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Identifying the Causes of Hidden Costs in Construction Projects: A Qualitative Study from the Perspective of Project Managers

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Abstract

Hidden costs in construction projects represent a critical yet underexplored dimension of cost management. Unlike visible cost overruns, hidden costs are not directly traceable to specific budget lines, making them difficult to identify and control. This study aims to identify and classify the causes of hidden costs in construction projects from the perspective of project managers. Adopting a qualitative exploratory approach, semi-structured interviews were conducted with 13 experienced project managers, site managers, and project control experts in Tonekabon, Iran. Through thematic analysis, 72 initial codes were extracted and organized into 18 sub-themes and 6 main themes. The findings reveal that hidden costs emerge from six interrelated domains: Managerial factors (weak planning and control, delayed decision-making, poor stakeholder coordination), technical and design factors (incomplete drawings, design changes, inaccurate estimation), execution-related factors (rework, poor quality, reduced productivity), financial factors (payment delays, increased indirect costs, weak cost control), contractual factors (ambiguities, changes and claims, disputes), and resource and supply factors (supply disruptions, resource waste, price volatility). The study demonstrates that hidden costs are not caused by isolated factors but rather emerge through the interaction and transfer of effects across multiple project phases. The paper concludes with practical recommendations for project managers, including implementing cause-tracking cost control systems, strengthening pre-construction coordination, and formalizing change management processes.

Keywords: Hidden costs, Construction projects, Project management, Cost management, Cost overrun, Rework.

1 | Introduction

Construction projects are characterized by their complex, multi-phase nature, involving interdependent activities distributed across various stakeholders, organizations, and resources throughout the design,

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planning, procurement, execution, and delivery lifecycle. Unlike routine organizational activities, each construction project possesses unique technical, operational, and environmental conditions, and decisions made in one part of the project can have cascading effects on other parts [1]. Consequently, construction project management extends beyond the control of execution activities; it requires harmonizing a set of decisions, information flows, and relationships among diverse stakeholders. One area that consistently demands attention in project management is cost flow. Project costs do not remain static during execution; rather, they evolve and are updated in parallel with activity progress, resource consumption, changing execution conditions, and decisions made. Cost control is therefore a continuous process that goes beyond comparing actual performance with the planned status—it involves tracking costs and resources, detecting deviations, and forecasting the future state of the project [2].

However, not all financial effects arising from project activities and decisions are equally visible or traceable. While some costs are clearly recorded in financial documents, others may be distributed across various activities or emerge gradually during execution. The concept of hidden costs in this study pertains to this less-obvious segment of the project cost stream. These are costs that are not independently and clearly recorded in initial budgets, contracts, schedules, payment certificates, or official project reports, yet they nonetheless impact the actual cost, profitability, timeline, and final quality of the project [3], [4].

The importance of addressing hidden costs is underscored by the persistent challenge of cost overruns in the construction industry. Systematic reviews have identified numerous interconnected factors contributing to cost overruns, including planning and scheduling issues, inaccurate estimation, design inefficiencies, scope definition challenges, contractual ambiguities, and unforeseen site conditions [5]. However, much of the existing literature focuses on concepts such as cost overrun, delay, rework, and change orders, while the concept of hidden costs—as a collection of non-obvious, dispersed, and under-recorded costs—requires more dedicated investigation.

A significant gap exists in understanding how hidden costs form and accumulate in construction projects, particularly from the perspective of project managers who are positioned at the nexus of client, consultant, contractor, and execution team interactions. Their practical experience can reveal causes that are not fully reflected in official project documents. This study therefore addresses the following research question: What are the causes of hidden costs in construction projects from the perspective of project managers?

2 | Literature Review

2.1 | The Concept of Hidden Costs

Hidden costs in construction projects are defined as costs that are not directly and clearly identified or recorded in conventional accounting, estimation, or reporting systems, but which arise from events such as design errors, rework, delays, reduced productivity, workflow disruptions, and poor coordination, and which can increase the actual cost of the project [6], [7].

The distinction between hidden costs and related concepts is important. Cost overrun typically results from comparing an actual, measurable cost with a specified budget baseline [5]. Indirect costs are recognized accounting categories that cannot be directly attributed to a specific activity but are necessary for project execution. In contrast, a hidden cost may not be defined as an expected cost from the outset, or its actual cause may be absorbed within indirect cost categories. Therefore, "indirectness" refers to the accounting allocation method, whereas "hiddenness" relates to the difficulty of observing, measuring, or linking a cost to its actual cause [8]. Rework is an event or corrective activity rather than an independent cost category. When work must be redone due to errors, non-compliance, changes, or poor quality, the direct costs include additional materials, labor, and equipment. However, the financial consequences extend beyond these items; additional supervision, increased management time, disruption of activity sequences, and reduced productivity also generate costs. In Engineering, Procurement, and Construction (EPC) contracts, rework costs include both direct and indirect components, with the latter potentially constituting a significant share of the total

financial impact [9]. Thus, rework can be viewed as a pathway for hidden cost generation, not equivalent to hidden costs themselves.

