge or at predetermined rates.

6. The formula is applicable across various contract types, encompassing lump sum contracts, percentage over schedule contracts, and items rate contracts. However, fixed price contracts are exempted. Price adjustment will be exclusively disbursed in the local currency (Pakistani Rupees), unless the contracting parties mutually agree on an alternative foreign currency for the adjustment.

7. Only cost elements with a cost impact of 5 percent or more are eligible for adjustment. However, High-Speed Diesel (HSD) and labor must be included in the Price Adjustment formula regardless of their percentage in a specific project, if applicable to that project.

8. If an item eligible for price adjustment as per the contract is not utilized in a given billing month, the ratio of the current date price to the base date price will be considered as "one" for the price adjustment for that particular month.

9. In instances where cost indices for current months are not promptly available, FIDIC 1999 stipulates that, until the cost index becomes available, the engineer may establish a provisional index for issuing Interim Payment Certificates (IPC) or may use the cost index from the previous month. Upon the availability of the cost index for the specific month, the adjustment will be recalculated accordingly.

2.4.5 Actual Base Price Adjustment Formula

Actual base price adjustment formula is also in use in Pakistan construction industry by Punjab planning and development commission [47]. The formula is given below as equation 2.2.

$$Increaseordecrease = \alpha xVOWx(CP - BP)/BP \tag{2.2}$$

Where:

VOW = the value of the work

CP = Current price of item

BP = Basic price of item

α= Factor decided in the contract

2.5 Price Adjustment formulae and Rational of Current Study

As explained in section 2.4, there are two formulae for price adjustment. There is no specific guideline on selection of the formulae. This study aims to understand why there are two formulae and what difficulties stakeholders face when using them. This study aims to figure out why these formulas exist together and what challenges they cause. By looking closely at these formulae and their consequences it is hoped to find suitability of each formulae for the specific project.

2.6 Summary

In this chapter, Price Escalation was discussed in detail. The detailed literature review covered the effects of price fluctuation, its causes and the methods & techniques used to minimize the adverse effects of price escalation. The commonly used method to cover the escalation in prices is the inclusion of Price Escalation Clause in the contract. The discussion on different types of price escalation clauses is also the part of this chapter. Then the background of price adjustment formula, its generalized form and factors, application of the formula to calculate the adjusted costs are discussed in detail, which was one of the objectives of this study. All this extensive literature review helped in the preparation of questionnaire which was the research tool for this thesis. In the next chapter the research methodology developed for this research study is discussed.

Chapter 3

Research Methodology

3.1 Background

In this chapter, the research methodology adopted for this thesis is discussed. Research strategy shows how the researchers are going to carry out their study to achieve the research objectives [40]. Generally the common methods used for the collection and generation of the research data are the questionnaire survey and interviews. This research is conducted as an exploratory and comparative study of the FIDIC price adjustment formula and its implications in construction contracts and suggested measures to improve the formula. Graphical presentation of the research methodology adopted in this research is shown in Figure 3.1.

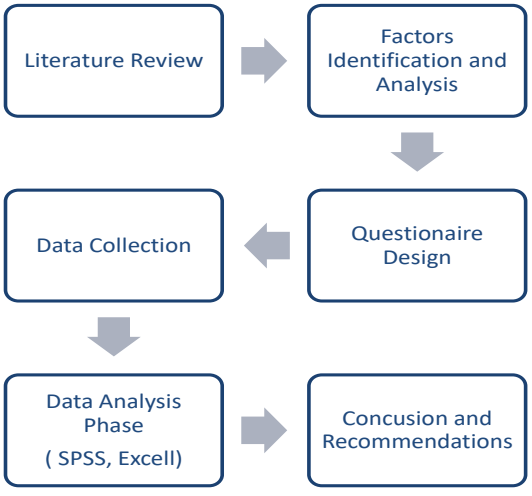

FIGURE 3.1: Graphical presentation of research methodology

After carrying out the pilot study, the questionnaire was reviewed further and necessary adjustments were made keeping in view the practices and requirement of the CI of Pakistan to make it suitable for the local environment. A five-point Likert scale, with 5 being very high and 1 being very low, is utilized to judge the opinion of the concerned stakeholders. The construction professionals, contractors and client are the sample population for this research. Total 110 questionnaires are received out of which 90 were valid, remaining were excluded being incomplete/invalid. Respondents to this survey include 15 from owners/client category, 30 were working as consultants and 45 respondents are from contractor/subcontractor side. The collected data was analyzed using MS excel and SPSS-18. The Cronbach's Coefficient Alpha method test was applied to measure the internal consistency (reliability). To check whether data was parametric or non-parametric (normally distributed or otherwise), the Shapiro-Wilk Normality Test was performed. Kruskal-Wallis test was conducted to have a view about the differences or similarities in the opinion of all stakeholders about escalation and price adjustment formula.

3.2 Factors Identification and Analysis

In this study, the survey was carried out through questionnaire method as it is the most appropriate method for this kind of study [41]. Instead of using "Yes/No" answers, for most of the questions, a five point Likert scale was used, to give respondent the extra range of possibilities between "Yes" and "No". The principal consideration for using Likert scale is to determine the extent to which respondents agree or disagree with a particular statement or view [42].

Analysis of data has been carried out using MS excel and SPSS-18, to have frequency analysis, reliability analysis. To check the differences in the opinions of all stakeholders, Kruskal-Wallis test was performed. The selection of these statistical methods will be introduced in relevant chapters. In the last, efforts were made to draw conclusions and give recommendations on the basis of analysis and results obtained.

3.2.1 Frequency Analysis

Before finalizing the factors for a questionnaire, it's important to do frequency analysis. This means looking at how often different factors appear in the literature. This helps in deciding which factors to focus on priority in the questionnaire. Frequency analysis also helps in avoiding asking about the same question in different ways. Thus, there is clarity of what to ask and how to ask. [43].

In this study, a comprehensive frequency analysis was conducted to examine the factors contributing to escalation and the subsequent effects within the construction industry. By systematically analyzing a dataset of literature review, purpose of frequency analysis was to uncover the most prevalent factors that lead to project escalation. The frequency analysis revealed a clear pattern, highlighting different factors of escalation according to different researchers. Additionally, the frequency analysis extended to the effects of escalation, underscoring the widespread impact on construction project. By quantifying the occurrence of factors causing escalation and effects, we gain a more nuanced understanding of the implications of escalation, aiding in the formulation of questionnaires for the data collection. Overall, this frequency analysis serves as a foundation for the development of the questionnaires. Table 3.1 shows the factor according to the number of occurrence in literature.

Table 3.1: Frequency Analysis for different factors

Sr. No.	**Factors**	**Frequency**
1	Delay in Payments	9
2	Poor planning	9
3	Inadequate contract management	8
4	Changes in project scope	13
5	Financial issues faced by client	5

Sr. No.	**Factors**	**Frequency**
6	Inflation	7
7	Delay in decisions	7
8	Project Location	5
9	Subletting of project	12
10	Resources constraint	10
11	Weather	7
12	Mistakes and Discrepancies in contract document	5
13	Mistakes during construction	5
14	Proper and Vigilant Supervision	13
15	Construction methods	6
16	Fraudulent practices and kickbacks	5
17	Local government pressures	7
18	Strikes	5
19	Insufficient/incomplete drawings	2
20	Depreciation of local currency	4
21	Disputes	5
22	Bank loans and financing offered at a high-interest rate	6
23	Uncertainties/risks of the project	6

Sr. No.	Factors	Frequency
24	Rework of bad quality performance	1

3.2.2 Grouping of Factors According to Stakeholders

In order to comprehensively understand the multifaceted aspects of our project, we conducted a thorough frequency analysis of various factors causing escalation. With the aim of addressing the diverse concerns and priorities of the key players involved, including clients, contractors, and consultants, we undertook a meticulous separation of these factors. This approach allowed us to categorize each factor according to its relevance to the different stakeholder groups. By doing so, we gained valuable insights into the distinct perspectives of each party. This categorization not only aids in aligning our efforts with the specific needs of our stakeholders but also facilitates effective communication and collaboration. Through this process, we can prioritize our actions based on the priorities of each group. Below table 3.2 shows the grouping factors according key stakeholders.

Table 3.2: Grouping of factors according to client, contractor and consultant

Sr. No.	Factors
	(a) Factors related to Client
1	Financial issues faced by client
2	Delay in Payments
3	Poor planning
4	Inadequate contract management
5	Changes in project scope
6	Delay in decisions

Sr. No.	Factors
7	Mistakes and Discrepancies in contract document
8	Proper and Vigilant Supervision
9	Fraudulent practices and kickbacks
10	Disputes
11	Bank loans and financing offered at a high-interest rate
	(b) Factors related to Contractor
1	Poor planning
2	Inadequate contract management
3	Delay in decisions
4	Subletting of project
5	Resources constraint
6	Weather
7	Mistakes during construction
8	Proper and Vigilant Supervision
9	Construction methods
10	Fraudulent practices and kickbacks
11	Disputes
12	Bank loans and financing offered at a high-interest rate
13	Rework of bad quality performance

Sr. No.	Factors
	(c) Factors Factors related to Consultant
1	Delay in Payments
2	Poor planning
3	Inadequate contract management
4	Changes in project scope
5	Delay in decisions
6	Mistakes and Discrepancies in contract document
7	Proper and Vigilant Supervision
8	Fraudulent practices and kickbacks
9	Insufficient/incomplete drawings
10	Uncertainties/risks of the project

3.3 Development of Questionnaire

3.3.1 Pilot Survey

Prior to conducting the actual survey, a pilot survey was initiated to test the efficacy of the questionnaire and refine the research approach. A selected group of individuals, representing a diverse spectrum of the target population, participated in the pilot survey. The detail of the participants of pilot survey is shown in table 3.3. This smaller sample size allowed for focused feedback collection and subsequent modifications before the main survey commenced.

TABLE 3.3: Pilot Survey Respondents Demographics

Sr. No.	**Participant**	**Details of Participant**
1	Client	- Deputy Director CDA - Deputy Project Director NHA - Sub Divisional Officer C&W
2	Consultant	- Resident Engineer H&TED NESPAK - Structural Engineer ZEERUK International Islamabad - Resident Engineer New Vision Engineering Consultant
3	Contractor	- M/S Zaheer Ahmed Govt. Contractor - M/S S.C.S Kazmi & Brother GOVT. Contractor - HDC Private limited - Start Sustainable Construction Co.

3.3.2 Actual Survey

The questionnaire developed for the research study consisted of four major sections. Section A was designed to gather the general information of the respondent like Name, Contact Details, Experience, and Employers Details etc. Section B is related to the factors causing the escalation in this section questions are based on the five point Likert Scale, with 1 being very low and 5 being very high. And Section C was related to the Effects of escalation. In the last section of the questionnaire to judge the opinion of respondents related to the escalation formula

questions respondent has to choose the answer of his choice from the given options.

The questionnaire was distributed for online filling and submission, as well as in hard form by visiting the potential respondents. Collection of data through online submission is always a speedy method which takes lesser time to record the opinion. Detail of the feedback of the respondents has been presented in Figure 3.2.

