

الاية:

(إِنَّ اللَّهَ يَأْمُرُكُمْ أَنْ تُؤَدُّوا الْأَمَانَاتِ إِلَىٰ أَهْلِهَا وَإِذَا حَكَمْتُمْ بَيْنَ
النَّاسِ أَنْ تَحْكُمُوا بِالْعَدْلِ إِنَّ اللَّهَ نِعِمَّا يَعِظُكُمْ بِهِ إِنَّ اللَّهَ كَانَ
سَمِيعًا بَصِيرًا)

سورة النساء الاية (58)

Al aya:

(Innallāha ya`murukum an tu`addul-amānāti ilā
ahlihā wa izā ḥakamtum bainan-nāsi an
taḥkumu bil-'adl, innallāha ni'immā ya'izukum
bih, innallāha kāna samī'am baṣīrā)

Surat An-Nisa Aya 58

Dedication

I dedicate this work to my beloved parents who nurtured my potentials.

*To my maternal grandmothers whom loved me and be very supportive
through my journey*

To my sisters and my brother

More especially my beloved husband

Thank you all, may allah protect you

“Pursue education when there is still time”

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So thank you all

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Abstract:

Disputes are common in the construction industry due to their relationship with many different industries and specializations and the complexity of the construction process, Conflict also occurs through accidents (injury), mismanagement, human error, disagreement or lack of communication between the contracting parties, Disputes affect the cash flow of the company, if not addressed and resolved in a timely manner, become very time consuming and costly.

Objective: This research aims to assess the impact of disputes on project cost, to reduce conflict between contracting parties that can develop into a dispute.

Methodology: The study was divided into two frameworks, the theoretical framework includes a comprehensive study on the stages of project implementation from the feasibility study stage to the delivery stage, disputes, their causes, types, ways to avoid them, claims, costs, pricing requirements, types of costs and estimates, while the second framework, which is the practical framework, in which a questionnaire containing research questions and hypotheses was prepared Data was analyzed computerized used statistical package for social science version 22 and presented through tables and figures.

Results: the most important results of this study ,lack of a sufficient feasibility study for projects, as well as engineering work is not carried out in standard ways according to the technical terms and conditions, lack of sufficient considerations for the variables that can occur during the implementation period, there is a significant impact when signing contracts without referring to the legal departments, and failure to sign the contract with subcontractors is a reason for the emergence of problems in the project stages.

Conclusion: Based on the results, this study concluded that engineers are not familiar with laws regulating the profession, lack of adequate feasibility study for the project, bad planning and lack of mechanisms to check the quality of engineering works.

Recommendations: this study recommend the need to use modern scientific methods, scheduling and planning programs before starting the project and documenting work during the project stages, Protection the rights of all parties, prices set in US dollars, reviewing all laws of taxes, duties and customs on construction companies, and more studies should be conducted to fill the gaps in this study.

1-1 Introduction

The construction industry is one of the largest industries .because of it's an exciting, dynamic process which often provides high income for workers and contractors, it is appealing career opportunity.

It is widely recognized that construction as a discipline is a combination of art and science. While understanding the technical aspects of construction is extremely important, it is also essential that construction professionals have knowledge of the business and management aspects of the profession. Close observation and participation in actual construction projects is very valuable in obtaining and understanding of the construction process as well. While construction has traditionally been a very conservative industry, the increasing rate of technological development and growing international competition in the industry are serving to accelerate the development of new construction methods, equipment, materials, and management techniques. As a result, coming years will see an increasing need for innovative and professionally competent construction professionals. ¹

The construction industry is a service industry for the rest of the economic sectors and industries, and it usually offers its products according to a specific request and specific goals.³

The construction industry is a regulator of economic growth. There is a direct relationship between economic growth and the growth of the construction sector, which is a complex industry because the final product is a complex of a large number of materials of different properties and shapes, as well as various mechanical and electrical equipment.

The final product is obtained in the construction industry through many contracting and supply strategies that differ from each other and their suitability for each type of project.⁴

A large number of temporary and permanent resources and high technical expertise are used, the development of which requires reliance on technological progress for the production of the project, and it may be stored or must be used within a certain time.

One of the distinguishing characteristics of the construction industry is that it is impossible to find in the projects of this industry two projects that are completely identical in their needs even if their goal are match.¹⁰

Disputes are common in construction projects because of the complexity of the construction process and fast-track construction projects the imperfect of the design and moreover, it takes so many individuals and companies to construct a project.

Disputes also occur through accidents, mismanagement, human error, disagreement or lack of communication. Dispute affect the cash flows of the company and also affects relationships between parties. Since disputes are the reason of worry because a well-planned construction project can't run smoothly.

These problems have become a widespread feature of the construction industry, if these are not resolute quickly they can causing delays in schedule results to claims that needs lawsuit measures to resolve them, loss of money and time.

Construction is a highly complex activity filled with uncertainties: economical, financial, and physical risks, as well as scope variations and documentation complexities.

Cost management systems are used as basic transaction reporting systems and for external financial reporting. Cost management systems not only provide reliable financial reporting, but they also track costs in order to provide information for management decision-making. The most important function of cost management is to help management focus on factors that make the firm successful. Critical success factors are a limited number of characteristics, conditions, or variables that have a direct and important impact on the efficiency, effectiveness and viability of an organization. They are the aspects of the company's performance that are essential to its competitive advantage and therefore to its success. Activities related to the critical success factors must be performed at the highest possible level of excellence.¹¹

1-2Problem statement:

Construction industry is facing a lot of problems, one of problems is increasing of project cost due to disputes.

1-3Research Objectives:

1-3-1 general objective:

1. This research aimed to evaluate the impact of disputes on project cost.

1-3-2sepecific objective:

1. To assess the effect of technical problems on the project cost.
2. To assess the misunderstanding of engineering contracts.

1-4Research questions:

1. Is there a feasibility study?
2. Does engineering criteria are established (cost, time, quality)?
3. Is existing laws are sufficient to regulate the profession?
4. Is there a legal department in organizations?

5. Is misunderstanding of engineering contracts leads to disputes?

1-5 Research hypotheses:

1. Accurate information gives accurate feasibility study.
2. Lack of engineering standards lead to technical problems.
3. The existing laws are not sufficient to regulate the profession.
4. Signing the contract without referring to the legal departments causes contractual disputes.
5. There is a relation between Misunderstanding of engineering contracts and disputes.

1-6 Research methodology:

The questionnaire was designed to collect the information needed for the study, the research relied on the preparation of the questionnaire in the method of scientific research and through the previous studies, and it was then brought the supervisor to see the suitability of the questionnaire then the statistician determine the number of the questionnaire required, and then brought to the Arabic language checker and psychology to see the convenient of the questionnaire.

1-7 Study Area:

The research was conducted in Sudan - Khartoum state, which covers companies (public and private) in different area in Khartoum locality.

1-8 Chapter outline:

- **Chapter one: introduction** - Chapter one will comprise the background, problem statement, objective, and hypotheses of the research.
- **Chapter two: literature review** - This chapter will explore data were reviewed from books and articles and web sites.
- **Chapter three: methodology**- This chapter will discuss the tools and methods to be used for data gathering in order to achieve the required objectives.
- **Chapter four: Results and discussion** -This chapter will constitute the presentation and analysis of data gathered. It will cover the exploratory study, analyse research instruments and the audit of site instructions.
- **Chapter five: conclusions and recommendations**- Conclusions and recommendations will be drawn based upon data analysis, linking them to hypothesis and objectives of the subject under investigation.

2-Literature review

2-1introduction:

A project is a group of activities that are implemented to achieve specific goals in a specific period of time.

2-2Phases of the construction projects:

The construction project goes through five main phases, which are⁹

2-2-1planning / preliminary engineering:

This is the stage at which the options are considered and the pros and cons evaluated. Most engineering projects involve the creation of a new product or the destruction and re-build of an existing one, and the project is defined on that basis. The options for the new product can be evaluated based on cost, quality, satisfaction in meeting the engineering criteria, etc.