2.2 | Causes of Cost Overruns and Hidden Costs

A substantial body of research has investigated the factors contributing to construction cost overruns. A systematic review by Afana et al. [4] categorized 99 factors into ten distinct categories: Execution, resource, and project management factors; design factors; contractor factors; consultant factors; client factors; financial management factors; bidding and cost estimation factors; contracts, legal, and regulatory factors; external risks and technology factors; and defects liability period operations and maintenance factors.

Abdelalim et al. [5], using scientometric analysis and social network analysis, identified seven critical drivers with high network centrality: Planning and scheduling issues, project estimation inaccuracies, design inefficiencies, negative weather conditions, scope definition challenges, contractual ambiguities, and unforeseeable site conditions. Their findings demonstrate that these factors are not independent; rather, they interact in complex ways that can compound cost impacts.

In the Iranian context, Ilka and Rejhanian [10] identified inflation, project prolongation, slow administrative processes, inappropriate resource planning, low productivity, and rework stemming from design errors or inconsistencies as major factors contributing to cost escalation and budget deviation in construction projects.

2.3 | Rework as a Pathway to Hidden Costs

Rework is widely recognized as a significant source of hidden costs in construction. Studies consistently show that design-related errors and deviations account for 1–9% of total project cost, while construction-related causes contribute up to 3% [11]. Love [12] found that actual field rework costs average 0.38% of contract value for precompletion corrections, rising to 0.76% when post-completion corrections are included. Critically, this research revealed that contractors under-reported their actual field rework costs by approximately 300%, indicating that rework costs are frequently absorbed quietly into budgets without being properly tracked or attributed. The causes of rework are multi-faceted.

Gumusburun Ayalp and Erdem [13] conducted a holistic bibliometric analysis and found that rework origins can be classified into three broad clusters: Human and contractual factors; design, quality, and project management factors; and organizational factors. This demonstrates that rework is not merely a technical issue in the field but often results from deficiencies originating in multiple project phases.

2.4 | Delays in Decision-Making and Coordination

Delayed decision-making by clients, consultants, or project management teams can cause dependent activities to halt, extend project duration, create uncertainty for execution teams, alter material procurement schedules, and increase overhead costs. Khahro et al. [14] found that delayed decision-making is a major impediment in construction projects, influenced by factors such as weak technical knowledge, incomplete documents, poor leadership, and weak communication and coordination. Poor coordination among project stakeholders represents another managerial pathway to hidden costs. When information flows between design, planning, execution, and procurement are fragmented across different organizations and units, inconsistencies can lead individuals to act based on incomplete information or conflicting document versions. The result may manifest as waiting for responses, incorrect execution, work correction, disputes over responsibility, or work stoppage. Effective managerial communication requires not only information transfer but also clear decision-making pathways and responsibility assignment [15].

2.5 | Financial and Contractual Factors

Payment delays and cash flow disruptions can have cascading effects on project execution. When payment certificates are not processed in a timely manner, contractors may struggle to pay wages, purchase materials, settle with suppliers, or continue planned activities. The financial consequences extend beyond the unpaid

amount itself; they can manifest through work stoppages, delayed material procurement, price increases, and schedule disruptions [16]. Contractual factors contribute to hidden costs when the scope of obligations, responsibilities, or risk allocation is not clearly defined. Ambiguity in contract language, inappropriate risk allocation, or unclear task assignments can lead to differing interpretations of obligations, resulting in decision delays, renegotiation, claims, and disputes that affect financial performance [17].

2.6 | Resource and Supply Chain Factors

Supply chain disruptions can disrupt the flow of project activities and create costs beyond the direct purchase price. Delays in ordering or delivery, unavailability of required equipment, or misalignment between supply timing and execution schedules can cause work stoppages, idle labor and equipment, and changes in activity sequences. Ding and Jie [18] demonstrated that supply chain uncertainty in construction projects can lead to delays and cost overruns, with factors such as information transparency and collaboration among supply chain parties playing important roles in mitigating these issues.