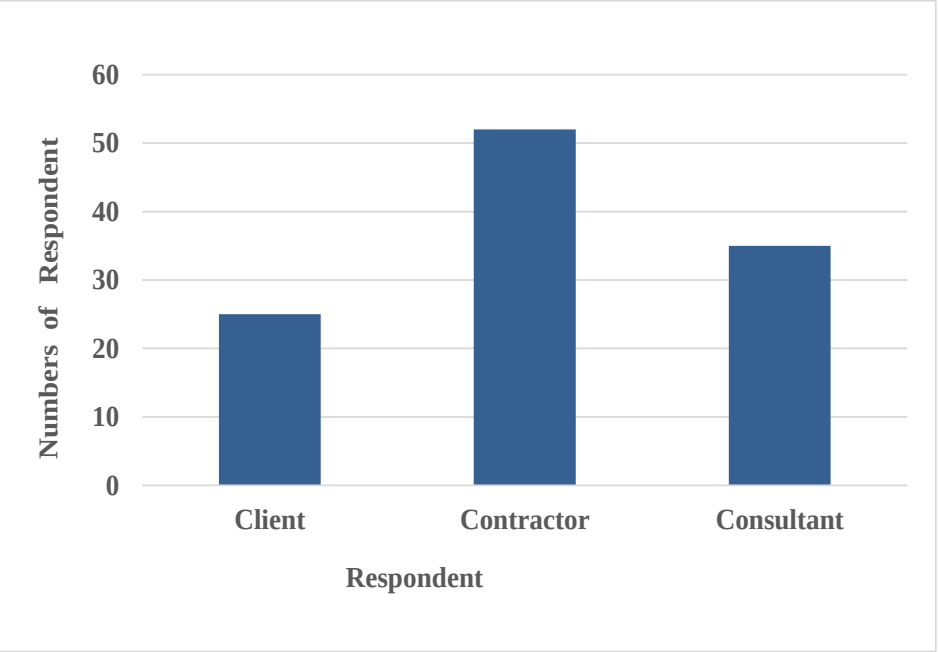

FIGURE 3.2: Respondents details of feedback

3.4 Data Collection

To comprehend the perspectives of stakeholders effectively, we conducted a survey using questionnaires. We distributed these surveys through various methods, including emails, face-toface meetings with professionals, and visits to construction sites and projects. This diverse approach aimed to gather a comprehensive understanding of stakeholder opinions within the construction industry.

In the field of statistics, the primary goal is to identify the characteristics of a population through sampling. It's crucial to ensure that the selected sample accurately represents the entire population. Considering the varied attributes of

construction enterprises and professionals in Pakistan, we explored different sampling methods. The chosen sample, drawn from this extensive population, was distributed through email, traditional mail, and direct engagement with professionals involved in various projects.

A fundamental random sampling, supported by existing literature, emphasizes the importance of obtaining a true representation of the population to ensure reliable research outcomes. Notably, the population of civil engineering professionals in Pakistan, based on Pakistan Engineering Council (PEC) statistics, exceeds a significant 70,000 individuals. We carefully determined an acceptable sample size, considering different sampling errors, to achieve precision and reliability in our research findings.

3.5 Statistical Analysis using SPSS

SPSS, or Statistical Package for the Social Sciences, is a widely-used software for statistical analysis in various research fields. It offers a comprehensive set of tools for data management and statistical analysis. The test performed by using SPSS software are explained below:

- Reliability Test
- Normality Test
- Non-parametric Test

3.5.1 Reliability Test

To check the reliability of data, when questions are asked on Likert scale, Cronbach's Coefficient Alpha method is the most commonly used test. If Cronbach's Coefficient Alpha value is higher than 0.7, this means that the data is acceptable for analysis [38].

In the context of our research study, the application of Cronbach's Alpha serves as a pivotal measure for assessing the internal consistency and reliability of the utilized questionnaires. Developed by Lee Cronbach in 1951, this statistical metric evaluates the degree of interrelatedness among items within a questionnaire or scale, thereby gauging the extent to which the items collectively measure the same underlying construct.

The interpretative framework of Cronbach's Alpha necessitates a nuanced understanding. A coefficient close to 1.0 implies strong internal consistency, signifying that the items within the questionnaire reliably measure the targeted construct. Conversely, a low Alpha coefficient suggests a lack of homogeneity among items, raising concerns about the scale's reliability. The integration of Cronbach's Alpha in our research methodology underscores our commitment to ensuring the precision and consistency of the data collected through our questionnaires. This statistical rigor enhances the robustness of our findings and bolsters the overall validity of our research outcomes.

3.5.2 Normality Test

To check the normality of the data, Shapiro-Wilk normality test was conducted as the sample size was less than 2000. This test was performed to evaluate whether the collected data was normally distributed or not, i.e. the data was parametric or non-parametric.

In the realm of statistical analysis, the Shapiro-Wilk normality test assumes a critical role in evaluating the distributional characteristics of data derived from our questionnaires. This test, developed by Samuel Shapiro and Martin Wilk in 1965, is specifically designed to assess the null hypothesis that a given sample follows a normal distribution. The Shapiro-Wilk test operates by generating a test statistic based on the covariance matrix of the sample, and subsequently comparing this statistic with critical values derived from the null distribution under the 44 assumption of normality. The test is particularly advantageous for moderate to

large sample sizes, as it exhibits robustness and superior power compared to other normality tests.

In the context of our research, the Shapiro-Wilk normality test serves as a crucial diagnostic tool. The outcome of this test informs the appropriateness of parametric statistical methods, as violations of normality assumptions can impact the reliability of results. In instances where normality is not established, alternative non-parametric methods may be considered to ensure the validity of statistical inferences. This meticulous examination of data distribution aligns with the methodological rigor of our study, bolstering the credibility of our statistical analyses.

3.5.3 Non parametric Test

Kruskal Wallis test was performed to check whether all stakeholders including owners/clients, consultants and contractors had similar perception regarding the price escalation and price adjustment formulae. In the landscape of statistical analyses, the Kruskal-Wallis test emerges as a robust non-parametric method employed within the framework of our research study. This test, an extension of the Mann-Whitney U test for multiple groups, serves the purpose of assessing whether there are statistically significant differences among the medians of three or more independent groups.

Developed by William H. Kruskal and Wallis A. Siegel, the Kruskal-Wallis test is particularly well-suited when assumptions of normality and homogeneity of variances are not met, making it a valuable alternative in scenarios where parametric approaches may be compromised. Our utilization of the Kruskal-Wallis test within the research methodology is strategic. This nonparametric approach allows for robust statistical comparisons among groups, especially when normality assumptions cannot be met. By employing this method, we enhance the versatility of our analyses, ensuring that the conclusions drawn from our study are robust and not contingent on specific distributional assumptions.

3.6 Summary

This Chapter presents a thorough exploration of factors identification, questionnaire development, and the subsequent statistical analysis. The section on background delves into the frequency analysis of identified factors, providing insights into their prevalence within the research domain. Furthermore, factors are systematically grouped based on stakeholders, offering a nuanced understanding of diverse perspectives. The development of the questionnaire follows a methodical approach, beginning with a pilot survey to refine questions and culminating in an actual survey for robust data collection. Statistical analysis, facilitated by SPSS, plays a pivotal role in extracting meaningful patterns from the dataset. The reliability test, employing Cronbach's Alpha, ensures the internal consistency of the questionnaire, enhancing the credibility of measurements. The normality test, utilizing the Shapiro-Wilk method, evaluates data distribution, guiding the appropriateness of parametric statistical methods. Additionally, the nonparametric Kruskal-Wallis test is employed to compare group medians when normality assumptions are unmet. Chapter 3's synthesis of factors identification, questionnaire development, and statistical analysis establishes a robust foundation for subsequent chapters, setting the stage for in-depth discussions and conclusions grounded in rigorous empirical evidence.

Chapter 4

Results and Analysis

4.1 Background

Recently, the price fluctuation of construction materials and services in Pakistan has become severe and very much unpredictable. Most of the contractors in CI, especially local contractors, are facing strong challenges during bid process due to the high uncertainty of predicting what would happen during the course of the execution of the project. The challenge gets even more severe not only as a result of the ever escalating market prices but also as a result of the nonavailability or weaker compensation practice in the event of price variation. Based on the above explained fact, the research problem has been addressed in this research by collecting data with the help of the questionnaires, distributed to local construction contractors, consultants and clients.

MS Excel and SPSS-18 are the softwares used to analyze the data collected through questionnaire based survey. Results of this survey are discussed in the subsequent paragraphs.

4.2 Characteristics of Respondents

4.2.1 Response Rate

Out of the 369 potential respondents, 122 responses were received. Hence the overall response rate of the survey was 33%. This response rate is above the

acceptable range (5%-30%) as per already published literature. The reason for 33% response rate is that above figure of 369 mostly counts the number of members of WhatsApp groups and it is not necessary that all members give their response to a request because of their preferences [44]. However, on scrutiny, 10 responses were found in-valid or incomplete which were rejected. Response by the clients was 22%, consultants 31% and contractors 47%. Grouping and frequencies (percentages) of respondents are shown in Table 4.1 and Figure 4.1:

TABLE 4.1: Respondents Response Percentages

Respondent	**Number of questionnaire returned**	**Percentage**
Client	25	22
Consultant	35	31
Contractor	52	47
Total	**112**	**100**

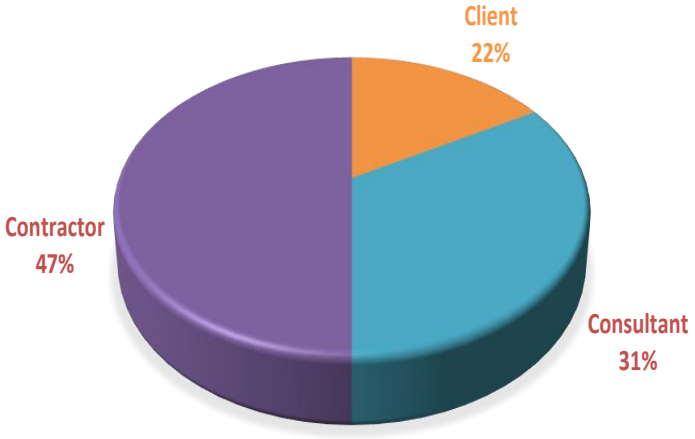

FIGURE 4.1: Response Rate

4.3 Experience of Respondents

Persons with different number of years of working with CI, responded to the questionnaire as shown in Table 4.2 and Figure 4.2. Approximately 19% of the respondents had accumulated over 15 years of construction experience, 28% had experience between 11 to 15 years, and 32% possessed 6 to 10 years of experience, whereas only 21% had 1 to 5 years of construction industry experience.