Usually some sort of criteria are established at the beginning of the project that can be used to guide project decision making.²

2-2-2 detailed design:

Once the exact product is chosen, detailed design can begin. The end result is usually a set of drawings and/or a tender package. At this stage all of the issues are investigated and a complete engineering analysis is performed.²

2-2-3tender and contract phase:

During this phase the project is put out to tender, this phase includes advertising, answering of a bidder questions, holding pre-tender meeting, and opening of the tenders.²

Contracts:

The contract is simply an elaborated agreement between two or more parties. One or more parties may provide products or services in return to something provided by other party (client).

Convention on the Control of technical, financial and legal relationship between two or more parties to get a job done, provided that such action is contrary to the law.

- **The duties and rights of the parties of contract it is done by international organization:**

Institution of civil engineering (ICE).

Federation International DisEngineers Consulting (FIDIC).

Basic conditions: the legitimacy of the contract:

- 1. Offer and acceptance** (There must be a view of one of the parties and the acceptance of the other part).
- 2. The presence of Agreement** (agreement between the parties concerned by way of satisfaction and acceptance).

Reasons for avoidance of the contract effect:

- Violation of the agreement or the law began.
 - The disappearance of the contracted thing at the time of the signing of the agreement.
 - Invalidate the contract if it is proved that a part or parties concerned are not signatories to the Convention represents a legitimate and legally represented part.
- 3. The subject of a legal agreement** (Agreement or the subject of the contract must be legal).
 - 4. Capacity Parties concerned to enter into agreement** (Must be the parties or a legal edema) interested parties.
 - 5. Contract formula** (must the wording of the contract are consistent with the law).

Terms of contract:

1. Assignment of the contract:

- It is possible for any part of the contract to waive his rights or duties or transfer any of them to a third part unless there is an explicit text of the inadmissibility of such an assignment or transfer.
- In the event that Part waive his rights or duties to a third part, that does not relieve him of his duties stipulated in the contract, but under an agreement of satisfaction and acceptance between the original parties to the original contract.
- All contracts are subject to waiver or transport with the exception of contracts that include the use of the skill or the ability or personal service to one of the parties to the contract.
- The approval of the owner is Necessary to be obtained prior to the waiver by the Contractor. Under the terms of the contract are usually on the need to obtain such consent, and when the waiver process must have access to the Convention A follow between the two parties or the parties to the original contract outlining the new relationship between the parties to the contract after the waiver and sets out the responsibilities, financial, technical and obligations for each of them.
- The contract should contain a condition or More than a clause in the contract to include the issues of death and disability.

2. Change or modification in the contract:

- You can change all, or part of, the content of the contract or amended in any later time after being signed during the duration of effect, by agreement of the parties or related parties.
- Most of the engineering services contracts and construction contracts contain clauses give the owner the right to make a change, modify, add, or delete any of the contracted work with Financial compensation be paid for the contractor.
- With respect to the amount of compensation for this a change, deletion or addition, there are many ways to determine such as direct negotiations, including the existence of the bill of quantities in the contracts that contain Priced quantities agenda. But the best way of all to determine these amounts are having a schedule for unit's price to be agreed upon and signed within the contract documents of the part or parties.

- Change order can be direct or indirect, as can be in writing or orally.
- Whenever the amount of work is clear, detailed and precise terms of the contract are not unambiguous, and specifications and drawings and the rest of his documents clearly cannot be construed the more areas of disagreement are few.
- The Change order should be written, and knowing the amount of work which it needed to be changed, deleted, with accuracy
- The Change order must be treated the implementation period and the cost of the change. At Most construction contracts and contracts for engineering services determine the terms of the contract maximum period for filing a claim for compensation for what he considers a change or amendment to the contractor. At the end of that period invalidate his right to claim compensation.

3. Execution time and a fine delay:

- If the text of the contract should be performed acts "as soon as possible" or "direct" or "without any delay", the judiciary or the Board of Grievances in the case of contracts that the government departments or institutions are a part of it, that will be considered for implementation is "Reasonable period" In such cases, perhaps assisted by the judiciary body or committee of a probus jurisdiction to determine the reasonable period in standard way. Given the importance of the implementation period, it is necessary to select a specific number of days, or any unit of time so that the other must be through the implementation of the business. It starts calculating that period from the moment of issuance launch work and the delivery of location
- If any of the parties fail Decade to fulfil its obligations under the contract within the execution time can cost that part to pay compensation to the part or parties against the damage to them as a result of the delay.
- Containing construction contracts are generally specific amount of compensation for each day in which my delayed the completion of the core business of the schedule. Can be **substantial completion** of the work is defined as the level at which it has become in the owner's expanded use of Origin contractor established for the purpose for which It was created for it.
- Under the implementation of government projects and secure purchases systems that the **delay fine** in construction contracts are calculated based on the average daily cost of the project by dividing the value of the contract by duration **the total fines should not excess ten percent of the value of the contract.**
- The Ministry of Finance has interpreted this article to be applied to the fine based on what has already been implemented and not on the basis of what was originally contracted. As it interpreted by the ministry the same article as including the increase or decrease in the range of 20% and any increase or decrease for a time of execution of the project as a result of the increase or decrease the amount of work.

- In business consulting contracts if delayed contractor in the implementation of its obligations it is committed to a fine of 1% of the value of what it was delayed for a month so as not to increase the fine for 10% of the contract value.
- The owner can exempt the contractor from compliance with all or some of the fine delay or extend the implementation period stipulated in the contract, especially if the owner added some extra work for the contracted volume of business it during implementation. As the contractor is entitled to extend the implementation date if the delay was the result of acts or orders or decisions of the owner.
- When the Palace of the execution time is crucial for the owner gives the contractor a bonus for each day progresses substantial completion of works on schedule, and an item Last it includes a fine for the delay on this date, so as to give more impetus Contractor To accelerate Business achievement.

4. Subcontracting:

Subcontracts are contracts between a prime contractor and a secondary contractors or suppliers. Subcontractor are widely used in building construction for the installation of electrical, plumping, and heating and ventilating systems. The contractual agreements between the prime contractor and the subcontractors are similar to those between the owner and the prime contractor. However, subcontractors are responsible only to the prime contractor (not to the owner) in the performance of their subcontractors.

Since subcontract costs often make up a major portion of the cost for the project, it is essential that the prime contractor obtain timely and competitive prices for subcontract services. In fairness, the successful prime contractor should execute contracts with those subcontractors whose prices have been used for preparation of the bid. ¹

5. Document consisting of the contract:

The main purpose of the existence of the contract documents in general is to determine the relationship between the parties or parties contracting accurately defines the rights and obligations of each part under. The contract. **In general, the following documents must be existent:**

- Invitation speech.
- Instructions to Contractors.
- Tender offer or formula.
- Agreement.
- Terms of the contract: can be divided into general terms and private terms a first type is a record in the habit. The type II shall be deemed specially for the project under study. This is sometimes the integration of general and special conditions in a single document called the terms of the contract. These terms and conditions govern the legal, technical and financial relationship between the parties or parties contracting.
- Tables attached to the contract terms.
- Specifications.
- Graphics.
- Quantities table.

- Items Brooks Price.
- Report on the state of the soil.
- Supplements and additives.

6. Negotiations of award contract:

There are reasons is the clarity of the contract documents could affect the reserves or labs "Contingency Or Mark Up" such as the economic situation in the country and the abundance of material and hands working or not, and the rate of inflation, and the extent of political stability in the country, as well as some of the causes of climatic and environmental. Contractors usually follows methods different to raise the possibility of danger and the crushing burdens and adds them to the contract value what he thinks will cover the loss due to the danger in the event of occurrence . of not adding those amounts humiliation as even seem to display tempting if compared to other offers but the contractor set specific conditions associated with the currently known in the language of the profession " reservations Contractors " and find the owner then be obliged to negotiate with a number contractors . Rarely empty view of certain reservations about him. As a result, it is difficult to evaluate offers an accurate assessment. Thus, the owner finds in front of him and one option is to negotiate with a number of contractors who seem the most suitable offers presentations to determine the best tender. And in any case they need technical skill and intelligence and experience in engineering project management and financing.

Types of contracts:

In the world of business, contracts are used for establishing business deals and partnerships. The parties involved in the business engagement decide the type of the contract.

Usually, the type of the contract used for the business engagement varies depending on the type of the work and the nature of the industry.