3 | Methodology

3.1 | Research Design

This study employed a qualitative, exploratory research design. Given the objective of identifying and explaining the causes of hidden costs in construction projects from the perspective of project managers, a qualitative approach was appropriate for capturing the depth and complexity of practitioners' experiences and insights. The research was applied in purpose and qualitative in approach.

3.2 | Study Population and Sampling

The study population consisted of project managers, site managers, project control experts, execution supervisors, technical managers, and other professionals with relevant experience in the management and execution of construction projects in Tonekabon, Iran, in 1405. Participants were selected through purposive sampling, with the criteria that they possessed sufficient experience and knowledge in construction project management and execution to provide deep and relevant information about the causes of hidden costs. The selection and interview process continued until data saturation was achieved. Ultimately, 13 project managers and experienced professionals participated in the study. Data saturation was reached when no new codes, concepts, or themes emerged from the final interviews, and the data obtained were predominantly repetitions of concepts identified in previous interviews. Guest et al. [19] demonstrated that the majority of themes in qualitative research are identifiable within the first twelve interviews, supporting the adequacy of this sample size.

The inclusion criteria for the study were: At least five years of activity experience in construction projects; direct experience in managing or executing construction projects in Tonekabon; familiarity with financial, execution, or control issues in projects; and informed willingness to participate in the interview. Exclusion criteria included: Lack of direct and relevant experience with construction projects; withdrawal from participation at any stage; and provision of information insufficiently related to the research topic.

3.3 | Data Collection

Semi-structured interviews were used as the primary data collection instrument. An interview guide was developed based on the research objective, conceptual framework, theoretical foundations, and literature related to hidden costs in construction projects. The semi-structured format allowed participants to express their experiences, perspectives, and interpretations freely and in detail while maintaining the core thematic axes of the research. The interview axes focused on topics such as initial cost estimation, design and technical documentation, rework, delayed decision-making, stakeholder coordination, material procurement, payments, contractual issues, resource waste, productivity, and cost control. Follow-up and probing questions were posed as appropriate based on participants' responses to explore different dimensions of hidden cost

formation in greater detail. Before each interview, the general purpose of the research was explained to the participant, and their informed consent was obtained for participation and recording of the interview content. Efforts were made to create an appropriate atmosphere for the free expression of views, and questions were posed in a non-directive manner. The content of each interview was fully recorded and prepared for subsequent data analysis.

3.4 | Data Analysis

Thematic analysis was employed to analyze the data. After each interview was transcribed, the interview text was read multiple times to achieve sufficient familiarity with the data. Sections relevant to the research topic were identified, and initial codes were extracted from the interview texts. In the next stage, codes with similar meanings and content were compared and combined, and sub-themes were formed based on conceptual proximity. After examining the relationships among sub-themes, they were organized into broader categories, and finally, the main themes related to the causes of hidden costs in construction projects were extracted. Throughout the analysis process, codes and themes were continuously compared with the original interview texts to ensure that their connection to participants' perspectives and experiences was preserved.

4 | Results

4.1 | Participant Characteristics

Table 1 presents the professional characteristics of the 13 participants. To maintain confidentiality, participants were assigned codes P1 through P13. Among the participants, four were project managers, three were site managers, two were project control experts, two were technical managers, and two were execution supervisors. In terms of education, five held bachelor's degrees, seven held master's degrees, and one held a doctoral degree. Professional experience ranged from 6 to 20 years, with an average of approximately 12.2 years. All participants met the minimum experience requirement for inclusion in the study.

Table 1. Professional characteristics of participants.

Participant Code	Professional Role	Education	Experience (Years)
P1	Project manager	Master's	18
P2	Site manager	Master's	12
P3	Project control expert	Master's	9
P4	Project manager	Master's	15
P5	Site manager	Bachelor's	10
P6	Technical manager	Master's	14
P7	Execution supervisor	Bachelor's	8
P8	Project manager	Master's	20
P9	Project control expert	Master's	11
P10	Technical manager	Bachelor's	13
P11	Project manager	Master's	16
P12	Site manager	Bachelor's	7
P13	Execution supervisor	Bachelor's	6

4.2 | Data Analysis Process

After complete transcription of the 13 interviews, the text of each interview was read multiple times, and sections related to the causes of hidden costs in construction projects were identified. In the first stage, 72 initial codes were extracted from the interview texts. Then, through continuous comparison of codes and elimination of duplicate or conceptually overlapping items, similar codes were grouped into common

categories, and 18 sub-themes were formed. In the next stage, based on conceptual proximity and relationships among sub-themes, they were categorized into six main themes: Managerial factors, technical and design factors, execution-related factors, financial factors, contractual factors, and factors related to resources and supply.