TABLE 4.2: Respondents Response Percentages

Respondent Experience	**Respondents Frequency**	**Respondents Percentage**	**Cumulative Percentage**
1-5 years	24	21	100
6-10 years	36	32	79
11-15 years	31	28	47
Over 15 years	21	19	19
Total	**112**	**100**	— ↑

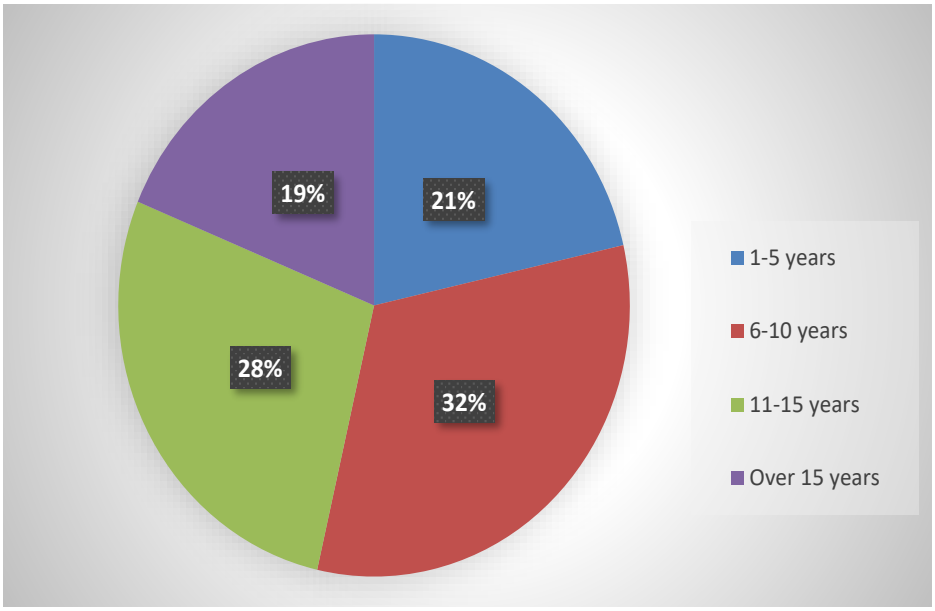

FIGURE 4.2: Respondents percentage of experience

4.3.1 Experience of Respondent Related to Escalation

Respondents to this research survey have different experience related to escalation. Table 4.3 and Figure 4.3 show the rate of experience or knowledge of respondents who responded to this survey. Approximately 19% of the respondents have excellent knowledge of escalation, 28% have very good knowledge of escalation, and 37% have good knowledge of escalation and 16% of respondent have satisfactory knowledge of escalation.

TABLE 4.3: Respondents Knowledge of Escalation

Respondent Experience	**Respondents Frequency**	**Respondents Percentage**	**Cumulative Percentage**
Excellent	21	19	100
Very Good	32	28	81
Good	42	37	53
Satisfactory	17	16	16
Total	**112**	**100**	— ↑

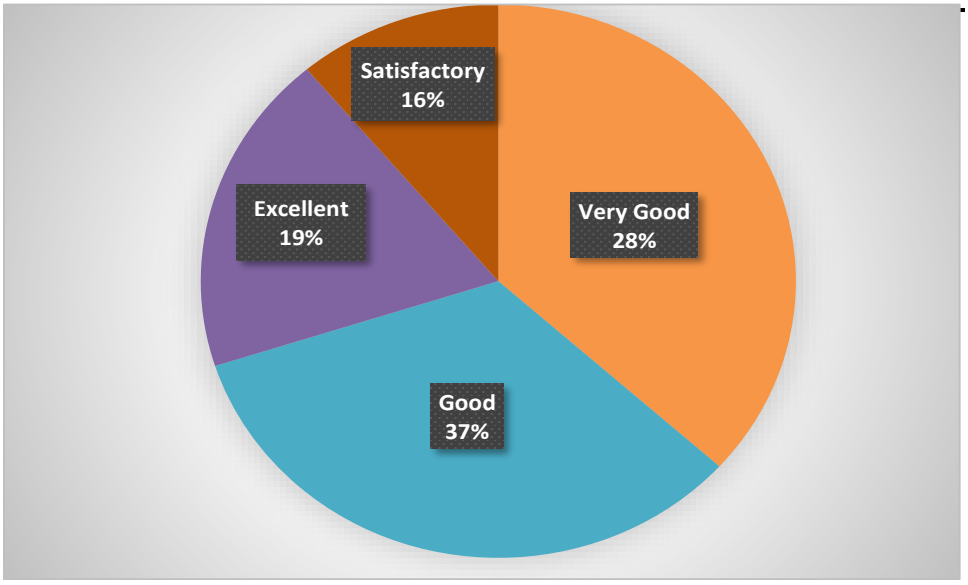

FIGURE 4.3: Respondents experience of escalation

4.4 Statistical Analysis

4.4.1 Reliability of the Data

4.4.1.1 Cronbachs Coefficient Alpha Method

For the collected data, of contractor, consultant and client Cronbach alpha values were calculated as 0.865, 0.812 and 0.901 using SPSS, as given in Table 4-4. Its higher values indicated that the data were consistent and reliable for further analysis.

TABLE 4.4: (a): Contractor Reliability Statistics

Case Processing Summary					
		N	%		
	Valid	52	100	Cronbachs Alpha	0.865
Cases	*Excluded*[a]	0	0		
	Total	52	100	Number of items	25
	a. List wise deletion based on all variables in the Procedure				

(b): Contractor Reliability Statistics

Case Processing Summary					
		N	%		
	Valid	35	100	Cronbachs Alpha	0.812
Cases	*Excluded*[a]	0	0		
	Total	35	100	Number of items	22
	a. List wise deletion based on all variables in the Procedure				

(c): Contractor Reliability Statistics

Case Processing Summary					
		N	%		
	Valid	25	100	Cronbachs Alpha	0.901
Cases	*Excluded*[a]	0	0		
	Total	25	100	Number of items	23
	a. List wise deletion based on all variables in the Procedure				

From the above table it can be seen that the value of Cronbach's coefficient alpha for the client is higher than the values for the contractor and consultant responses. It means that the client's data is more consistent and reliable than contractor and consultant data. However the value of Cronbach's coefficient for the contractor and consultant are also higher than standard value 0.7, which means that the data is also reliable and consistent.

4.4.2 Assessment of Normality of Data

Shapiro-Wilk normality test was performed to evaluate whether the collected data was normally distributed or not, i.e. the data was parametric or non-parametric. Significance values being less than 0.05 (the data will be sufficiently normal if significance value exceeds 0.05), therefore, data was not normally distributed and to further analyze, non-parametric tests were required. Table 4.5(a), Table 4.5(b) and Table 4.5(c) show the result of the Shapiro-Wilk test for contractor, Consultant and Client responses respectively.

Table 4.7: (a): Normality test for contractor responses

No.	**Parameter**	**Statistics**	**Df**	**Sig.**
1	Poor planning	0.975	52	0.000
2	Inadequate contract management	0.784	52	0.000
3	Delay in decisions	0.658	52	0.000
4	Subletting of project	0.968	52	0.000
5	Resources constraint	0.915	52	0.000
6	Weather	0.864	52	0.000
7	Mistakes during construction	0.745	52	0.000
8	Proper and Vigilant Supervision	0.812	52	0.000

No.	Parameter	Statistics	Df	Sig.
9	Construction methods	0.925	52	0.000
10	Fraudulent practices and kickbacks	0.689	52	0.000
11	Disputes	0.918	52	0.000
12	Bank loans and financing offered at a high-interest rate	0.795	52	0.000
13	Rework of bad quality performance	0.864	52	0.000
14	Inflation	0.973	52	0.000
15	Project Location	0.916	52	0.000
16	Local Government Pressure	0.984	52	0.000
17	Strikes/Force Majeure	0.855	52	0.000
18	Depreciation of local Currency	0.795	52	0.000

TABLE 4.8: (b): Normality test for consultant responses

No.	Parameter	Statistics	Df	Sig.
1	Delay in Payments	0.95	35	0.000
2	Poor planning	0.918	35	0.000
3	Inadequate contract management	0.856	35	0.000
4	Changes in project scope	0.843	35	0.000
5	Delay in decisions	0.789	35	0.000
6	Mistakes and Discrepancies in contract document	0.645	35	0.000

No.	Parameter	Statistics	Df	Sig.
7	Proper and Vigilant Supervision	0.942	35	0.000
8	Fraudulent practices and kickbacks	0.825	35	0.000
9	Insufficient/incomplete drawings	0.823	35	0.000
10	Uncertainties/risks of the project	0.947	35	0.000
11	Inflation	0.975	35	0.000
12	Project Location	0.836	35	0.000
13	Local Government Pressure	0.963	35	0.000
14	Strikes/Force Majeure	0.965	35	0.000
15	Depreciation of local Currency	0.975	35	0.000

TABLE 4.9: (c): Normality test for client responses

No.	Parameter	Statistics	Df	Sig.
1	Financial issues faced by client	0.985	25	0.000
2	Delay in Payments	0.975	25	0.000
3	Poor planning	0.968	25	0.000
4	Inadequate contract management	0.856	25	0.000
5	Changes in project scope	0.814	25	0.000
6	Delay in decisions	0.726	25	0.000
7	Mistakes and Discrepancies in contract document	0.816	25	0.000
8	Proper and Vigilant Supervision	0.945	25	0.000

No.	Parameter	Statistics	Df	Sig.
9	Fraudulent practices and kickbacks	0.985	25	0.000
10	Disputes	0.974	25	0.000
11	Bank loans and financing offered at a high-interest rate	0.956	25	0.000
12	Inflation	0.925	25	0.000
13	Project Location	0.658	25	0.000
14	Local Government Pressure	0.978	25	0.000
15	Strikes/Force Majeure	0.896	25	0.000
16	Depreciation of local Currency	0.756	25	0.000

The results of the Shapiro-Wilk normality test indicate that the data pertaining to the client, consultant, and contractor variables do not conform to a normal distribution, as evidenced by significance values below the conventional threshold of 0.05. This departure from normality holds substantial implications for subsequent statistical analyses, prompting the adoption of nonparametric methods. The recommendation for non-parametric test, such as the Kruskal-Wallis test, stems from their robustness in accommodating non-normally distributed data. Unlike parametric tests that hinge on the assumption of normality, these non-parametric alternatives focus on medians, making them particularly suited for skewed datasets.

4.4.3 Kruskal Wallis Test for Non-Parametric Data

Since the data collected for this research was non-parametric, Kruskal Wallis test was performed to check whether all stakeholders including owners/clients, consultants and contractors had similar perception regarding the price escalation and price adjustment formulae.