The contract type is the key relationship between the parties engaged in the business and the contract type determines the project risk.

Contracts can be divided in different ways:

1. Types of contracts in terms of form:
 - Bilateral contract.
 - Unilateral contract.
 - Express contract.
 - Implied -in- fact contract.
 - Quasi contract.
 - Formal contract.
 - In formal contract.
2. Types of contracts in terms of contractual arrangements:
 - Lump sum contract.
 - Cost plus of fees.
 - Cost plus a percentage.
 - Schedules of rates.
 - Labour only.

- Do and charge.
- Design and contract.
- 3. Types of contracts in terms of depletion:
 - Valid contract.
 - Void contract.
 - Voidable contract.
 - Unenforceable contract.
- 4. Types of contracts in terms of performance:
 - Executed contract.
 - Executory contract.
- 5. Classified by method of evaluating contract price:
 - Fixed Price Contract.
 - Price – adjustment Contract.
 - Cost – Plus Contract.
 - Target – Cost Contract.
 - Bills of Quantity Contract.
 - Schedule of Rates Contract.
- 6. Classified Other than by Method of Evaluating Contract Price:
 - Competitive Contract.
 - Negotiated contract.
 - Package Contract (Package Deal).
 - Turnkey contract.
 - Continues contract.
 - Service Contract.
 - Running contract.

Contract termination/breach:

It may occur as a result of owner-specific reasons or may occur as a result of contractor-specific reasons and in each case the contractor can claim his dues.

The owner shall be the cause of the termination of the contract in the following solutions:

- Bankruptcy of the owner or dissolution of the owner's company.
- Giving unclear information to the contractor is difficult to implement.
- Cancellation of an essential part of the project affecting the price of the contractor.
- Object to giving necessary work approvals.
- Not to spend extracts on schedule at work.

The owner may have the right to terminate the contract in the following cases:

- The contractor failed to bring in trained workers or to use poor materials at work.
- Deliberate negligence and failure to follow regulations, laws and regulations.
- Non-compliance with the terms of the contract
- Bribery.

Other reasons:

- The end of a contract for the completion of the work.
- The end of the contract by agreement.
- The end of the decade cassation.
- Terminate the contract to the impossibility of implementation.
- Terminate the contract due to force majeure.

2-2-4 Construction / implementation phase:

This phase involves the physical implementation of the work that the engineer has design. The engineer's responsibility to ensure adequate construction of the work, particularly for items that become concealed like concrete reinforcement.

Also, since the engineer is more concerned with the suitability of the final product from an engineering standpoint, there are usually constructability issues that require addressing.²

2-2-5 Post construction:

Once the product is complete, the final documentation phase is required to ensure that stakeholders have the documentation they need and project funding and administration issues are finalized.²

2-3Disputes:

It is a litigation that usually arises from a difference of interests in a particular issue, and the dispute is not necessarily resolved through the judiciary.²

Conflict emanating from opposing interest due to scarce resources, goal divergence, frustration and mixed motive relationships, it exists wherever there is incompatibility of interests among the disputants. It is suggested that conflict can be managed to the point before it leads to disputes.

It is observed that disputes occur when a claim is rejected and the rejection is not accepted by the other party.³

2-3-1The nature of engineering disputes:

1- Conflict between parties.

- **Contractual dispute.**

It is the dispute that arises regarding the interpretation of the terms of the contract.

- **practical dispute**

It is the one that arises during the execution of the business.

- **Financial dispute**

It is the dispute that they arise regarding monetary compensation.

- **The dispute over the intellectual property of the schemes.**

The dispute over the intellectual property of the plans is considered a serious dispute because it is criminal and not civil, and therefore the penalty for it is imprisonment, not just financial compensation.

2- The dispute between one of the parties or the arbitrator or the arbitration panel.

The dispute here does not mean the disagreement with the arbitrator over taking a specific action, or the application of a certain principle, but rather the dispute that leads to the refusal of the arbitrator or the arbitration panel (if the reasons for the response are available).

Many laws in the world restrict cases of the possibility of recusal of arbitrators and make them often the same cases in which judges respond accordingly, and therefore arbitrators are not dismissed randomly, but according to the cases stipulated in the law.

3- The dispute related to the integrity of the arbitration award.

The dispute regarding the integrity of the arbitration award means that one of the parties has found a loophole in the procedures followed by the arbitrator.

2-3-2 Causes of disputes:

a) Owner related:

- Variations initiated by the owner.
- Change of scope.
- Acceleration.
- Unrealistic expectations.
- Payment delay.

Late giving of possession.

b) Contractor related:

- Delays in work progress.
- Time extensions.
- Finance failure of the contractor.
- Technical inadequacy of the contractor.
- Tendering.
- Quality of works.

c) Design related:

- Design error.
- Inadequate/ incomplete specification.
- Quality of design.
- Availability of information.

d) Contract related:

- Ambiguities in contract document.
- Different interpretations of the contract provision.
- Risk allocation.
- Other contract problem.

e) Human behaviour related:

- Adversarial / controversial culture.
- Lack of communication.
- Lack of team spirit.

f) Project relate:

- Site condition.
- Unforeseen change.

g) External factors:

- Weather.
- Legal and economic factors.
- Fragmented structure for the sector.³

2-3-3dispute resolution:

- Engineer decision
- settlement
- arbitration

2-3-4Alternative dispute resolution (ADR):

The time consuming and sometimes expensive traditional methods of resolution of disputes by reference to the courts or arbitration led to the adoption of processes known as **alternative dispute resolution** (ADR). These include direct discussion between executives of the parties; obtaining the advice of independent experts; or using a conciliator trying to find common ground, or of a mediator looking for an agreed solution. The ICE conditions permit either party to refer a dispute to conciliation procedure, provided the other has not already elected to go to arbitration. The difference between arbitration and conciliation needs to be appreciated. With arbitration each party states its case and is subject to cross-examination by the other party. The arbitrator's decision is based only on evidence submitted to him, although of course he can put queries to either party. But in a conciliation procedure the conciliator, often a professional engineer can investigate, and call for information on all matters he considers relevant to the dispute, and may interview the parties separately. This gives him a good chance of discovering the root cause of a dispute, enabling him to find a solution both parties can accept.

Of course for any method of conciliation or mediation to be successful, there must be a willingness in both parties to try to find a solution and the introduction of an outside independent party assists this process. Such methods of resolving problems are attractive due to reduced costs in employing lawyers and experts as well as in staff costs and in tying up senior management if they pursue arbitration or court action.

Many standard forms of contract refer to ADR methods and encourage the parties to try to settle disputes by such means. The introduction of provisions for adjudication into UK contracts has opened up the opportunities for early resolution of problems but there is still considerable interest in conciliation and mediation and the courts have encouraged parties to try such methods before commencing court actions. There is considerable debate concerning the relative merits of conciliation and adjudication. Conciliation proceedings are confidential, and the conciliator's recommendations cannot be quoted by either party in any subsequent arbitration. This aids reaching agreement as the disputants can state their views to the conciliator without prejudice. Adjudication is more formal. It is not a method of reaching agreement between the parties but a decision as to what the contract provides with respect to the matter in dispute. Any submissions to the adjudicator can be referred to in a subsequent arbitration, and the adjudicator may decide that he needs to employ specialist advice on technical or legal matters. Under adjudication the parties may feel it necessary to employ legal advice in presenting submissions and thus increase their potential costs.

Litigation Arbitration Mediation Conciliation Adjudication/Security of Payment Mini-Trials Facilitated Negotiation Expert Determination/Appraisal.⁷

2-3-4-1 Factors which impact upon the selection of dispute resolution methods:

- **Cost:**

The costs associated with dispute resolution involve reaching settlement agreements including expenses relating to revenue, the neutral third party fee, documentation, and settlement costs.

Cost is the one of the most critical criteria for organization when assessing which dispute resolution method to use for dispute resolution as it affects the profit share of the project outcome. In assessing the suitability of a case for ADR, a cost-benefit analysis of the costs and value of the case must be undertaken. This involves trading off the various criteria and also helps the parties to better understand the issues involved and the expense likely to be incurred if the dispute Continues.⁸

- **Openness, neutrality and fairness:**

Neutrality and fairness depend heavily on the competence, training, and integrity of the neutral third parties. During the resolution process, a neutral third party owes a duty of care to his or her clients to remain impartial. He or she facilitates the parties 'reaching a settlement but must make a conscientious effort to avoid personal biases. The neutral third must not have any professional or financial relationship with any party otherwise the information must be disclosed to the other party.