Table 2. Summary of the coding and theme extraction process.

Analysis Stage	Quantity
Interviews analyzed	13
Initial codes extracted	72
Sub-themes	18
Main themes	6

Table 3. Proposed structure of main themes and sub-themes related to the causes of hidden costs.

Main Theme	Sub-Themes	Sample Conceptual Codes
Managerial factors	Weak planning and project control	Inadequate planning, irregular cost control, lack of continuous monitoring
	Delayed decision-making	Delayed approvals, last-minute decisions, uncertainty
	Poor stakeholder coordination	Weak client-consultant-contractor communication, incomplete information transfer
Technical and design factors	Deficiencies in drawings	Insufficient details, drawing discrepancies, incomplete technical information
	Design changes	Repeated drawing revisions, changing client requirements, specification changes
	Weak initial estimation	Unrealistic estimates, omitted items, calculation errors
Execution-related factors	Rework	Demolition and re-execution, correction of completed work, repeated activities
	Poor execution quality	Incorrect execution, inadequate quality control, non-compliance with drawings
	Reduced productivity	Idle labor time, work stoppages, improper equipment use
Financial factors	Payment delays	Delayed payment certificates, cash shortage, delayed contractor payment
	Increased indirect costs	Increased overhead, extended site presence, equipment costs
	Weak cost control	Incomplete cost recording, delayed deviation detection, lack of continuous control
Contractual factors	Ambiguity in contract provisions	Unclear responsibilities, scope ambiguity, differing interpretations
	Changes and claims	Additional cost claims, new work orders, scope changes
	Disputes among parties	Client-contractor disputes, responsibility disagreements, delayed resolution
Resource and supply factors	Supply problems	Delayed procurement, material shortage, late equipment delivery
	Resource waste	Material waste, improper machinery use, over-consumption
	Supply condition fluctuations	Price increases, supplier changes, emergency purchases

4.3 | Main Themes and Sub-Themes

4.3.1 | Managerial factors

This main theme encompasses three sub-themes: Weak planning and project control, delayed decision-making, and poor coordination among stakeholders. Weak planning and project control refers to conditions where activity planning, resource allocation, and cost control are not performed accurately and continuously. This can cause project needs and problems to be identified at a stage when correction costs are higher. The absence of continuous cost control allows small deviations to gradually accumulate and eventually manifest as significant costs. Participant P4 stated: "Many times, we have a cost plan at the beginning, but it's not regularly controlled afterward. A small cost arises this month, another item is added next month, and at the end of the project, we see it has become a significant figure that wasn't visible at the start". Participant P9 remarked: "When resource planning is not precise, we may bring labor or equipment to the site earlier than needed, and it sits idle for several days. These costs are usually not recorded under a specific hidden cost category, but they practically consume the project's money".

Delayed decision-making relates to delays in adopting needed project decisions. Delays in drawing approval, material selection, change approval, or resolution of execution issues can cause work stoppages or slowdowns. During such periods, costs for labor, equipment, site management, and other resources continue. Participant P2 noted: "Sometimes a simple decision from the client takes two weeks. During this time, the work doesn't stop, so the costs don't stop either; labor, site office, equipment, and other costs continue". Participant P11 stated: "The worst case is when the work has been done and then the decision changes. Then both the cost of the work already performed is lost, and we have to spend again to correct it". Poor coordination among stakeholders among the client, consultant, contractor, and execution parties can lead to incomplete or delayed information transfer, execution based on outdated drawings or instructions, and ultimately the need for correction or rework. The cost of poor communication typically does not appear as an independent line in financial reports but manifests through increased consumption of materials, labor, time, and overhead costs. Participant P6 explained: "Many reworks are not a technical problem at all; the problem is that information wasn't transferred properly between the technical office and execution. The execution team did something, then the consultant says a new drawing has arrived and it needs to be changed".

4.3.2 | Technical and design factors

This theme comprises three sub-themes: Deficiencies and ambiguities in drawings and technical documents, design changes, and weaknesses in initial estimation. Deficiencies and ambiguities in drawings and technical documents occur when execution details are not fully specified or when coordination among architectural, structural, and MEP drawings is insufficient. The execution team may be forced to stop work, request clarification, correct execution, or even demolish and redo part of the activities.

Participant P3 stated: "One of the places where hidden costs are created is incomplete drawings. Execution starts, then we find that details are not specified or the structural drawing doesn't match the MEP, and we have to redo part of the work". Participant P8 remarked: "Sometimes the drawing looks fine on paper, but when we get to execution, we discover that several parts interfere with each other. Then the cost is not just correcting the drawing; the cost of execution labor and lost time is also added". Design changes during project execution can affect activities already performed or planned. The later a change occurs in the project, the greater the likelihood of increased rework, work stoppages, and repeated resource consumption.