TABLE 4.10: (a). Kruskal Wallis test for Contractor

Sr. No.	**Parameters**	**Sig.**
1	Poor planning	0.625
2	Inadequate contract management	0.056
3	Delay in decisions	0.055
4	Subletting of project	0
5	Resources constraint	0.03
6	Weather	0
7	Mistakes during construction	0
8	Proper and Vigilant Supervision	0.01
9	Construction methods	0
10	Fraudulent practices and kickbacks	0
11	Disputes	0
12	Bank loans and financing offered at a high-interest rate	0.04
13	Rework of bad quality performance	0
14	Inflation	0.785
15	Project Location	0
16	Local Government Pressure	0.045
17	Strikes/Force Majeure	0.065
18	Depreciation of local Currency	0.055

(b). Kruskal Wallis test for Consultant

Sr. No.	**Parameters**	**Sig.**
1	Delay in Payments	0
2	Poor planning	0.131
3	Inadequate contract management	0.524
4	Changes in project scope	0
5	Delay in decisions	0.624
6	Mistakes and Discrepancies in contract document	0.032

Sr. No.	Parameters	Sig.
7	Proper and Vigilant Supervision	0
8	Fraudulent practices and kickbacks	0
9	Insufficient/incomplete drawings	0
10	Uncertainties/risks of the project	0.05
11	Inflation	0.635
12	Project Location	0
13	Local Government Pressure	0
14	Strikes/Force Majeure	0.054
15	Depreciation of local Currency	0.078

(c). Kruskal Wallis test for Client

Sr. No.	Parameters	Sig.
1	Financial issues faced by client	0
2	Delay in Payments	0
3	Poor planning	0.051
4	Inadequate contract management	0.083
5	Changes in project scope	0.021
6	Delay in decisions	0.075
7	Mistakes and Discrepancies in contract document	0
8	Proper and Vigilant Supervision	0
9	Fraudulent practices and kickbacks	0
10	Disputes	0.852
11	Bank loans and financing offered at a high-interest rate	0
12	Inflation	0.059
13	Project Location	0
14	Local Government Pressure	0
15	Strikes/Force Majeure	0.057
16	Depreciation of local Currency	0.081

From the results of Kruskal Wallis test mentioned in Table 4-6, it is clear that significance value for the following factors is greater than 0.05. Hence the stake holders have similar perception for the following parameter:

a. Poor planning

b. Delay in decisions

c. Inflation

d. Strikes/Force Majeure

e. Depreciation of local Currency

f. Disputes

g. Time

h. Cost

i. Uncertainties and communication

j. Inadequate contract management

However the Consultants, Contractors and Owners/Clients have different perceptions for the following parameters and the significance value for these factors is less than 0.05.

a. Subletting of project

b. Resources constraint

c. Weather

d. Mistakes during construction

e. Proper and Vigilant Supervision

f. Construction methods

g. Fraudulent practices and kickbacks

h. Bank loans and financing offered at a high-interest rate

i. Rework of bad quality performance Project Location

j. Local Government Pressure

k. Resource allocation

l. Changes in scope or details

The Kruskal-Wallis test has yielded diverse outcomes. The obtained results indicate that, for certain factors, the significance value fall below the chosen significance level of 0.05, signifying significant differences perception about the factors. This suggests that these specific factors may not play a substantial role in influencing the escalation. On the contrary, for other factors, the significance value surpass the significance threshold, implying an absence of statistically significant differences in perception among the key stakeholders across. These non-significant results suggest a homogeneity for these particular factors. The identification of both significant and non-significant factors sheds light on the nuanced nature of the dataset, where certain variables exert a discernible impact on the outcome, while others may not contribute significantly to observed variations. Further investigations could explore the factors that have a significant impact. Overall, the mixed findings emphasize the multifaceted nature of the examined factors, Adding more details helps to better understand the information in the dataset.

4.5 Main Finding from Questionnaire Survey

After detailed statistical analysis of the data and applying different tests, the understanding of the stakeholders towards the price fluctuation and price adjustment formula was evaluated. The same is discussed as follow.

4.5.1 Responses from Contractor

In this section, valuable responses obtained from the contractors involved in the study are explored. Their perspectives and experiences contribute crucial insights that form the foundation for the subsequent detailed discussions.

4.5.1.1 Factors Causing Escalation According to Contractor

In order to know that what can be the major factors which can cause the price escalation in construction projects in Pakistan, the respondents were asked to choose the very important factors out of the different factors. The result is presented in Figure 4.4. Which reflects that 3 factors were very important out of 18 factors. The respondents think that Inflation, Depreciation in local currency and Poor Planning are the very important factors for the price escalation in construction projects in Pakistan.

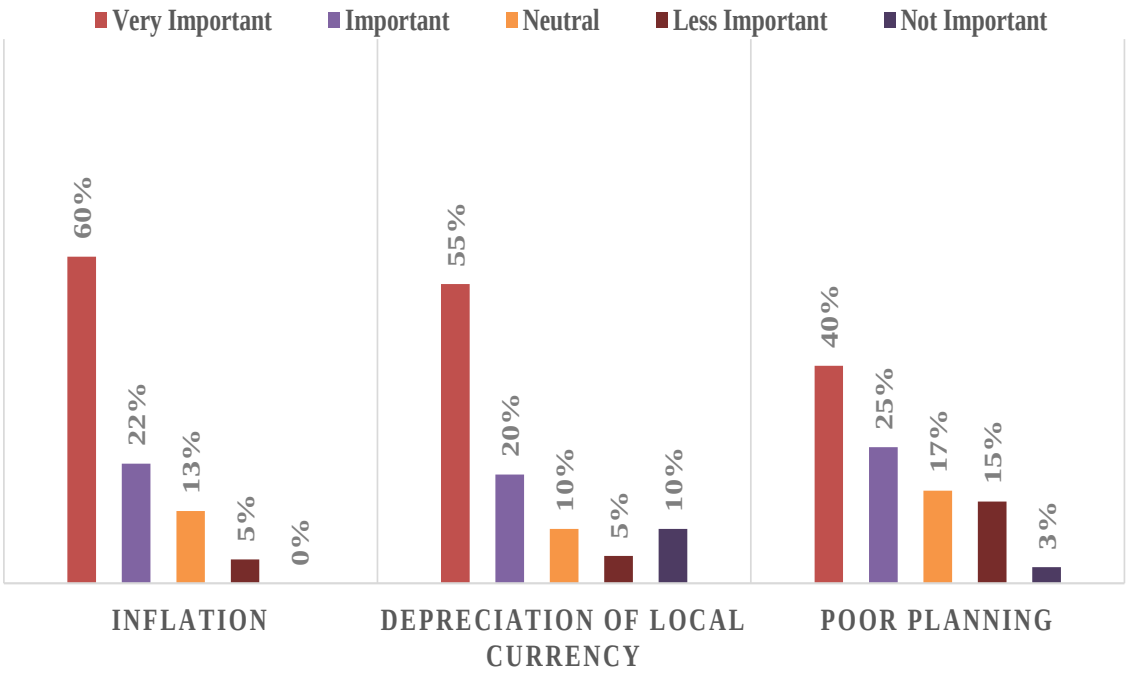

FIGURE 4.4: Factors causing Escalation according to Contractors

In figure 4.4 it can be seen that 82% respondent think that Inflation is very important/important factor for causing escalation and 5% think that inflation is less important for causing escalation in construction industry of Pakistan. Similarly 75% respondent think that depreciation of local currency is the major factor for causing escalation and only 10% think that depreciation of local currency is not important for causing escalation. Furthermore 65% respondent think that escalation is caused by the poor planning and 3% think that poor planning is not the cause of escalation in construction industry of Pakistan.

4.5.1.2 Effects of Escalation According to Contractor

In order to know that what can be the major effect of the price escalation in construction projects in Pakistan, the respondents were asked to choose the effect from option provided in a questionnaire. The result is presented in Figure 4.5. Which reflects that respondent strongly agree that Cost of project and dispute are major effects cause by the escalation in construction project in Pakistan.

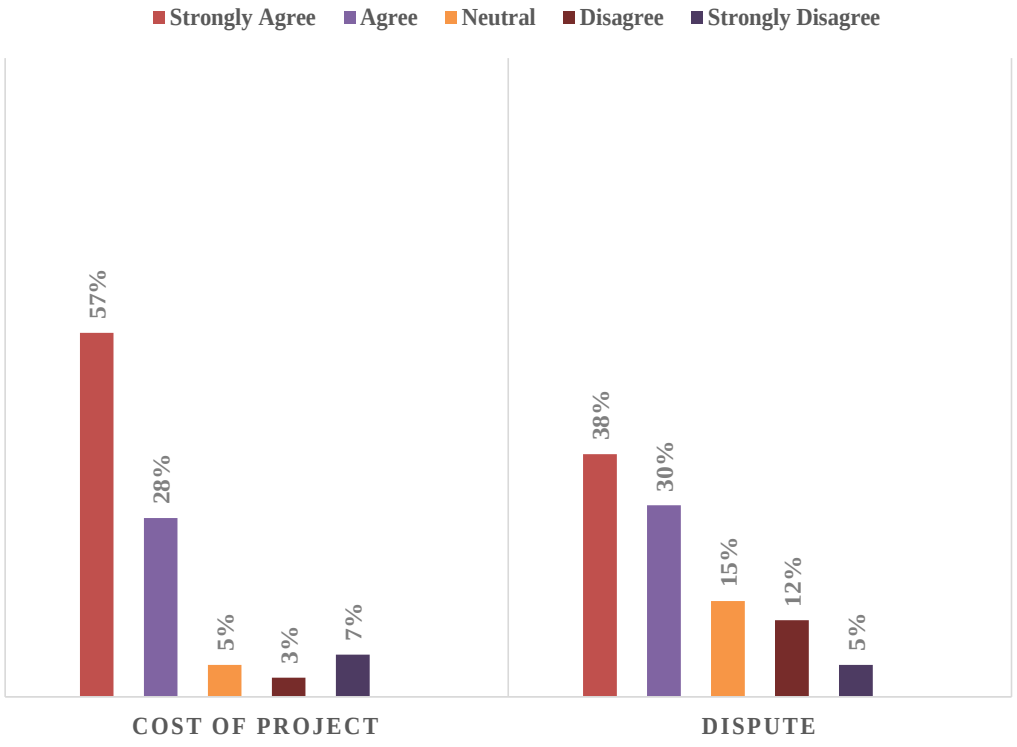

FIGURE 4.5: Effects of escalation according to Contractors

In figure 4.5 it can be seen that 85% respondent strongly agree/agree that escalation effect the cost of project in Pakistan and 6% strongly disagree that cost of the project is effected by the escalation. Similarly 68% respondent think that dispute in the construction project in Pakistan are caused by the escalation and only 5% strongly disagree with it that disputes in the construction project are caused by the escalation. Furthermore 12% respondent only disagree with it that dispute in the construction project in Pakistan are caused by the escalation.

4.5.2 Responses from Consultant

In this section, valuable responses obtained from the consultant involved in the study are explored. Their perspectives and experiences contribute crucial insights that form the foundation for the subsequent detailed discussions.

4.5.2.1 Factors Causing Escalation According to Consultant

In order to know the consultant opinion that what can be the major factors which can cause the price escalation in construction projects in Pakistan, the respondents were asked to choose the very important factors out of the different factors. The result is presented in Figure 4.6 which reflects that 4 factors were very important out of 15 factors. The respondents think that Inflation, Depreciation in local currency, Strikes/Force Majeure and delay in payments are the very important factors for the price escalation in construction projects in Pakistan.