Finally the neutral third party must be agreed by both sides. Since the choice of the neutral third party is of paramount importance there must be a code of conduct to monitor the standard of professional mediators, conciliators and arbitrators. This will enhance the trust and comfort level between parties to voluntarily reach a settlement.⁸

- **Speed:**

Time is money in the world of business and project management. Lengthy delay of dispute resolution will delay the progress of works resulting in extra costs and incur potential penalty points.⁸

- **Outcome:**

The outcome of a construction dispute is usually related to the costs liability. The party which initiates the dispute feels that the other party owe costs for reasons such as variation of payments, quality of workmanship, and final payments or owes compensation costs due to factors such as delay of works, payment for extension of time and liquidated damages.⁸

- **Privacy and confidentiality:**

Confidentiality is an implied and inherent feature of ADR processes that parties to a dispute are not allowed to disclose any information or materials to the public unless by mutual consent of the parties.⁸

- **Enforceability:**

ADR methods of dispute resolution are non-binding therefore it cannot be enforced upon by the courts unless a written agreement is concluded. However, the selection of a competent neutral facilitator with excellent negotiation skills can encourage the parties to settle.⁸

- **Preservation of relationship:**

A continuing relationship is one of the key elements for any organization to strive for. A good relationship is always based on trust, common interests, and respect and requires the effort and commitment of the parties to make it last. ADR methods allow parties to negotiate the process of dispute resolution and the neutral facilitator assists both parties to always focus on the issue of the dispute and to try to achieve a win-win situation which is crucial to the Melbourne construction industry as it is heavily reliant on relationships.⁸

- **Flexibility:**

The non-binding nature of ADR methods is likely to encourage cooperation for all parties to reach an agreement through negotiation as it is more flexible than traditional methods.⁸

- **Creative remedies:**

Creative agreement is directly related to the skills, experience, and inherent character of a neutral third party. Depending on the nature and requirements of the parties, he or she should try to come up with a solution that can satisfy both parties' needs. Settlements can include human factors such as business relationships and personal issues can be considered. Lateral thinking by the facilitator is vital as it takes the various factors into consideration before reaching a settlement. Reality testing by writing down the pros and cons of each possible outcome will allow parties to feel fully informed with the decision making power in their hands.⁸

- **Degree of control:**

When parties feel in control of the outcome and processes involved to reach an agreement, it will also mitigate the adversarial climate between disputing parties.⁸

2-4claims:

A claim is a request by the contractor for a time extension or for additional payment based on the occurrence of an event beyond the contractor's control that has not been covered by the change order. The usual construction contract empowers the owner's representative (architect/engineer or government contracting officer) to decide on the validity of such claims. However, if the contractor is not satisfied with the decision, the matter becomes dispute.¹

2-4-1the process of submitting claims:

- **Pre-award-taking**

- a) Bid protesters (fair/objective manner).
- b) Correctable mistakes in bidding.
- c) Correctable mistakes in contract document.¹¹

- **Project implementation and management phase**

1. Changes claims

- a) Formal or directed changes.
- b) Indirect (constructive) changes.

Types of constructive changes:

- Differing in site condition.
- Design related (design errors) changes.
- Payment changes.

- Owner-furnished property.
- Over inspection.
- Rejection of (or-equivalent) substitution.
- Non-disclosure of technical information.
- Higher standard than contracts.

c) Cardinal changes

2. Impact claims

a) Delay.

- Excusable delays.
- Compensable delays.

b) Acceleration.

c) Disruption.

3. Performance quality claims.

4. Bad faith claims.¹¹

2-4-2 causes of claims:

- Contracts.
- Fast track construction.
- Design errors.
- Contract administration.
- Pre-design investigation.
- Contractor problems.
- Owner problems.
- Project conditions.
- Outside forces.

2-4-3 cost of claim:

- Pre pricing.
- Post pricing.
- Force account.

2-4-4 Basic requirements for claim pricing

- Breakdown cost.
- Cost allocation.
- Cost allow ability.
- Cost accounting.

2-5 Cost:

The amount measured in money, cash expended or liability incurred, in consideration of goods and/or services received... (AACE, 2003).

Cost engineering as a discipline has been around for a number of years. A number of standards have been developed over these years by various organizations. The most widely recognized organization for these standards currently is the Association for the Advancement of Cost Engineering International or AACEI.

Cost Engineering refers to cost, schedule and resource analysis, planning, estimating, forecasting, control, and change management practices. Note that:

The word 'engineering' reflects the linkage of cost and schedule skills with specific technical knowledge.

Owner cost engineers work jointly with design engineers to optimize the project scope and improve its business value.⁶

2-6 Cost accounting:

The cost engineer must be familiar with cost accounting since it is the accountant who keeps the cost records. Moreover the cost engineer should be part of a team in the allocation of overhead and other indirect costs.⁵

2-7 Project cost accounting:

An understanding of the terms total cost and profit is essential to gain an understanding of cost accounting. For a business to be successful, it must earn a profit. Several terms for sales are employed by accountants, including selling price, contract value, or billable value. They represent the total expected income from the customer.

Considered next are the estimated costs of producing the product, be it a manufactured item or a service. Many firms use the term *total base cost* and commonly have a standard list that defines all the elements that account for the cost of the work. Subtracting the total base cost from the estimated project sales or income gives what is commonly termed *gross profit* or *total overhead and profit*. Another term used is *gross margin*.

Considered also are the costs involved in selling the product or service.

The most common terms used are *overhead cost* or selling and general administration expenses.⁷

2-8 Role of cost accounting:

Cost accounting, the principal subject of this chapter, expands the techniques of financial accounting and is part of managerial accounting, as opposed to historical or audit functions. A general definition of accounting is:

Accounting is the art of recording, classifying, and summarizing in a significant manner and in terms of money, transactions and events which are, in part at least, of a financial character, and interpreting the results thereof.

All accounting systems include three basic steps: recording, classifying, and summarizing economic data, all three in terms of money. Classification of accounts is based on a listing called the chart of accounts, which plays a major role in all accounting systems. It is employed extensively in computer applications in the form of management information systems. A good chart of accounts structure provides the following:

- A standard method by which a business prepares cost estimates in a consistent manner
- A means for recording and classifying cost to permit direct comparison with estimates and budgets
- Facilities for creation of cost centres such as department or sections
- Means for dividing cost centres into smaller segments for ease of control and for obtaining unit return cost data

- The opportunity for cost engineers to follow the chart of accounts in trending the project costs and in preparing cost forecasts and management cost reports.

Definition for “cost” is the amount measured in money, cash expended or liability incurred, in consideration of goods and/or services received (AACE, 2003).⁷

2-9 Classification of costs:

Costs can be classified as unexpired and expired.

Unexpired costs (assets) are those which are applicable to the production of future revenues.

Expired costs are those which are not applicable to the production of future revenues and for that reason are treated as deductions from current revenues or are charged against retained earnings. Some examples are:

a) Equipment and machinery.

This could be automobiles, trucks, desks, computers, or machines in a machine shop. All are assigned an estimated useful life, and they are written off or depreciated over a given period of time.

The useful life of any piece of equipment is determined by government regulation or by guidelines set by historical data. The guidelines are flexible and may be changed from time to time by modern technology.

When the write off is made, the cost becomes an expired cost. The write off or depreciation, depending on what it is for, can be classified as direct, indirect, or overhead cost.

b) Raw materials inventory.

An accumulation of unused items or components (raw materials) related to producing a product is called an inventory. Items in the inventory may have been acquired at different times and at different prices.

In such cases a rule or guideline is required to determine the value at which these units shall be transferred out of inventory and into expired costs.

The rule applies to pricing and has nothing to do with which unit is removed physically from the inventory.

c) Prepaid costs.

These are costs for which cash has been expended for a service or benefit that extends over more than one production cycle, or 1 year. Insurance on a sales office is not inventorial and is therefore transferred from Prepaid Insurance to an outright expense account. The same determination has to be made for local taxes and rent.

d) Salaries.