Participant P5 stated: "Design changes before execution are not a big issue, but when the wall has been raised or MEP has been installed and then the drawing changes, the real cost is much higher than the amount recorded for that change". Weaknesses in initial estimation—including incomplete quantity surveys, omission of certain items, unrealistic pricing, or failure to anticipate ancillary costs—can create a gap between the estimated budget and actual financial needs from the very beginning. This gap may not be apparent in the

early stages and only becomes evident as execution progresses. Participant P1 stated: "If quantity surveying and estimation are not accurate from the start, the project carries a hidden cost from day one; it just hasn't been seen yet. As execution progresses, the budget shortfall reveals itself". Participant P10 remarked: "Some costs are not seen in the initial estimate at all, for example, ancillary execution costs or actual site conditions. Later, these gradually accumulate and create a large discrepancy with the initial budget".

4.3.3 | Execution-related factors

This theme includes three sub-themes: Rework, poor execution quality, and reduced resource productivity. Rework is one of the most important pathways through which hidden costs can form during project execution. Redoing activities that require correction due to errors, changes, inconsistencies, or improper execution consumes additional time, equipment, and management capacity beyond the direct costs of materials and labor. Part of these costs may not be recorded as an independent line item but remain hidden within ordinary execution, labor, or material costs.

Participant P7 stated: "When a job is done a second time, it's not just the material cost again. The labor that should be working elsewhere comes back, the equipment is re-engaged, and the schedule for several other activities falls behind". Participant P11 remarked: "Some reworks are so small that they are never recorded separately in the project cost, but when their number increases, they create a significant figure". Poor execution quality—including execution contrary to drawings, improper use of materials, human error, or inadequate quality supervision—can create defects that require correction in later stages. If a problem is not identified at the time and is discovered after subsequent activities have progressed, the correction cost increases and may affect multiple other parts of the project.

Participant P5 stated: "If an execution defect is caught the first day, it might be solved with little cost, but if the next work is done on top of it and then we realize the mistake, we have to open up several parts to correct it". Reduced resource productivity occurs when labor and equipment are present on site and their costs are fully recorded, but due to unready work fronts, activity interference, stoppages between successive activities, correction of previous work, or poor workflow, the output is not proportional to the resources consumed. In such situations, part of the cost is visible as wages or equipment rental, but the amount of resources lost due to productivity decline is not necessarily attributed to a specific cause.

4.3.4 | Financial factors

This theme focuses on three sub-themes: Payment delays, increased indirect costs, and weak cost control. Payment delays and cash flow constraints can affect many project activities. The contractor may face difficulties in paying wages, purchasing materials, settling with suppliers, or continuing planned activities. The financial consequence is not limited to the unpaid amount; it can create additional costs through work stoppages, delayed material purchases, price increases, and schedule changes. Participant P4 stated: "When the payment certificate is delayed, the problem is not just that the money reaches the contractor late. Material purchases fall behind, and we may end up buying the same item more expensively a month later". Participant P10 remarked: "Cash shortages cause some work to proceed based on financial priority rather than execution priority. This disrupts the project's order and creates additional costs later". Increased indirect costs include site management and maintenance costs, salaries of project-based personnel, equipment rental, utilities, and other overhead costs that increase with the duration of project execution. These costs may be recorded under general headings in financial reports, and the actual cause of their increase may not be clearly observable. Participant P6 stated: "Sometimes an activity falls behind by just one week, but the cost it creates is not just the cost of that activity. The site office, security, engineer, and equipment all have to stay for one more week".

Weak cost control relates to inadequate recording, monitoring, and analysis of project costs. If costs are not continuously controlled, financial deviations may be identified at a stage when correction options are limited. Recording costs without specifying their cause can also cause costs from rework, stoppages, resource waste, or managerial decisions to remain hidden among other project costs. Participant P3 stated: "If we only see at the end of the month how much we have spent, many of the causes are no longer identifiable. Cost control

must be concurrent with execution so it becomes clear where each deviation came from". Participant P9 remarked: "Many costs are recorded, but their cause is not. For example, it's not clear whether increased material consumption was due to a change, rework, or material waste. This is what keeps the cost hidden".

4.3.5 | Contractual factors

This theme comprises three sub-themes: Ambiguity in contract provisions, changes and contractual claims, and disputes among project parties. Ambiguity in contract provisions can create hidden costs when responsibilities, scope of work, or approaches to dealing with changes are not clearly defined. This can lead to differing interpretations of contractual obligations, causing decision delays, work stoppages, work outside the original scope, or costs not anticipated at the time of contract preparation.