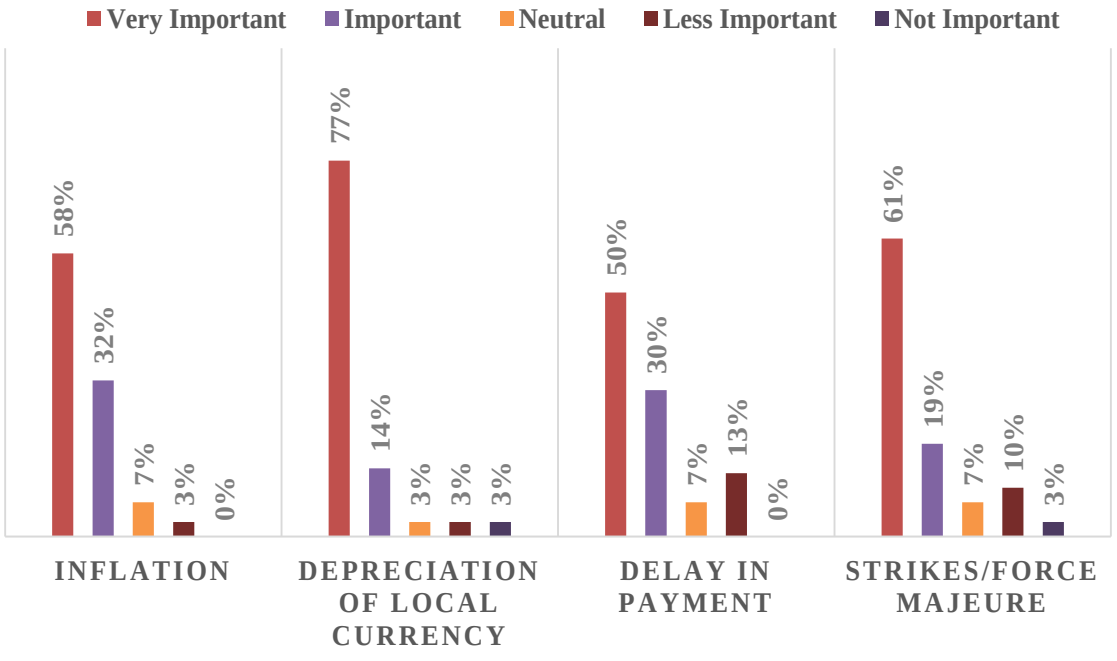

FIGURE 4.6: Factors causing Escalation according to Consultant

In figure 4.6 it can be seen that 90% respondent think that Inflation is very important/important factor for causing escalation and 3% think that inflation is less important for causing escalation in construction industry of Pakistan. Similarly

91% respondent think that depreciation of local currency is the major factor for causing escalation and only 3% think that depreciation of local currency is not important for causing escalation. Furthermore 80% respondent think that escalation is caused by the delay in payment and 13% think that delay in payment is less important in causing escalation in construction industry of Pakistan. Likewise 61% of respondent think that Strikes and force majeure on the construction site cause the escalation in the project and only 3% respondent think that strikes and force majeure is less important factor for causing escalation in construction project in Pakistan.

4.5.2.2 Effects of Escalation According to Consultant

In order to know the opinion of the consultant about the major effect of the price escalation in construction projects in Pakistan, the respondents were asked to choose the effect from option provided in a questionnaire. The result is presented in Figure 4.7. Which reflects that respondent strongly agree that Cost of project, dispute and time are major effects cause by the escalation in construction project in Pakistan.

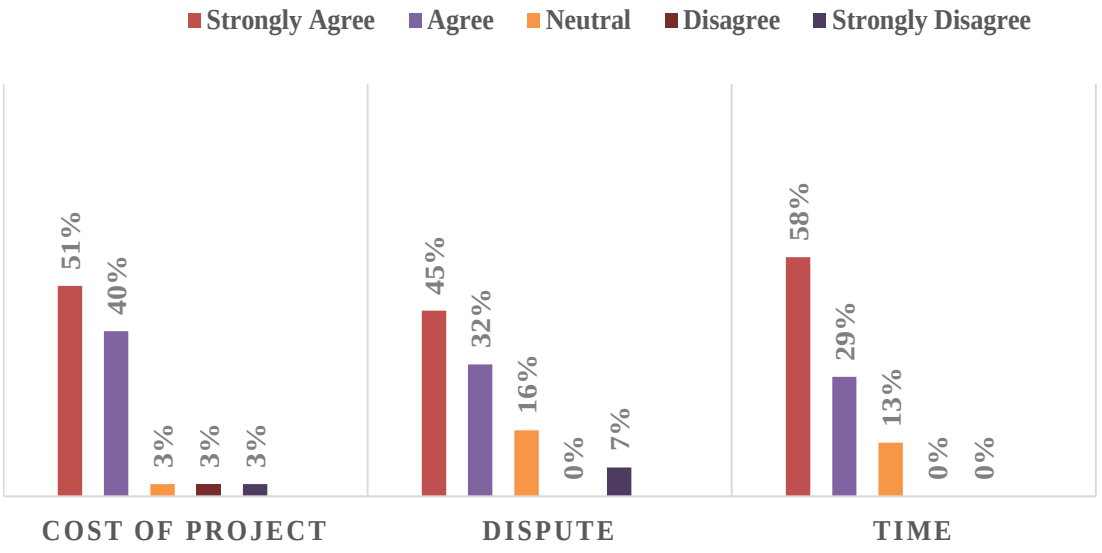

FIGURE 4.7: Effects of escalation according to Consultant

In figure 4.7 it can be seen that 91% respondent strongly agree/agree that escalation effect the cost of project in Pakistan and 3% strongly disagree that cost

of the project is effected by the escalation. Similarly 77% respondent think that dispute in the construction project in Pakistan are caused by the escalation and only 7% strongly disagree with it that disputes in the construction project are caused by the escalation. Furthermore 87% respondent strongly agree/agree with it that time of construction project in Pakistan is effected by the escalation and not even a single respondent disagree with this effect of escalation.

4.5.3 Responses from Client

In this section, valuable responses obtained from the client involved in the study are explored. Their perspectives and experiences contribute crucial insights that form the foundation for the subsequent detailed discussions.

4.5.3.1 Factors Causing Escalation According to Client

In order to know the client opinion that what can be the major factors which can cause the price escalation in construction projects in Pakistan, the clients were asked to choose the very important factors out of the different factors. The result is presented in Figure 4.8. Which reflects that 3 factors were very important out of 17 factors. The respondents think that Inflation, Inadequate contract management, and poor planning are the very important factors for the price escalation in construction projects in Pakistan.

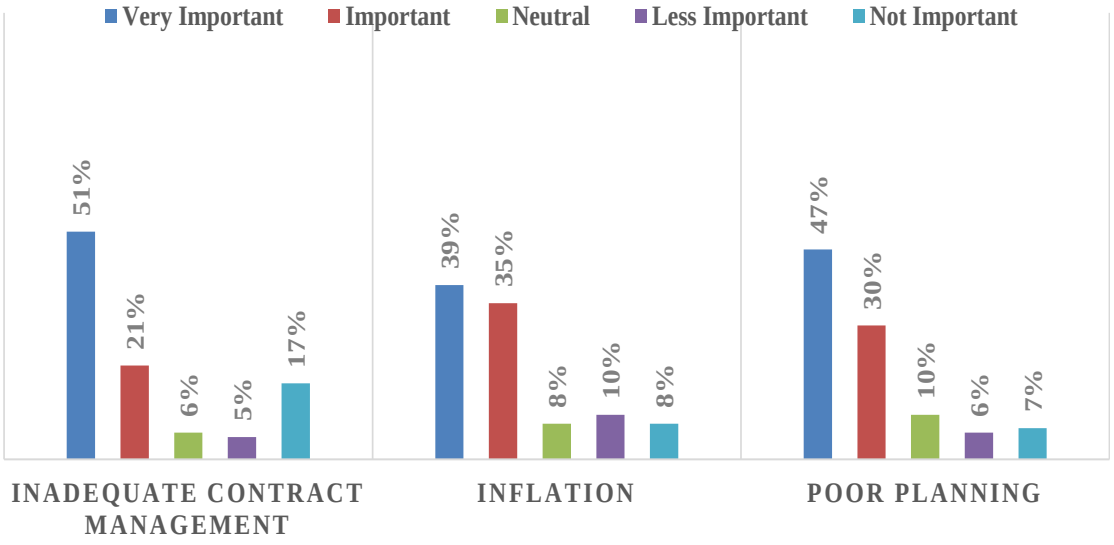

FIGURE 4.8: Factors causing Escalation according to Clients

In figure 4.8 it can be seen that 74% respondent think that Inflation is very important/important factor for causing escalation and 8% think that inflation is not important for causing escalation in construction industry of Pakistan. Similarly 72% respondent think that inadequate contract management is the major factor for causing escalation and only 17% think that inadequate contract management is not important for causing escalation. Furthermore 77% respondent think that escalation is caused by the poor planning and 7% think that poor planning is less important in causing escalation in construction industry of Pakistan.

4.5.3.2 Effects of Escalation According to Clients

In order to know the opinion of the client about the major effect of the price escalation in construction projects in Pakistan, the respondents were asked to choose the effect from option provided in a questionnaire. The result is presented in Figure 4.9. Which reflects that respondent strongly agree that uncertainties and communication problems is the major effects cause by the escalation in construction project in Pakistan.

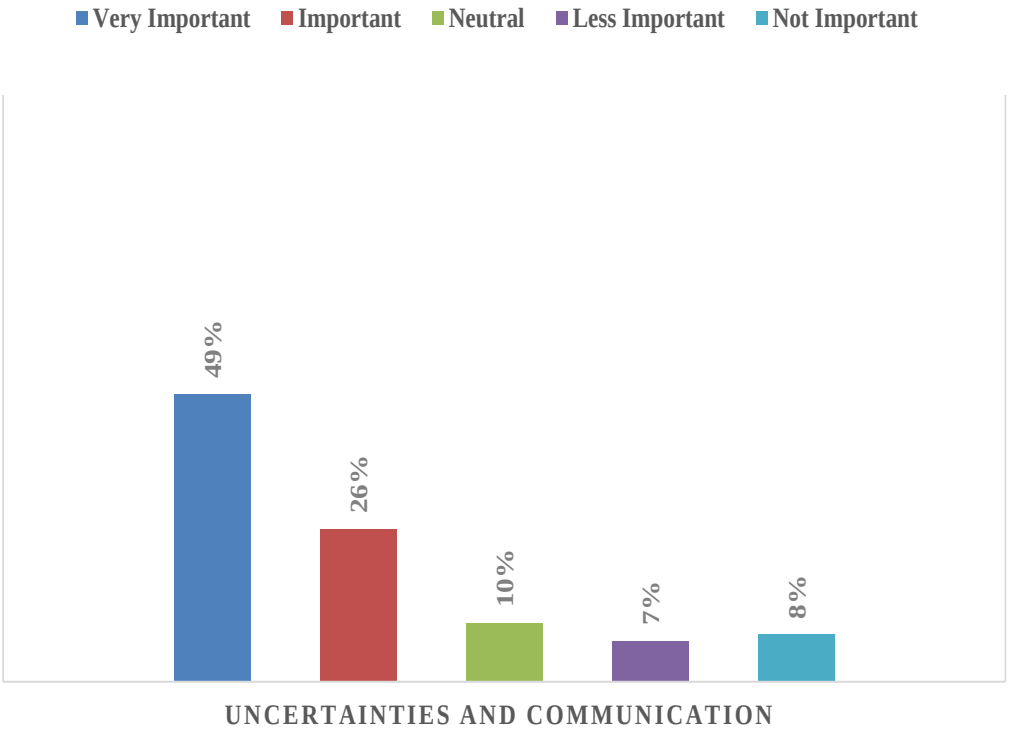

FIGURE 4.9: Effects of escalation according to Clients

4.6 Techniques/Formulae adopted for Escalation Measurement

In order to know the opinion of the contractor about the escalation measurement techniques adopted in the construction industry of Pakistan. The question was asked about the formula which they prefer for the escalation measurements and reason were asked from the respondent that why they prefer that formula. The results indicates that majority of respondent prefer to use the PEC FIDIC based price adjustment formula instead of invoice method. The results are shown in the Figure 4.10.