These can be an unexpired cost. Work on a particular product could be done perhaps months before the final assembly of the items is completed. Also a portion of the product could be fabricated outside and returned for final assembly. The salary is written off to the job or to products in the end. Unexpired costs are found in balance sheets, and expired costs are found in the profit and loss (income) section of the final statements.

Cost data found in conventional financial statements, however, are for the specific purpose of reporting to interested outsiders and are not necessarily useful for other

applications. The requirement of selecting the appropriate cost type for individual objectives is important. No general rules are possible because of the wide variety of circumstances.⁵

2-9-1 Direct costs:

Direct costs are also called prime costs and are traceable directly to the product being manufactured or fabricated, for an engineering and construction firm one of the prime costs on a project is the design department work hours or salary.

In a manufacturing operation, costs are accumulated through three separate accounts:

1. Direct material. Cost of materials, assemblies, and parts which are used for the completion of the project

2. Direct labour. Wages of workers who are participating in the completion of the product

3. Manufacturing Overhead. The costs of all other factors contributing to the completion of the product

Material cost consists of the basic purchase price and all other expenses required to transfer the materials to the purchaser's premises, such as transportation, insurance, and tariff duties.

Labour cost is made up of many different factors. It includes the basic hourly rate for hours worked, overtime pay, social security taxes, vacation pay, holidays, sick leave, and so on.⁷

2-9-2 Indirect costs:

Indirect costs are all the costs of manufacturing that cannot be classified as direct costs because it is either impractical or impossible. Each classification is initially accumulated in a separate account and at the end of the accounting period is allocated to individual benefiting activities, such as a cost centre or project. **It is a two-step procedure:** accumulation and allocation.⁵

1. Indirect labor:

Indirect labor is labor that is part of the overall production process but does not come into direct contact with the product. A common example is labor cost for employees of the manufacturing equipment maintenance department. Indirect labor is a manufacturing overhead cost.¹¹

2. Indirect material:

Similar to indirect labor, indirect materials are materials that are not the main components of the finished goods. Examples are glue, screws, nails, and other materials such as machine oils, lubricants, and miscellaneous supplies that may not even be physically incorporated into the finished good. Indirect materials are a manufacturing overhead cost.¹¹

Supervisory services, for example, benefit many units of profit and the cost accumulates in a separate account. At the end of the accounting period the cost is allocated to individual products as part of the overhead.

Modern technology tends to increase the share of indirect costs while the share of direct labor cost is declining. This is really the purpose of automation—to replace direct labor cost with the indirect cost of machines.

All businesses are organized by departments or cost centers, but the two are not necessarily synonymous. Costs are accumulated by cost centers, which may or may not coincide with operating departments. Cost centers are located where costs can be measured and recorded as conveniently and accurately as possible. The advantages of having departments and cost centers are:

- A more accurate selling price can be gained for a product.
- Cost can be controlled more easily.
- Long-range forecasting can be more exact.

Cost engineers should maintain a close liaison with the cost accountants and those who design and apply the cost accumulation system. Cost engineers need to make the requirements known so that all work can be accomplished within appropriate cost and practicality limitations.⁵

2-9-3 Overhead costs:

The classification includes all product costs that are not considered prime costs (direct material and direct labor). There is no limit to the possible number of overhead classifications; however, principal groups are:

Indirect materials (also known as supplies): materials, such as lubricants, that do not become a part of the finished product.

Indirect labor: the wages and salaries of employees who are not directly connected with the manufacture of a product, such as supervisors, maintenance workers, and internal transportation workers. Frequently the cost of fringe benefits is included in this classification.

Facilities costs: both short-term cost of the current year and the depreciated part of long-term costs for the current year. The former includes building and equipment maintenance, local real estate taxes, and other periodic items; the latter includes buildings and equipment.

Service department costs: for facilities that support production—for example, accounting, laboratories, stores, cafeteria, and first-aid stations.

Overhead is considered one of the most tedious problems of cost accounting.

Accumulated overhead costs are allocated in stages. First the overhead costs are allocated to the cost centers and in turn are allocated to job order costs and process costs. With a large number of indirect cost classifications and a large number of cost centers, the computations can be voluminous.

Cost engineers must recognize that the cost data that emerge from these calculations are affected significantly by the measures used for allocation, and they should understand fully the techniques used for the allocation. A basis must be selected to allocate the costs fairly. Consider building maintenance as an example. Measurement can be made on the basis of square feet and allocated on the basis of floor space occupied by each cost center. In turn, cost centers must have a measure to allocate this overhead, which might be labor hours, machine hours, material, and so on.

Allocating overhead based on actual data has two distinct disadvantages:

(1) It is complicated, and (2) the information is not timely. Units made at the beginning of a month cannot be priced out until the end of the month when actual data become

known, and use of actual overhead cost is subject to fluctuation from period to period for such items as taxes, which may occur only once a year. A shortcut method, called an *estimated burden rate*, has been devised. Managers predict an amount for the overhead cost for a fixed period, usually a year, and determine the measure or basis for charging a job or product for its appropriate share of the overhead cost. Direct labor has been used most widely for this basis.

A rate can be established by dividing total estimated overhead cost by the estimated quantity of the selected basis, which becomes the burden rate. These are estimated amounts and variances will occur. The variances should be reviewed periodically and adjusted accordingly.

The advantages of the estimated burden rate method are (1) savings of time, and (2) increased possibility of obtaining better data for determination of operating efficiency.⁵

2-9-4 Standard costs:

Standard costs and budgets are not identical. Standard costs usually refer to a unit of production, and budget to a total concept like a department. In a sense the standard is the budget for 1 unit of production. The purposes of standard costs are:

- To build a budget and feedback system
- To aid in management predictions
- To save in bookkeeping cost
- To aid in cash flow forecasting

Standard costs are determined with scientific techniques and objective quantity measurements. The costs developed do not necessarily represent expected performance but rather, desired objectives. Standard costs are merely references to which actual costs are compared. The variances are used in management reports as a valuable tool to highlight areas of good and poor performance.

2-9-5 Joint costs:

The term joint costs applies to two or more kinds of products that are produced simultaneously and are not identifiable as individual types of products until a certain stage of production, the split-off point, is reached. A product for which there is little or no demand is called a by-product. Joint costs are combined cost up to the point of separation. Since joint costs cannot be traced directly to units worked, the apportioning of the costs to various units of production has to be arbitrary. Joint cost distribution is limited to purposes of inventory costing and income measurement.

2-9-6 Job Order and Process Costing:

The two basic types of accounting techniques for accumulating production costs are (1) job order costing, and (2) process costing. In job order costing the production cycle and the cost cycle are of equal length. Job order costing is used for specialized production jobs for which costs can be recorded accurately, but for which considerable work is involved. Job orders can be issued for individual customers or for stock items.

Process costing is used for continuous process industries which operate 24 hours per day, such as chemical, steel, and so forth. The production cycle continues without interruption while the cost cycle is cut off for each accounting period to determine the result of operations. Process costs use averages and are less accurate than job order

costs, but they are simpler and cheaper to operate. The method is applicable to mass-production industries as well as to process industries.⁵

2-10 Cost estimating:

A cost estimate is defined as “a compilation of all the costs of the elements of a project or effort included within an agreed upon scope.” To a contractor, this is the cost that will most likely be incurred in completing the project as defined in the contract documents. The contractor’s cost includes its own internal costs, as well as those of its subcontractors, suppliers, and third parties.⁴

2-10-1 Basic steps of estimating:

1. Take-Off :

Measuring and cataloguing the quantities of work derived from the scope documents.

2. Costing:

Using the take-off and the information presented in the scope documents to assign cost values to the elements of work previously catalogued.