Participant P1 stated: "If the contract doesn't precisely specify what work is the responsibility of whom, disputes begin mid-project. By the time it's determined whose responsibility it was, both time has been lost and costs have been incurred". Changes and contractual claims after project commencement can create direct costs for new work, as well as ancillary costs from schedule adjustments, re-mobilization, work stoppages, or repeated use of resources. These ancillary costs are not always reflected in the official change order amount and may remain partially hidden.

Participant P4 stated: "A change may start with just a change order, but its effect falls on several other activities. The amount recorded for the change itself does not always cover all the costs it has created". Disputes among project parties—client, consultant, and contractor—can disrupt the natural project flow and increase costs. Resolving disputes requires gathering documentation, reviewing schedules, calculating damages, holding meetings, and negotiation, all of which consume time and resources that are not typically recorded as an independent "contractual cost" line.

4.3.6 | Factors related to resources and supply

This final theme includes three sub-themes: Material and equipment supply problems, resource waste, and supply condition fluctuations. Material and equipment supply problems can disrupt project activity flow and create costs beyond the direct purchase price. Delays in ordering or delivery, unavailability of required equipment, or misalignment between supply timing and execution schedules can cause work stoppages, idle labor and equipment, and changes in activity sequences.

Participant P5 stated: "If materials arrive a few days late, it's not just that purchase that falls behind; a whole team may wait, and several other activities may not start because of it". Participant P13 remarked: "Sometimes, to keep the project from stopping, we have to buy the item quickly from another supplier, which is usually more expensive". Resource waste—including high material waste, improper use of equipment, purchasing more than needed, and inadequate resource storage—can increase the actual project cost. Because some of this waste is recorded as ordinary site consumption, it may not have a clear origin in financial reports and remains as hidden costs. Participant P2 stated: "Material waste usually happens gradually. Each time the amount is not much, but when we calculate for the whole project, it becomes a high figure for which we had no specific line from the start". Participant P9 remarked: "If machinery is not properly planned, it may stay on site for several days and we pay rental costs without any useful work being done". Supply condition fluctuations—changes in material and equipment prices, inability to purchase from the original supplier, or changes in quality and specifications—can cause actual purchase costs to differ from the initial estimate. In some cases, emergency purchases to prevent work stoppage reduce negotiating power and force the project to accept less favorable prices or conditions.

5 | Discussion

5.1 | The Systemic Nature of Hidden Costs

The findings of this study demonstrate that hidden costs in construction projects cannot be attributed to a single factor or a specific project phase. Rather, they emerge from a combination of deficiencies and

disruptions related to management, design, execution, finance, contracts, and resource supply. The six main themes and 18 sub-themes identified through thematic analysis provide a comprehensive framework for understanding the multifaceted origins of these costs.

A critical insight is that the identified factors do not operate independently; there is a chain-like relationship among them. For example, poor coordination among the client, consultant, and contractor can delay decision-making; a late decision may lead to a design change or execution method change; a change after operations have begun can cause rework, work stoppage, and repeated consumption of materials and labor; and ultimately this increases overhead and indirect costs. This chain-like pattern was observed throughout the analysis and is consistent with the findings of Nguyen et al. [20], who showed that execution, managerial, financial, contractual, legal, and external factors in consortium projects are not independent and their interrelationships can intensify cost problems.

This finding aligns with the broader literature on cost overruns. Afana et al. [4] classified cost overrun factors into ten categories including project management, design, execution, resources, financial management, contracts, and external factors. Similarly, Abdelalim et al. [5] found that seven core factors—planning and scheduling issues, estimation inaccuracies, design inefficiencies, adverse weather, scope definition challenges, contractual ambiguities, and unforeseen site conditions—have high network centrality and are strongly interconnected. These findings support the view that analyzing project costs solely based on a single variable such as price increase or delay does not provide a complete picture of the origins of cost escalation.

5.2 | Explanation of Managerial Factors

The managerial factors theme—comprising weak planning and control, delayed decision-making, and poor coordination—was found to play a significant role in hidden cost formation. This is consistent with Acharya et al. [21], who argued that planning quality, resource allocation, and risk anticipation are interconnected components of project management, and weakness in any one can disrupt other project functions. Delayed decision-making deserves particular attention. Many construction activities depend on approvals, material selections, change approvals, or resolution of execution issues. Delays in these decisions not only affect the project schedule but also cause ongoing costs for labor, equipment, site management, and other resources. Ahmed et al. [22] identified slow managerial decision-making, approval delays, communication problems, and scope changes as major factors disrupting project performance. Our findings confirm that a delayed decision may appear as a time issue but its financial consequences are dispersed across multiple cost lines and thus manifest as hidden costs.