FIGURE 4.10: Formula adopted by respondent for escalation measurement

In figure 4.6 it can be seen that majority of the stakeholder prefer the PEC factored based price adjustment formula instead of the actual price adjustment formula. The respondent claims that price adjustment formula is quite fair for all the parties, and gives equal grounds for every stakeholder in the contract. Majority of the stakeholder claims that PEC factored based price adjustment formula is more effective than the actual based price adjustment formula. Respondent also claim that price adjustment formula have very few limitation as compared to the actual price adjustment formula.

4.7 Summary

Detailed analysis of the collected data and results obtained, have been discussed in this chapter. Various statistical tests have been used to get the output from the collected data using MS Excel and SPSS-18, so as to assess the data for the detailed study of price adjustment procedure and price adjustment formula. All the responses obtained from the three categories of stakeholders, were analyzed in detail to get the in-depth perception of the stakeholders about the price adjustment process and methods.

To validate the results obtained from statistical analysis using SPSS software, validation process is conducted involving the opinions of respondents regarding the different factors under study. After obtaining the initial results from SPSS analysis, these result are compared with the result obtained from the excel aiming to validate the quantitative results with primary stakeholders perceptions. The respondents were asked to provide their opinions and insights on the factors studied, including their importance, relevance, and impact. Their feedback was then compared with the results obtained from the SPSS analysis. It was observed that the opinions expressed by the respondents were largely in line with the statistical findings, confirming the validity of the results. This alignment between quantitative and qualitative data strengthened the credibility of the research findings and provided a more comprehensive understanding of the factors under investigation.

The study reveals distinctive perspectives among the three key stakeholders clients, contractors, and consultants regarding factors contributing to project cost escalation. Notably, all stakeholders unanimously identify inflation as a highly significant factor in causing escalation. Both contractors and consultants concur on the importance of the depreciation of the local currency, considering it a critical element, while clients express a differing viewpoint, indicating a perception that currency depreciation is not as pivotal.

A noteworthy divergence is observed regarding the significance of inadequate contract management. While contractors and clients highlight its critical role in

causing escalation, consultants assign it a lesser degree of importance. This discrepancy emphasizes the need for a comprehensive understanding of the dynamics surrounding contract management practices.

In the realm of poor planning, both contractors and clients align in deeming it a very important factor contributing to escalation. In contrast, consultants assert that delay in payments and strikes outweigh poor planning in their impact on cost escalation. This disparity underscores the varying emphasis placed on different factors within the project management landscape.

The study's findings illuminate the perspectives of each stakeholder group, emphasizing the complexity of project dynamics and the multifaceted nature of factors contributing to cost escalation. These insights provide a foundation for targeted interventions and strategic planning to mitigate potential risks and enhance project efficiency.

Chapter 5

Conclusion and Recommendations

5.1 Review of Research Goals

The research goals of this study are:

- To study the different factors causing escalation, effect of escalation and methods of price adjustment being used in construction industry.
- To make a comparison of different price adjustment techniques.
- To analyze the responses of the construction project participants regarding the price adjustment formulae in construction contracts and suggest improvements.

The first objective of this research study was to study the different factors causing escalation, effect of escalation and methods of price adjustment in construction contracts in Pakistan. This was achieved through extensive literature review and previously published research papers. To achieve the second objective, the price adjustment formula is explained in detail in the light of the guidelines provided by the PEC documents. Third and fourth objectives were achieved by getting the perception of the stakeholders of the construction industry in Pakistan and then

analyzing their opinions and inferring the results which have come into light after the statistical analysis of the data.

5.2 Conclusion

After carrying out the detailed survey and statistical analysis, the major findings of the research are:

1. The research has shown that the stakeholders of construction industry of Pakistan do not respond actively in the questionnaire survey. Only 33% of the stakeholders respond to the survey.
   The main reason for this lack of interest in responding the questionnaires survey is:

   a. Professionals in the construction industry often have busy schedules due to project deadlines, site visits, and meetings. They perceive filling out a questionnaire as timeconsuming and prioritize other tasks.

   b. Stakeholders have been receiving multiple survey requests, they experience survey fatigue and they feel overwhelmed by the frequency of questionnaires survey forms.

2. In Pakistan, the major causes for the escalation are inflation, depreciation of local currency and poor planning as the majority of the respondents gave their opinion in favor of these factors.

3. The major problem faced by the stakeholders due to the price escalation is the problem of cash flow, which creates hindrance towards the successful completion of the projects.

4. As per opinion of the professionals of the CI, the most sensitive material with respect to the price fluctuation is the POL prices.

5. Each of the categories of the stakeholders has the realization of the importance of the escalation clause; therefore the respondents suggested that the escalation clause should be the part of the contracts.

6. The escalation clause is helpful in:

   a) Reducing the conflicts which may arise due to price fluctuation.

   b) Bid amounts may get higher in the absence of the escalation clause as the contractors have to include the future fluctuations of prices at the time of quoting their bids.

7. When talking about the price adjustment formula, it was revealed that the exposure of the stakeholders is much lesser towards the price adjustment formula.

8. The price adjustment formula was studied in comparison to the actual based price adjustment formula. The research has revealed following:

   a. Contractors can get unfair advantage in the actual based price adjustment method by playing with the purchase dates in their favor

   b. All the parties in a contract are on the same grounds and have equal opportunities to get the benefit of the increase/decrease in the prices of commodities and services, when the FIDIC price adjustment formula is the part of the contract under the escalation clause. The basic prices are monitored through an impartial body which provides the fair environment to all parties.

9. Keeping in view the current energy crises and ever increasing rates of electricity in Pakistan, Respondent suggested that the "electricity" is another component which should be added to the list of the items on which escalation is admissible through price adjustment formula.

10. The weight-ages or coefficients of the items on which escalation is admissible, are provided in the contract documents. These weightages are based on the Engineers estimate. The formula is silent whether these weight-ages should be re-calculated at the completion of the project, on the basis of actual consumptions or not.

11. The PEC document says that the weightages should not be changed until there is any substantial change in the scope of work; however the limit of substantial change is not defined.

5.2.1 Merits and De-merits of Factored Based Price Adjustment Formula

In the light of the research carried, following are the merits and de-merits of using the price adjustment formula as the tool for the calculation of the price adjustments in construction contracts:

5.2.1.1 Merits

- Basic prices are linked with an impartial third party which eliminates the chances of any malpractice by any party.
- Formula does not favor any particular party in a construction contract.
- All the stakeholders in a construction contract are at equal grounds.
- Clients or contractors need not to maintain the record of purchases of the material on which escalation is admissible.
- Stakeholders satisfaction level

5.2.1.2 Difficulties

- Client has to provide the weightages for the components on which escalation is admissible, for which the client has to do calculation before the tender with appropriate rate analysis.
- Monthly record of the measurements of the work done is to be maintained to apply the corresponding monthly rates of the items on which escalation is to be paid.
- Often the statistical bulletins (used for the basic rates of the items) are not published timely, due to which the provisional price adjustment for that month is to be calculated on the basis of last available bulletin. Adjustment is to be made later on when the rates are made available for that particular month.

5.3 Recommendations

On the basis of the research findings and conclusions, some recommendations are enlisted below:

1. The professionals and stakeholders of the CI should be provided with more knowledge and expertise about the price fluctuations, escalation clauses and price adjustments. PEC and educational institutes may hold seminars, conferences and training workshops to highlight the important and debatable aspects of the issue.

2. Pakistans economy is very un-predictable due to the countrys dependency on many external factors, which makes it even more important that the construction contracts, specially the long term contracts, should be provided with escalation clause.

3. The introduction of price adjustment formula by PEC is very much supported by the stakeholders of the construction industry. However, the majority of the professionals of the industry does not have much expertise or practical experience of using the formula and knowledge about the merits & de-merits of the formula.

4. The stakeholders of the CI and regulatory bodies should work together to improve the compensation system in Pakistan and a wider range of inputs should be allowed for compensation. Keeping in view the current energy crisis and increasing rates, electricity is the far most important input which should be included in the list of the components on which escalation should be admissible.

5. As the price adjustments through formula require the basic prices of the items on which escalation is admissible, therefore, a comprehensive and reliable price database should be established by the joint effort of all the stakeholders. This database should not only be acceptable to all stakeholders for the price adjustments, but also be used by the clients or consultants at the time of

the preparing the estimates. The important aspect of this database should be the updating at short intervals to achieve the realistic current prices.

6. PEC should define the limits for the revision of weight-ages of the components on which escalation is admissible, in case of change in the scope of work.

7. Non-adjustable portion factor should be minimize by the PEC in the current economic scenario in order to compensate the stakeholders.

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Appendix A: Questionnaire for Client

Comparative assessment of escalation formulae adopted in construction industry of Pakistan

I **Engr. Muhammad Usman Khan** Student of MS Civil Engineering at Capital University of science and Technology Islamabad having registration number **MCE203025** hereby cordially invite you to complete the attached questionnaire for a MS research entitled "**Comparative assessment of escalation formulae adopted in construction industry of Pakistan**". This project is being supervised by **Prof. Dr. Ishtiaq Hassan**. This research aims to identify and prioritize the factors causing escalation, Effects of escalation on construction project and techniques/formulae adopted to calculate the escalation in construction industry of Pakistan.

The questionnaire is simple and takes approximately 10 minutes to complete. **There are no wrong or correct answers, only your much-needed opinions are requested**. All of your responses will be treated with strict confidentiality and used only for academic purpose.

We understand that this survey will consume some of your precious time, but this research will not be successful without your expert opinions. **Lastly, we would be grateful if you can forward the questionnaire to other experts, who you know have rich experience or knowledge of the topic**. Many thanks for your kind consideration. For any enquiries, please contact Muhammad Usman Khan (Tel.: +923115584992; and email: usmankhan8929@yahoo.com).

Your views are valuable for the success of this research. We would be grateful if you could complete and return the questionnaire to the researchers. Thank you again for your kind consideration.

Comparative assessment of escalation formulae adopted in construction industry of Pakistan

Questionnaire Survey

Important instructions:

1. Please consider your experience in the Pakistan construction industry to complete this survey.
2. Use any suitable symbol (such as "√") to indicate your opinions.
3. Please you have **ONE WEEK** to complete the questionnaire.