3. Pricing:

Determining the amount to be charged to the owner/client so as to fully include direct and indirect cost items, as well as contingency and profit.⁴

2-10-2 Basic cost estimating terminology:

- **Change Order:** A document requesting a change or correction; a written change made by the architect / engineer to the contract drawings and/or specifications after the contract award. Generally, a change order must be approved by the owner/client and the contractor before it becomes a legal change to contract.
- **Contingency:** An amount added to the estimate to allow for changes that experience shows will likely be required. This may be derived through statistical analysis of past project cost or by applying experience gained on similar projects. Contingency usually does not include changes in scope or unforeseeable major events such as strikes or earthquakes.
- **Bid Documents:** The advertisement for bids, instructions to bidders, information available to bidders, bid form with all attachments, and proposed contract documents.
- **Alternate:** A request from the owner for the cost of adding or deleting an item or work element from the basic bid. The cost of adding an item is usually known as an additive alternate, while the cost of deleting an item is known as a deductive alternate.
- **Contract Documents:** The contract forms, general and specific conditions, drawings, specifications, and addenda describing the project scope and contract terms.
- **Direct Cost:** Costs that can be directly attributed to a particular item of work or activity.
- **Distributable Cost:** A cost item that is spread over other cost items rather than managed as a separate account.

- **Indirect Costs:** In construction, all costs that do not become a final part of the installation. They **include, but** are not limited to, field administration, direct supervision, capital tools, start-up costs, contractor's fees, insurance, and taxes.⁴

2-10-3 Types of estimates:

There are numerous characteristics that can be used to categorize cost estimate types. The most significant characteristics are degree of project definition, end usage of the estimate, estimate methodology, as well as the effort and time needed to prepare the estimate.⁴

The Most Commonly Used Estimates

- **Order-of-Magnitude Estimates:**

Estimates made without detailed engineering data. An estimate of this type would normally be expected to be accurate within +50 percent or – 30 percent. Order-of-magnitude estimates are sometimes referred to as “conceptual” or “ballpark” estimates. They have a wide range of accuracy, and have important applications, such as using them to determine the feasibility of a project quickly or to screen several types of alternative designs. Order-of-magnitude estimates are generally prepared using only basic criteria such as desired output, total square meters, or number of units.

- **Budget Estimates:**

Budget estimates are prepared with the help of flow sheets, layouts, and equipment details. In other words, enough preliminary engineering has taken place to further define the project scope. An estimate of this type is normally expected to be accurate within +30 percent or -15 percent. Since the budget estimate is more definitive than the order-of-magnitude estimate, it is better suited for determining project feasibility and establishing definitive budget. The accuracy and usefulness of a budget estimate depends, to a large extent, on the amount and quality of information available.

- **Definitive Estimates:**

As the name implies, these are estimates prepared from much defined engineering data. The definitive estimate includes various degrees of detail estimates which could be made from “approved for construction” drawings and specifications. Definitive estimates are also called “check” lump sum, “tender,” and “post-contract change estimates. An estimate of this type is usually expected to be accurate within +15 percent or – 5 percent.

2-10-4 Estimate classifications:

There are numerous characteristics that can be used to categorize cost estimates types. The most significant of these are degree of project definition, end usage of the estimate, estimating methodology, and the effort and time needed to prepare the estimate. The “primary” characteristic used in this guideline to define the classification category is the degree of project definition. The other characteristics are “secondary”.

The discrete levels of project definition used for classifying estimates correspond to the typical phases and gates of evaluation, authorization, and execution often used by project stakeholders during a project life cycle.

Five cost estimate classes have been established. The estimate class designations are labelled Class 1, 2, 3, 4, and 5. A Class 5 estimate is based upon the lowest level of

project definition, and a Class 1 estimate is closest to full project definition and maturity.

- Class 5- 0% to 2% Level of Project Definition; Screening End Usage.
- Class 4 -1% to 15% Level of Project Definition; Concept Study End Usage.
- Class 3 - 10% to 40% Level of Project Definition; Budget End Usage.
- Class 2 - 30% to 70% Level of Project Definition; Control or Bid End Usage.
- Class 1 – 50% to 100% Level of Project Definition; Check or Bid End Usage.⁴

2-10-5 Basis of estimate:

The Basis of Estimate (BOE) is characterized as the one deliverable that defines the scope of the project, and ultimately becomes the basis for change management. When prepared correctly, any person with capital project experience can use the BOE to understand and assess the estimate, independent of any other supporting documentation. A well-written BOE achieves those goals by clearly and concisely stating the purpose of the estimate being prepared (i.e., cost study, project options, funding, etc), the project scope, pricing basis, allowances, assumptions, exclusions, cost risks and opportunities, and any deviations from standard practices. In addition the BOE is a documented record of pertinent communications that have occurred and agreements that have been made between the estimator and other project stakeholders.

2-10-6 Estimate structure:

The control structure for a project is the breakdown of the total work into manageable units or packages for the purpose of estimating and control of cost and schedule. The proper structuring of a project for control purposes contributes greatly to the effective implementation of project control procedures and the success of the project itself

Large projects will often use work breakdown structures (WBS) and resource breakdown structures (RBS) as components of the overall coding structure. Smaller projects will often use a simpler code of accounts based simply on the disciplines or construction trades used on the project The WBS and RBS are basic project management tools that define the project along activity levels that can be clearly identified, managed, and controlled

Other estimate formats may include CSI breakdown, UNIFORMAT (Building Systems) breakdown or bid packages.

2-10-7 Factored estimates:

- Capacity Factored Method: A capacity factored estimate is one in which the cost of a new facility is derived from the cost of a similar facility of a known (but usually different) capacity. It relies on the nonlinear relationship between capacity and cost.
- Ratio Factored Methods: Ratio or factored estimating methods are used in situations where the total cost of an item or facility can be reliably estimated from the cost of a primary component. This is often referred to as “equipment factor” estimating.

2-10-8 Cost of making estimates:

A cost estimate does not come free, and the cost of preparing the estimate rises rapidly with the accuracy required. The expense of an estimate may or may not be calculated to include the cost of detailed engineering required to prepare the estimate. From a

practical point of view, the estimate cannot be prepared without adequate engineering work to support the estimate.

2-10-9 Representation of cost data:

Cost estimates can be prepared from three sources of data:

1. Similar project costs: costs of similar projects, and costs of project components.
2. Proprietary cost data files: historical company costs, and in-house projects.
3. Published cost information.

Extreme care should be used when using published information because the accuracy level of such data is not known. Sometimes the basis for such data is not even indicated.⁵

2-10-10 operating cost estimation:

Operating Cost: (or manufacturing cost): the expenses incurred during the normal operation of a facility, or component, including labor, materials, utilities, and other related costs.

Overhead: a cost or expense inherent in the performing of an operation, i.e., engineering, construction, operating or manufacturing, which cannot be charged to or identified with a part of the work, product or asset and, therefore, must be allocated on some arbitrary base believed to be equitable, or handled as a business expense independent of the volume of production. Plant overhead is also called factory expense.

Direct Costs: the portion of the operating costs that is generally assignable to a specific product or process area.

Indirect Costs: costs not directly assignable to the end product or process, such as overhead and general purpose labor, or costs of outside operations, such as transportation and distribution.⁵

• Purposes of Operating Cost Estimates:

Operating cost estimates can be important from several standpoints. They are necessary in order to determine the potential profitability of a product or process and are very useful for screening alternative project possibilities.

Frequently they can act as a guide to pinpoint potential areas in which to conduct research and to evaluate the commercial viability of research results. And they provide a tool for sensitivity analysis for individual components. It is very important to remember to perform operating cost estimates at both full and reduced capacities for the operating system in question. It is not uncommon for a system to be highly efficient at full capacity, but very inefficient when operating at less than design capacity. The important question to be answered is what range of operations can a plant operate over and still make a profit. Such costs can be calculated either as stand-alone estimates or as incremental costs for specified projects. Depending upon the situation, these different viewpoints could result in different decisions.

Commonly, three differing bases for comparison are used, although others may be used for special applications. **The most common three are:**

- Daily cost
- Cost per unit-of-production
- Annual cost

For some manufacturing considerations, a cost-per-unit analysis can be valuable. When making comparisons, it is very important to make sure each iteration or calculation is made using the same techniques and assumptions.