The finding on poor stakeholder coordination can be explained by the multi-organizational nature of construction projects. When information flows are fragmented across different units and organizations, the likelihood of executing work based on outdated or conflicting information increases. Muhaemin and Suroso [15] emphasized the role of effective communication between the project team and the client in improving the quality and speed of client decisions. In our study, the costs of poor coordination were not recorded as "communication costs" but appeared as rework, time waste, increased resource consumption, or higher overhead.

5.3 | Explanation of Technical and Design Factors

Technical and design factors were found to contribute to hidden costs through three pathways: Incomplete or ambiguous drawings, design changes during execution, and weak initial estimation.

The first pathway relates to the quality of technical information before execution. When drawings, specifications, and execution details are incomplete or ambiguous, the likelihood of on-site decisions and errors increases. Zhang et al. [23] emphasized the multi-stakeholder origins of design errors, while Qing et al. [24] demonstrated that design errors can have direct cost consequences for construction projects. Our findings show that when a technical deficiency is transferred from the design phase to the execution phase,

the cost of correction increases significantly because it involves not only drawing revision but also labor time, consumed materials, equipment, and dependent activities.

The second pathway—design changes—becomes more costly the later it occurs in the project. Wang et al. [25] showed that examining changes simultaneously in the technical model and execution schedule can reveal their effects before they spread. Our findings confirm that the official change order amount represents only part of the actual cost, with waiting time, productivity loss, and sequence disruption often not separately recorded. The third pathway—weak initial estimation—creates a gap between estimated budget and actual financial needs from the project's inception. Aljordi et al. [26] identified design errors, contractual documents, delays in drawing preparation, insufficient budget allocation, and lack of appropriate change management planning as factors affecting project time and cost. Our study extends this by showing that estimation weaknesses may manifest later as "project cost increase", obscuring their true origin.

5.4 | Explanation of Execution-Related Factors and Rework

Execution-related factors—rework, poor quality, and reduced productivity—represent a significant share of hidden costs. Rework is one of the clearest pathways from execution weakness to hidden cost. When an activity requires correction or redoing due to errors, non-compliance, changes, or improper execution, the cost includes not only materials for the second attempt but also re-engagement of labor, re-use of equipment, management and supervision capacity, and potential delays in dependent activities. This dispersion of consequences causes part of the rework cost to remain hidden among ordinary material, labor, and equipment costs.

This finding is consistent with Gumusburun Ayalp and Erdem [13], who demonstrated that rework cannot be attributed solely to execution crew errors, as its origins can be traced to human and contractual factors, design, quality, project management, and organizational structure. Therefore, rework is often the point where weaknesses created in other project phases or components become manifest in the field. This explains the difficulty of tracing hidden costs: The location where the cost occurs is not necessarily where the root cause originated. The finding on reduced productivity is also significant. When labor and equipment are present and their costs are fully recorded, but output is insufficient due to unready work fronts, waiting for materials, activity interference, or correction of previous work, the cost is fully recorded in the financial system, but what remains hidden is the cause of the low return on that expenditure. Rathnayake et al. [27] showed that workflow interruptions and extra time between activity handovers are important factors reducing productivity at the activity level. Thus, hidden cost here appears as "resources consumed without proportional progress".

5.5 | Explanation of Financial Factors

Financial factors contribute to hidden costs through three pathways: Cash flow disruption and its transfer to execution operations, gradual increase in duration-dependent costs, and weak tracking of financial deviation origins. The first pathway—payment delays—creates a cascading effect. When the client delays payment, the contractor may delay payment to suppliers, suppliers may delay material delivery, and execution activities may be disrupted. Part of the cost created in this path may appear as higher purchase prices, emergency procurement costs, reduced productivity, or increased overhead, with the connection to the initial payment delay being difficult to trace [28].

The second pathway—increased indirect costs—reflects the duration-dependent nature of many project costs. Site office and maintenance costs, salaries of management and supervisory personnel, utilities, security, and support services continue as long as the project continues. Even a delay that does not directly create significant costs for an activity can cause gradual overhead increases if it prolongs the project. These costs are typically recorded under general financial headings, and it is not always clear what portion of their increase is due to a specific delay, change, or stoppage. The third pathway—weak cost control—relates to inadequate recording and analysis. When cost recording is limited to the amount paid and the cause is not recorded, the ability to identify the origin of deviation is reduced. For example, increased material consumption may be due

to design change, rework, or waste, but if only the purchase amount is recorded, these three causes cannot be distinguished. Alotaibi et al. [29] showed that the effectiveness of project control systems depends on factors such as estimation accuracy, information integration, auditing, and corrective actions. Our findings confirm that weak cost control can itself be a factor in "keeping costs hidden", even if the amounts are recorded in the financial system.