Section A: Background of respondent

QA1. What type of organization do you work for?

Contractor□; Consultancy□; Client□; other(s) (specify) _____

QA2. Name of person providing information (optional)? _____

QA3. Professional role?

Engineer□; Architect □ other(s) (specify): _____

QA4. Position/ Rank: _____

QA5. Your years of practical experience in the construction industry.

1-5yrs□; 6-10yrs□; 11-15yrs□; 16-20yrs□; Over 20yrs□

QA6. How would you rate your experience/knowledge related to escalation?

Excellent□; Very good□; Good□; satisfactory□

Section B: Factors of escalation in construction Industry of Pakistan

Instructions:
The table below provides a list of factors that cause escalation in construction project. Please consider the **escalation** and your experience in the Pakistan construction industry to answer following:

What do you believe are the **important** factors for the escalation in construction industry? Rate the importance with respect to the categories under which they are listed.
1 = not important; 2 = less important; 3 = neutral; 4 = important; 5 = very important.

No.	Factors causing Escalation	Relative importance
		Low ⟺ High
1	Financial issues faced by client	☐1; ☐2; ☐3; ☐4; ☐ 5
2	Delay in Payments	☐1; ☐2; ☐3; ☐4; ☐5
3	Poor planning	☐1; ☐2; ☐3; ☐4; ☐5
4	Inadequate contract management	☐1; ☐2; ☐3; ☐4; ☐5
5	Changes in project scope	☐1; ☐2; ☐3; ☐4; ☐5
6	Delay in decisions	☐1; ☐2; ☐3; ☐4; ☐5
7	Mistakes and Discrepancies in contract document	☐1; ☐2; ☐3; ☐4; ☐5
8	Proper and Vigilant Supervision	☐1; ☐2; ☐3; ☐4; ☐5
9	Fraudulent practices and kickbacks	☐1; ☐2; ☐3; ☐4; ☐5
10	Disputes	☐1; ☐2; ☐3; ☐4; ☐5
11	Bank loans and financing offered at a high-interest rate	☐1; ☐2; ☐3; ☐4; ☐5
Other Factors		
12	Inflation	☐1; ☐2; ☐3; ☐4; ☐5
13	Project Location	☐1; ☐2; ☐3; ☐4; ☐5
14	Local Government Pressure	☐1; ☐2; ☐3; ☐4; ☐5
15	Strikes/Force Majeure	☐1; ☐2; ☐3; ☐4; ☐5
16	Depreciation of local Currency	☐1; ☐2; ☐3; ☐4; ☐5

Section C: Effects of Escalation on construction Project

Either Escalation has impact on the following factors or vice versa. How would you relate these factors with escalation?
1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

No.	Factors	Level of agreement
		Low ⟺ High
1	Resource allocation	☐1; ☐2; ☐3; ☐4; ☐5
2	Disputes	☐1; ☐2; ☐3; ☐4; ☐5
3	Time	☐1; ☐2; ☐3; ☐4; ☐5
4	Cost	☐1; ☐2; ☐3; ☐4; ☐5
5	Quality	☐1; ☐2; ☐3; ☐4; ☐5
6	Changes in scope or details	☐1; ☐2; ☐3; ☐4; ☐5
7	Uncertainties and communication	☐1; ☐2; ☐3; ☐4; ☐5

Section D: Techniques adopted for escalation measurement

Following two Formulae are used in construction industry of Pakistan for escalation calculation

1-PEC factor based price adjustment formulae

Pn= A +bLn/Lo + c Mn/Mo + d En/Eo + --

Pn=Dependent Variable

Mn, Mo, Ln, Lo ,En, Eo= Independent Variable

Where

P_n = Price Adjustment factor for the work carried out in the period "n"
A = Nonadjustable portion of contract price
b, c, d = coefficient or weightages of the order
L_o, M_o, E_o= Base Date Indices for the specified (adjustable) elements
Ln, Mn, En = Current Date Indices of the specified (adjustable) elements for periods'n"

2-Actual based priced adjustment

Increase or decrease=α x VOW x (CP-BP) / BP in contract price.

Where:

VOW= the value of the work for which payment has been certified by the Engineer-in-charge, executed subsequent to such increase or decrease in the Basic Price as shall be obtained by applying the approved unit rates and prices entered in the measurement book.

CP= Current price of item.

BP= Basic price of item.

α = Factor decided in the contract.

Question D1: Which formulae do you recommend for escalation measurement?

Formula1: ☐ Formula2 : ☐

Specify Reason:----------

Question D2: What do you think is (are) the most critical factor(s) in above formulae?

i:----------ii:----------iii:----------iv:----------
v:----------

Question D3: Are you aware of any other formula other than above two that are used for escalation calculation? If yes, please mention.

Question D4: Do you recommend any modification in formula?

- This is the end of the survey - Thank you for your time!

Please take a minute to make sure you have answered all questions correctly

Respondent & Project Details

Appendix B: Questionnaire for Consultant

Comparative assessment of escalation formulae adopted in construction industry of Pakistan

I **Engr. Muhammad Usman Khan** Student of MS Civil Engineering at Capital University of science and Technology Islamabad having registration number **MCE203025** hereby cordially invite you to complete the attached questionnaire for a MS research entitled "**Comparative assessment of escalation formulae adopted in construction industry of Pakistan**". This project is being supervised by **Prof. Dr. Ishtiaq Hassan**. This research aims to identify and prioritize the factors causing escalation, Effects of escalation on construction project and techniques/formulae adopted to calculate the escalation in construction industry of Pakistan.

The questionnaire is simple and takes approximately 10 minutes to complete. **There are no wrong or correct answers, only your much-needed opinions are requested**. All of your responses will be treated with strict confidentiality and used only for academic purpose.

We understand that this survey will consume some of your precious time, but this research will not be successful without your expert opinions. **Lastly, we would be grateful if you can forward the questionnaire to other experts, who you know have rich experience or knowledge of the topic**. Many thanks for your kind consideration. For any enquiries, please contact Muhammad Usman Khan (Tel.: +923115584992; and email: usmankhan8929@yahoo.com).

Your views are valuable for the success of this research. We would be grateful if you could complete and return the questionnaire to the researchers. Thank you again for your kind consideration.

Comparative assessment of escalation formulae adopted in construction industry of Pakistan

Questionnaire Survey

Important instructions:

1. Please consider your experience in the Pakistan construction industry to complete this survey.
2. Use any suitable symbol (such as "√") to indicate your opinions.
3. Please you have **ONE WEEK** to complete the questionnaire.

Section A: Background of respondent

QA1. What type of organization do you work for?

Contractor☐; Consultancy☐; Client☐; other(s) (specify) _____

QA2. Professional role?

Engineer☐; Architect ☐ Other(s) (specify): _____

QA3. Position/ Rank: _____

QA4. Your years of practical experience in the construction industry.

1-5yrs☐; 6-10yrs☐; 11-15yrs☐; 16-20yrs☐; Over 20yrs☐

QA5. How would you rate your experience/knowledge related to escalation?

Excellent☐; Very good☐; Good☐; satisfactory☐

Section B: Factors of escalation in construction Industry of Pakistan

Instructions:
The table below provides a list of factors that cause escalation in construction project. Please consider the **escalation** and your experience in the Pakistan construction industry to answer following:

What do you believe are the **important** factors for the escalation in construction industry? Rate the importance with respect to the categories under which they are listed.
1 = not important; 2 = less important; 3 = neutral; 4 = important; 5 = very important.

No.	Factors causing Escalation	Relative importance
	Factors related to client	Low ⟺ High
1	Delay in Payments	☐1; ☐2; ☐3; ☐4; ☐ 5
2	Poor planning	☐1; ☐2; ☐3; ☐4; ☐5
3	Inadequate contract management	☐1; ☐2; ☐3; ☐4; ☐5
4	Changes in project scope	☐1; ☐2; ☐3; ☐4; ☐5
5	Delay in decisions	☐1; ☐2; ☐3; ☐4; ☐5
6	Mistakes and Discrepancies in contract document	☐1; ☐2; ☐3; ☐4; ☐5
7	Proper and Vigilant Supervision	☐1; ☐2; ☐3; ☐4; ☐5
8	Fraudulent practices and kickbacks	☐1; ☐2; ☐3; ☐4; ☐5
9	Insufficient/incomplete drawings	☐1; ☐2; ☐3; ☐4; ☐5
10	Uncertainties/risks of the project	☐1; ☐2; ☐3; ☐4; ☐5
Other Factors		
11	Inflation	☐1; ☐2; ☐3; ☐4; ☐5
12	Project Location	☐1; ☐2; ☐3; ☐4; ☐5
13	Local Government Pressure	☐1; ☐2; ☐3; ☐4; ☐5
14	Strikes/Force Majeure	☐1; ☐2; ☐3; ☐4; ☐5
15	Depreciation of local Currency	☐1; ☐2; ☐3; ☐4; ☐5

Section C: Effects of Escalation on construction Project

Either Escalation has impact on the following factors or vice versa. How would you relate these factors with escalation?
1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

No.	Factors	Level of agreement
		Low ⟺ High
1	Resource allocation	☐1; ☐2; ☐3; ☐4; ☐5
2	Disputes	☐1; ☐2; ☐3; ☐4; ☐5
3	Time	☐1; ☐2; ☐3; ☐4; ☐5
4	Cost	☐1; ☐2; ☐3; ☐4; ☐5
5	Quality	☐1; ☐2; ☐3; ☐4; ☐5
6	Changes in scope or details	☐1; ☐2; ☐3; ☐4; ☐5
7	Uncertainties and communication	☐1; ☐2; ☐3; ☐4; ☐5

Section D: Techniques adopted for escalation measurement

Following two Formulae are used in construction industry of Pakistan for escalation calculation

1-PEC factor based price adjustment formulae

Pn= A +bLn/Lo + c Mn/Mo + d En/Eo + --

Pn=Dependent Variable

Mn, Mo, Ln, Lo ,En, Eo= Independent Variable

Where

P_n = Price Adjustment factor for the work carried out in the period "n"
A = Non adjustable portion of contract price
b, c, d = coefficient or weightages of the order
L_o, M_o, E_o= Base Date Indices for the specified (adjustable) elements
Ln, Mn, En = Current Date Indices of the specified (adjustable) elements for periods'n"

2-Actual based priced adjustment

Increase or decrease=α x VOW x (CP-BP) / BP in contract price.

Where:

VOW= the value of the work for which payment has been certified by the Engineer-in-charge, executed subsequent to such increase or decrease in the Basic Price as shall be obtained by applying the approved unit rates and prices entered in the measurement book.

CP= Current price of item.

BP= Basic price of item.

α = Factor decided in the contract.

Question D1: Which formulae do you recommend for escalation measurement?

Formula1: ☐ Formula2 : ☐

Specify Reason:----------

Question D2: What do you think is (are) the most critical factor(s) in above formulae?

i:----------ii:----------iii:----------iv:----------
v:----------

Question D3: Are you aware of any other formula other than above two that are used for escalation calculation? If yes, please mention.

Question D4: Do you recommend any modification in formula?