Otherwise, comparisons may not be valid. All other factors being equal, making comparisons using an annualized basis instead of on shorter time increments has a number of advantages:

- Seasonal variations are evened out.
- On-stream time factors are considered.
- More accurate analysis of less-than-full capacity situations is obtained.
- Infrequently occurring large expenses are factored in (scheduled maintenance, vacation shutdowns, catalyst changes, etc.).
- The output is in a form easily used in standard profitability analysis.
- The annual basis is readily convertible to the other bases, daily cost and unit-of-production, yielding mean annual figures rather than a potentially high or low figure for an arbitrarily selected time of year.

• **Raw Materials and Utilities:**

Raw materials and/or utilities are frequently the largest operating cost being considered in an estimation. The estimations involving raw materials are not always straightforward, as the following list of considerations shows.

- Raw materials frequently are the largest operating cost.
- By-products and scrap may be a debit or credit.
- Prices may be obtained either from suppliers or from published data.
- Raw materials costs may vary significantly depending upon the quality required (concentration, acceptable impurity levels, etc.).
- Raw materials costs entail quantity discounts in many cases leading to a trade-off of lower prices for purchase of large quantities vs. storage and inventory cost for raw materials that cannot be used immediately.
- Raw materials costs vary significantly depending upon the mode of purchase and transport (bulk quantities, truck lots, rail car lots, pipeline delivery, bags, boxes, etc.).
- Supplies and catalysts are sometimes considered to be raw materials.
- Fuels may be either raw materials or utilities.
- Freight and handling costs must be included in pricing raw materials.

The cost of utilities can vary widely with the location, with the size of the service required, with the national and local economy, and even with the season. Utilities must be examined closely on a local basis, especially if they form a major part of the operating costs. Generally utility pricing is regulated and the approved tariffs are readily available from the utility company or the cognizant regulatory agency. However, if the utilities are internally generated within a process, a separate estimate of the utility cost must be performed.

• **Operating Labor**

The best estimates of operating labor are based on a complete staffing table.

This table should indicate the following:

- The particular craft or skill required in each operation.

- Labor rates for the various types of operations.
- Supervision required for each process step.
- Maintenance personnel required.

❖ **Maintenance:**

Few published data on maintenance data are available. Maintenance cost can vary from 1 or 2% to over 15% of the project capital cost per year. For simple plants with relatively mild, noncorrosive conditions, an allowance of 3 to 5% should be adequate. For complex plants and severe corrosive conditions, this factor can be 10 to 12% or even higher.

❖ **Indirect Payroll Cost:**

Indirect payroll cost includes workers' compensation, pensions, group insurance, paid vacations and holidays, social security, unemployment taxes, fringe benefits, and so on. It is generally based on labor cost, usually at about 30 to 45% of the labor cost in the United States. In other countries, this percentage may vary greatly and should be verified locally.

❖ **Operating Supplies:**

Operating supplies include lubricants, instrument charts, brooms, and so on, and may be generally assumed to be 6% of the operating labor or as 0.5% to 1% of the capital investment per year. For highly automated, complex operations these costs can increase substantially as a percentage of labor costs.

❖ **Laboratory and Other Service Costs:**

Laboratory and other service costs can be based on one or more of the following:

1. Experience.
2. Work hours required.
3. A percentage of operating labor cost (3 to 10% is common, but it may be as high as 20%).

❖ **Royalties and Rentals**

Royalties and rentals are generally an operating expense but may be part of capital investment. Single-sum payments for royalties, rental, or license payments are properly considered as capital investment items, whereas payments in proportion to production or fixed payments per annum are treated as direct operating costs. Royalty payments may range between 1% and 5% of product sales price.

❖ **Indirect Costs**

Factory overhead is the indirect cost of operating a plant. It is dependent upon both investment and labor. Some data on the allocation for new plants follow (Black, 1991). The figures represent what percentage of the investment and labor, respectively, can be used for estimating the factory overhead.

❖ **Distribution Costs**

Distribution costs include handling and transportation costs. These costs vary with the types of containers and with methods of shipment. Cost without distribution cost is called bulk cost.

❖ **Avoidance of Nuisances**

Nuisances include waste disposal and pollution control costs. Each case must be calculated individually. The topic is becoming increasingly more expensive and includes such items as product liability. These cost are mounting rapidly.

❖ **Contingencies**

As is true for the capital cost estimate, an operating cost estimate should include a contingency allowance to account for those costs that cannot readily be determined or are too small to be readily determined or defined, but may be significant in the aggregate.⁵

3-Research methodology

3-1 data collection:

Data collection is the process of gathering and measuring information on target variables in an established system, which then enable one to answer relevant questions and evaluate outcomes

The questionnaire was used as a data collection method, and it was analysed using Statistical Product for Social Solutions (SPSS) data analysis program version 22.

T test set at 0.05 significant level.

3-2 pilot study:

questionnaire was designed to collect the information needed for the study, the researcher relied on the preparation of the questionnaire the method of scientific research and through the previous studies, it was then brought the supervisor to see the suitability of the questionnaire then to the statistician to determine the number of the questionnaire required, and then brought to Arabic language checker and psychology to see the convenient of the questionnaire, the questionnaire in appendix no(1).

3-3 Questionnaire final version:

Questionnaire consist of three sections ,first section to assess the socio demographic data ,second section to assess the effect of technical problems on the project cost and third section to assess the misunderstanding of engineering contracts, using two scale

the first one likert scale (5 point)range from strongly agree 5 to don't know 1 ,the second scale (4 point)range from always 4 to never 1, Filled in 25 to 35 minutes.

The validity and reliability were tested using:

- The Pearson correlation, coefficient is a descriptive statistic, meaning that it summarizes the characteristics of a dataset. Specifically, it describes the strength and direction of the linear relationship between two quantitative variables.
- alpha cronbach Cronbach's alpha is the most common measure of internal consistency (reliability).it is most commonly used when you have multiple likert questions in a survey/questionnaire that form a scale, the final questionnaire in appendix no(2).
- **Table (1) shows the internal consistency using Pearson correlation coefficient, the correlation of each item with the total score of the scale.**

Sector name	numb	correlation	numb	correlation	numb	correlation
Technical	1	0.688	4	0.577	7	-0.318
	2	0.727	5	0.758	8	0.707
	3	0.682	6	0.512		
Legal	1	-0.177	5	0.786	9	0.839
	2	0.664	6	0.097	10	0.511
	3	0.597	7	0.758	11	0.829
	4	0.687	8	0.619	12	0.653
Reasons for conflicts	1	0.726	4	0.650	7	0.781
	2	0.680	5	0.868	8	0.642
	3	0.691	6	0.534		

It is evident from the above table the correlation of the phrases was found to be statistically significant at the significance level of 0.05 Except for statement No. (6) With a weak correlation and phrases No. (1, 7) with a negative correlation, therefore it must be deleted so as not to affect the internal consistency of the scale.

- **Table (2) shows Stability by Alpha Cronbach's and subjective validity by**

sector	numb	No. of deleted		remaining	constancy by Alpha Cronbach	Honesty by square root of stability
		Negative Correlation	Weak correlation			
technical	8	1	-	7	0.722	0.849
legal	12	1	1	10	0.871	0.933
Reasons for conflicts	9	-	-	9	0.851	0.922

square foot of stability.

3-4 sample design:

The study will include engineers with different qualifications (diploma, bachelor, master, PhD) Specialize in the field of construction industry.

Variable	Frequency	Percentage %	Mean
Age			

3-5 Sample size:

The research sample includes a number 80 questionn aire Distribute d to engineers in the public

sector and private sector working in the field of construction projects.

4- Results and discussions

<30years	36	45.0	1.80
31-40	29	36.2	
41-50	10	12.5	
Above50	5	6.2	
Total	80	100.0	
Years of experience			
<5 years	31	38.8	2.06
5-10 years	23	28.8	
11-15 years	16	20.0	
More than 15 years	10	12.5	
Total	80	100.0	
Qualification			
Diploma degree	7	8.8	2.32
Bachelor degree	43	53.8	
Master degree	27	33.8	
PhD degree	3	3.8	
Total	80	100.0	
Your specialty			
Architecture	19	23.8	1.82
Civil	56	70.0	
Else	5	6.2	
Total	80	100.0	

Table (3): demographic characteristic of study Participants.