5.6 | Explanation of Contractual Factors

Contractual factors contribute to hidden costs through ambiguity in obligations and responsibilities, expansion of change and claim effects, and prolongation of disputes. The importance of contractual ambiguity for hidden costs lies in the fact that not all financial consequences appear as an independent line item. For example, if project managers and technical experts hold several meetings to determine responsibility for an issue, the time and management cost of this process is typically not recorded as a "cost arising from contractual ambiguity". The same applies to work stoppages, document review, additional correspondence, and waiting for resolution. Changes and claims represent a second pathway. A change in scope, quantities, or specifications typically extends beyond the direct cost of the new work. Changes can disrupt activity sequences, reorganize resources, reduce productivity, and extend the duration of labor or equipment use. If these consequences are not fully recorded and evaluated, the official change order amount represents only part of the actual cost. Disputes among project parties constitute a third pathway. When the client, consultant, and contractor cannot agree on responsibility for a cost, work quality, payment conditions, or contract interpretation, dispute resolution itself becomes a time-consuming activity. Documentation gathering, schedule review, damage calculation, meetings, negotiation, and legal or contractual follow-up all require time and resources.

5.7 | Explanation of Resource and Supply Factors

Resource and supply factors contribute to hidden costs through delayed access to required resources, inefficient resource consumption, and changes in purchase and supply conditions. The first pathway—supply delays—demonstrates that the actual cost of material shortage is not merely the difference in purchase price. Work stoppages, resource idling, and schedule changes add to the financial impact. Ding and Jie [18] showed that supply chain uncertainty can lead to delays and cost overruns, with factors such as information transparency and supply chain collaboration playing mitigating roles. From a hidden cost perspective, weak supply becomes a hidden cost when the initial disruption transfers to other activities. The second pathway—resource waste—includes material waste, over-purchasing, improper storage, and inefficient equipment use. A key feature of this type of cost is that much of the waste is recorded as "ordinary consumption", and the financial system does not necessarily show what portion of consumed materials was truly necessary for output production. Similarly, equipment rental costs are fully recorded, but if the equipment sits idle for several days due to poor planning, the idle portion is not independently visible. The third pathway—supply condition fluctuations—demonstrates that price changes, supplier changes, and emergency purchases can cause actual costs to deviate from initial estimates. Angmor et al. [30] showed that supply chain disruptions are associated with material cost volatility, and flexibility in procurement and organizational response capacity can mitigate some of these effects. Our findings confirm that the cost of supply condition changes is not merely the price difference of an item; it may include the cost of finding alternative suppliers, different transportation arrangements, changed purchase timing, and schedule readjustment—all of which are typically absorbed into various cost lines and thus increase their hidden nature.

5.8 | Summary: The Systemic Nature of Hidden Costs

The overall response to the research question indicates that the formation of hidden costs in construction projects has a multi-factorial and systemic nature. Weak planning or design can transform into rework at another stage; cash flow problems can disrupt material supply; contractual ambiguity can delay decision-making; and supply disruption can reduce labor and equipment productivity. Therefore, identifying hidden

costs requires the project manager to trace not only the cost amount but also the formation path, root cause, and secondary consequences—because focusing solely on the final cost figure cannot reveal the actual mechanism of hidden cost creation.

6 | Conclusion

This study aimed to identify the causes of hidden costs in construction projects from the perspective of project managers. Through qualitative analysis of interviews with 13 experienced professionals, six main themes and 18 sub-themes were identified. The findings demonstrate that hidden costs are not caused by isolated factors but emerge through the interaction and transfer of effects across multiple project phases and domains. The study makes both theoretical and practical contributions. Theoretically, it extends the concept of hidden costs by providing an empirically grounded framework that distinguishes hidden costs from related concepts such as cost overrun, indirect costs, and rework. It demonstrates that hidden costs arise at the intersection of managerial, technical, execution, financial, contractual, and resource factors. Practically, the findings provide project managers with a systematic understanding of where hidden costs form and how they accumulate, enabling more targeted preventive and corrective actions.

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Author Contributions

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Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to confidentiality requirements.

Conflicts of Interest

The author(s) declare no conflicts of interest regarding the research or publication of this article.

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