- This is the end of the survey - Thank you for your time!

Please take a minute to make sure you have answered all questions correctly!

Responded & Project Details

Appendix C: Questionnaire for Contractor

Comparative assessment of escalation formulae adopted in construction industry of Pakistan

I **Engr. Muhammad Usman Khan** Student of MS Civil Engineering at Capital University of science and Technology Islamabad having registration number **MCE203025** hereby cordially invite you to complete the attached questionnaire for a MS research entitled "**Comparative assessment of escalation formulae adopted in construction industry of Pakistan**". This project is being supervised by **Prof. Dr. Ishtiaq Hassan**. This research aims to identify and prioritize the factors causing escalation, Effects of escalation on construction project and techniques/formulae adopted to calculate the escalation in construction industry of Pakistan.

The questionnaire is simple and takes approximately 10 minutes to complete. **There are no wrong or correct answers, only your much-needed opinions are requested**. All of your responses will be treated with strict confidentiality and used only for academic purpose.

We understand that this survey will consume some of your precious time, but this research will not be successful without your expert opinions. **Lastly, we would be grateful if you can forward the questionnaire to other experts, who you know have rich experience or knowledge of the topic**. Many thanks for your kind consideration. For any enquiries, please contact Muhammad Usman Khan (Tel.: +923115584992; and email: usmankhan8929@yahoo.com).

Your views are valuable for the success of this research. We would be grateful if you could complete and return the questionnaire to the researchers. Thank you again for your kind consideration.

Comparative assessment of escalation formulae adopted in construction industry of Pakistan

Questionnaire Survey

Important instructions:

1. Please consider your experience in the Pakistan construction industry to complete this survey.
2. Use any suitable symbol (such as "√") to indicate your opinions.
3. Please you have **ONE WEEK** to complete the questionnaire.

Section A: Background of respondent

QA1. What type of organization do you work for?

Contractor☐; Consultancy☐; Client☐; other(s) (specify) _____

QA2. Professional role?

Engineer☐; Architect ☐ Other(s) (specify): _____

QA3. Position/ Rank: _____

QA4. Your years of practical experience in the construction industry.

1-5yrs☐; 6-10yrs☐; 11-15yrs☐; 16-20yrs☐; Over 20yrs☐

QA5. How would you rate your experience/knowledge related to escalation?

Excellent☐; Very good☐; Good☐; satisfactory☐

Section B: Factors of escalation in construction Industry of Pakistan

Instructions:
The table below provides a list of factors that cause escalation in construction project. Please consider the **escalation** and your experience in the Pakistan construction industry to answer following:

What do you believe are the **important** factors for the escalation in construction industry? Rate the importance with respect to the categories under which they are listed.
1 = not important; 2 = less important; 3 = neutral; 4 = important; 5 = very important.

No.	Factors causing Escalation	Relative importance
		Low ⟺ High
1	Poor planning	□1; □2; □3; □4; □5
2	Inadequate contract management	□1; □2; □3; □4; □5
3	Delay in decisions	□1; □2; □3; □4; □5
4	Subletting of project	□1; □2; □3; □4; □5
5	Resources constraint	□1; □2; □3; □4; □5
6	Weather	□1; □2; □3; □4; □5
7	Mistakes during construction	□1; □2; □3; □4; □5
8	Proper and Vigilant Supervision	□1; □2; □3; □4; □5
9	Construction methods	□1; □2; □3; □4; □5
10	Fraudulent practices and kickbacks	□1; □2; □3; □4; □5
11	Disputes	□1; □2; □3; □4; □5
12	Bank loans and financing offered at a high-interest rate	□1; □2; □3; □4; □5
13	Rework of bad quality performance	□1; □2; □3; □4; □5
Other Factors		
14	Inflation	□1; □2; □3; □4; □5
15	Project Location	□1; □2; □3; □4; □5
16	Local Government Pressure	□1; □2; □3; □4; □5
17	Strikes/Force Majeure	□1; □2; □3; □4; □5
18	Depreciation of local Currency	□1; □2; □3; □4; □5

Section C: Effects of Escalation on construction Project

Either Escalation has impact on the following factors or vice versa. How would you relate these factors with escalation?
1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

No.	Factors	Level of agreement Low ⟺ High
1	Resource allocation	☐1; ☐2; ☐3; ☐4; ☐5
2	Disputes	☐1; ☐2; ☐3; ☐4; ☐5
3	Time	☐1; ☐2; ☐3; ☐4; ☐5
4	Cost	☐1; ☐2; ☐3; ☐4; ☐5
5	Quality	☐1; ☐2; ☐3; ☐4; ☐5
6	Changes in scope or details	☐1; ☐2; ☐3; ☐4; ☐5
7	Uncertainties and communication	☐1; ☐2; ☐3; ☐4; ☐5

Section D: Techniques adopted for escalation measurement

Following two Formulae are used in construction industry of Pakistan for escalation calculation

1-PEC factor based price adjustment formulae

Pn= A +bLn/Lo + c Mn/Mo + d En/Eo + --

Pn=Dependent Variable

Mn, Mo, Ln, Lo ,En, Eo= Independent Variable
Where

P_n = Price Adjustment factor for the work carried out in the period "n"
A = Non adjustable portion of contract price
b, c, d = coefficient or weightages of the order
L_o, M_o, E_o= Base Date Indices for the specified (adjustable) elements
Ln, Mn, En = Current Date Indices of the specified (adjustable) elements for periods'n"

2-Actual based priced adjustment

Increase or decrease=α x VOW x (CP-BP) / BP in contract price.

Where:

VOW= the value of the work for which payment has been certified by the Engineer-in-charge, executed subsequent to such increase or decrease in the Basic Price as shall be obtained by applying the approved unit rates and prices entered in the measurement book.

CP= Current price of item.

BP= Basic price of item.

α = Factor decided in the contract.

Question D1: Which formulae do you recommend for escalation measurement?

Formula1: ☐ Formula2 : ☐

Specify Reason:----------

Question D2: What do you think is (are) the most critical factor(s) in above formulae?

i:----------**ii:**----------**iii:**----------**iv:**----------

v:----------

Question D3: Are you aware of any other formula other than above two that are used for escalation calculation? If yes, please mention.

Question D4: Do you recommend any modification in formula?

- This is the end of the survey - Thank you for your time!

Please take a minute to make sure you have answered all questions correctly!

Responded & Project Details

Appendix D: Actual base formula document

Stereo I.B No.386 (Revised)
Stereo I.B No.389 (Revised) Agreement No._____
Stereo B&R No.28 (Revised)
Stereo B&R No.29 (Revised)

GOVERNMENT OF THE PUNJAB

_____DEPARTMENT

_____ CIRCLE

_____ DIVISION

_____ SUB-DIVISION

PERCENTAGE / ITEM RATE TENDER AND CONTRACT FOR WORKS

1. Name of work_____

   _____

   _____

2. Estimated cost _____Rs._____
   (both in figures and words)

   _____

3. Time for completion _____

4. Amount of earnest money Rs. _____(in figures)

   Rupees _____(in words)

5. Issued to _____
   (Name of the contractor)

6. On payment of Rs._____
   (Both in words and figures)

Signature_____
(Official issuing the form)

Dated _____

Office stamp_____

Note: - The officer opening the tender shall reject the tender which does not bear the stamp and signature of the issuing official and which is not submitted by the same contractor to whom the tender form was issued.
(This page is to be filled in by the issuing official)

VARIATION IN PRICES OF SPECIFIED MATERIALS

Clause 55:

1) Where any variation (increase or decrease), to the extent of 5% or more, in the price of any of the item mentioned in sub-clause (2) below takes place after the acceptance of tender and before the completion of contract, the amount payable under the contract shall be adjustable to the extent of the actual variation in the cost of the item concerned
2) No price variation under the clause shall be admissible except in respect of the following items:-
   i. Cement
   ii. Steel
      a) M.S Bars (Plain and deformed)
      b) M.S. sections.
      c) High Tensile steel wire.
      d) M.S. and G.I.Pipes.
   iii. Asbestos Cement Pipes.
   iv. P.V.C.Pipes.
   v. R.C.C/P.C.C.Pipes.
   vi. Bitumen.
   vii. High Speed Diesel.
   viii. Bricks
      a. Brick
      b. Tiles
      c. Gutka
   ix Stone aggregate
      a. Stone metal for sub base.
      b. Stone metal for base course.
      c. Crushed bajjri.
   x. Labour
3) The base price for the purposes of calculation of the price variation shall be the price prevalent in the month during which the last day of the submission of tender falls.
4) The price variation under this clause shall be worked out on the basis of the price of the particular item prevalent in a particular District on first day of each month as per price list of such manufacturers or suppliers at such places as are notified by the Finance Department from time to time. The prices of the manufacturer or supplier at the place(s) so notified shall be applicable to the particular District or the entire Punjab (where district wise list of manufacturers or suppliers has not been notified).
5) If no notification in respect of any of the item mentioned in sub-clause (2) is issued under sub-clause (4) no price variation shall be admissible in respect of that item during that month.

6) The amount payable or deductible in respect of **items No.(i) to (x)** of sub-clause (2) shall be calculated on the basis of the quantity of the item actually consumed on the work during the month.
7) The amount payable or deductible in respect of item No.(v) of sub clause (2) shall be calculated on the basis of the actual quantity of cement and steel bars used in the manufacture of the pipes during the month.
8) No escalation shall be allowed to the contractor in respect of the period extended for the completion of the work due to his own fault.
9) If, under the existing codal rules, secured advance is paid on all or any of the imperishable items mentioned at (ii) to (vi) & (viii) to (ix) in sub-clause (2) above, no price variation shall be admissible on such item(s) in respect of the quantity or quantities for which secured advance has been paid to the contractor.
10) The increase or decrease in the contract price subsequent to any increase or decrease in the cost of high speed diesel shall be calculated from the increase or decrease in the basic price of high speed diesel using the following formula:
Increase or decrease= α x VOW x (CPD-BPD) / BPD in contract price.
Where:

VOW= the value of the work for which payment has been certified by the Engineer-in-charge, executed subsequent to such increase or decrease in the Basic Price as shall be obtained by applying the approved unit rates and prices entered in the measurement book.
CPD= Current price of high speed diesel, and
BPD= Basic price of high speed diesel.
Factor α =0.15 for Highway / Road works &
α =0.07 for Buildings and R.C.C structures &
α =0.07 for Irrigation Works

11) The increase or decrease in the contract price subsequent to any increase or decrease in the cost of labour shall be calculated from the increase or decrease in the basic price of labour using the following formula:
Increase or decrease=□x VOW x (CLR-BLR) / BLR in contract price.
Where:

VOW= the value of the work for which payment has been certified by the Engineer-in-charge, executed subsequent to such increase or decrease in the Basic Price as shall be obtained by applying the approved unit rates and prices entered in the measurement book.

CLR= Current labour rates for unskilled worker
(as placed on website of Finance Department).
BLR= Basic labour rates of unskilled worker on the date of receipt of tenders
(as placed on website of Finance Department)
Factor β =0.15 both for building & road works &
Factor β =0.15 for Irrigation works