Table (4): Distribution of study participant according to nature of work

Variable	Frequenc	Percentage%
office	14	17.5
field	16	20.0
both	50	62.5
Total	80	100.0

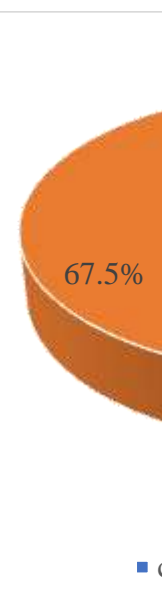


Figure (1): Distribution of study participant according to company field.

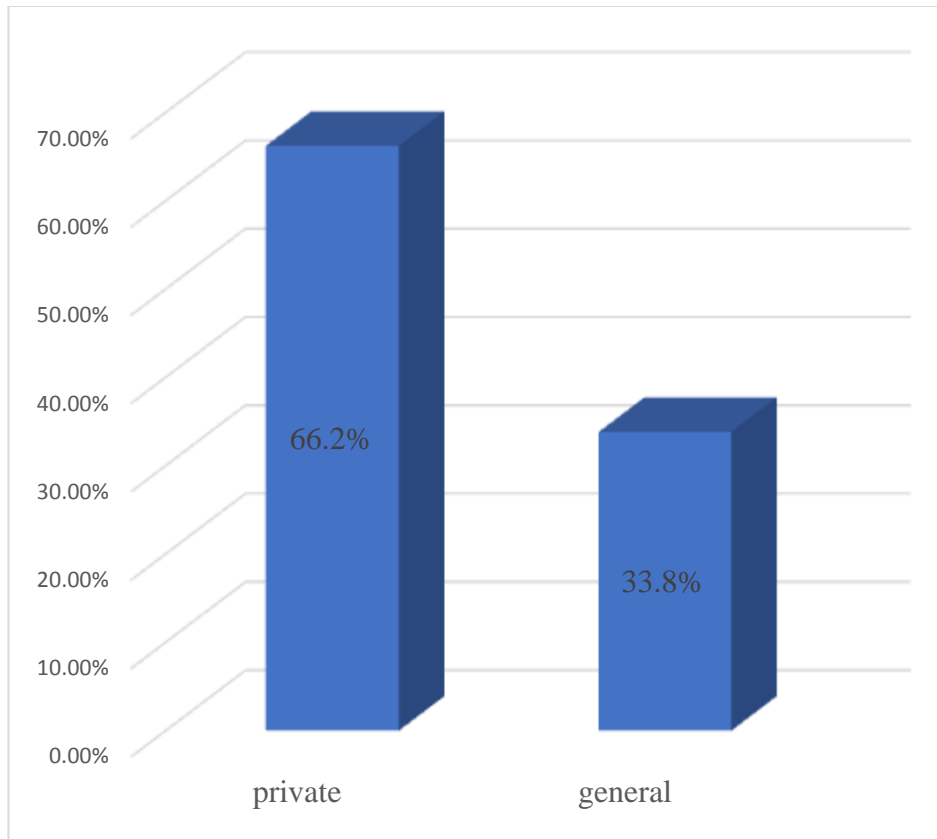


Figure (2): Distribution of study participant according to sector of work.

First hypotheses: Accurate information gives accurate feasibility study.

1. Is there a feasibility study?

Table (5): Feasibility study of projects.

T- Test

Item	Test Value = 1.90					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Is there a feasibility study	-.945	79	.348	-.087	-.27	.10

Since the significance is 0.348 that means to reject the null hypotheses, there is no feasibility study of projects for the researched sample.

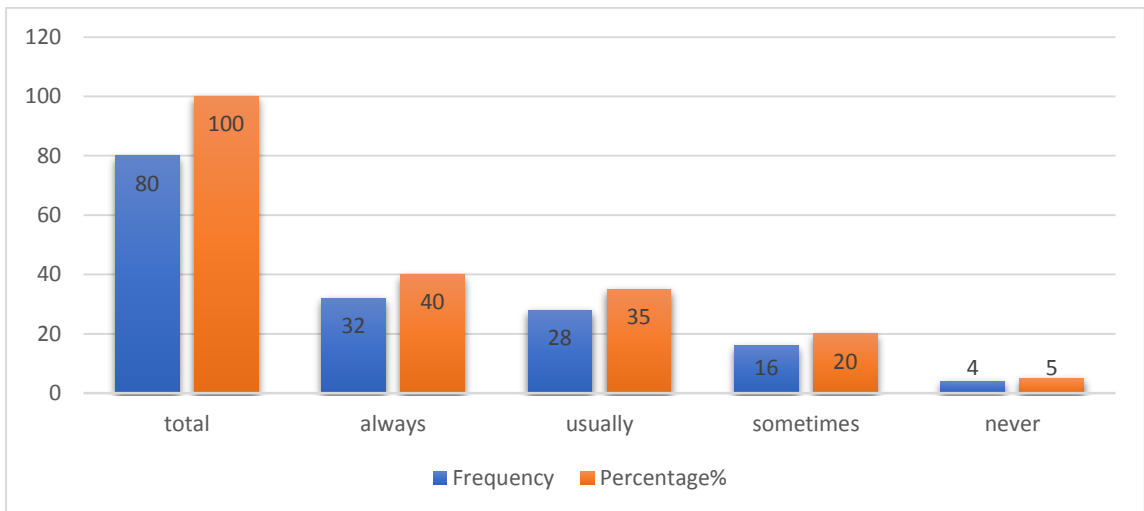


Figure (3): Feasibility study of projects.

Less than half (40%) use feasibility studies for projects.

The result revealed that, accurate information gives accurate feasibility study.

Second hypotheses: Lack of engineering criteria leads to technical problems.

1- Is there a mechanism to check the quality of engineering work?

Table (6): the Mechanism to check the quality of engineering works.

T- Test

Item	Test Value = 1.96					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper

T- Test

Item	Test Value = 1.96					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Is there a mechanism to check the quality of engineering work?	.479	79	.633	.040	-.13	.21

The null hypotheses is reject, there is no mechanism to check the quality of engineering work for the researched sample.

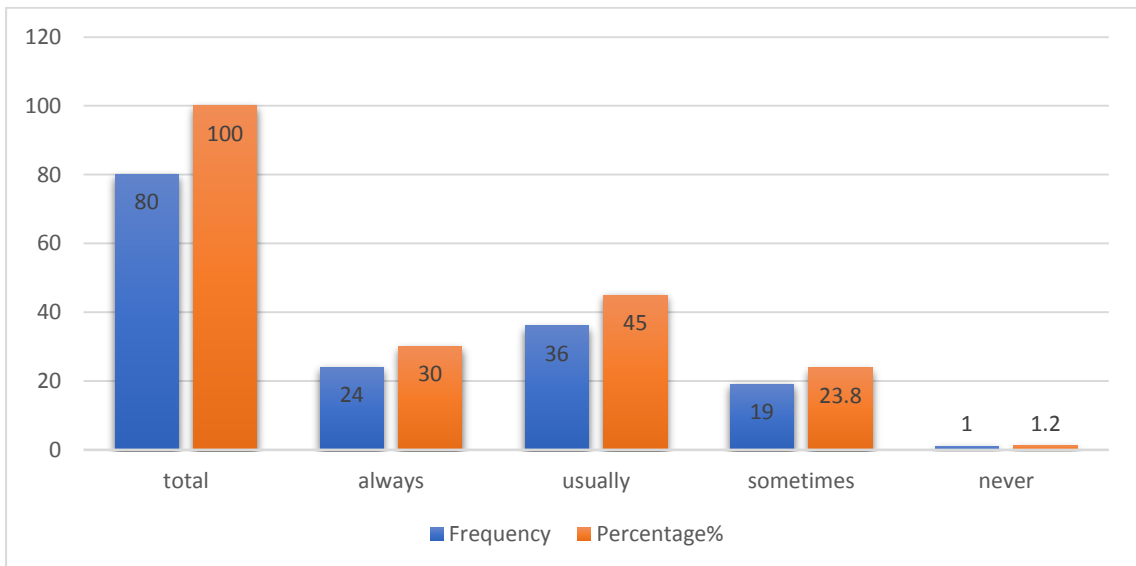


Figure (4): Mechanism to check the quality of engineering works.

Less than half (45%) of engineering company have a mechanism to continuous evaluate the quality of engineering work for the researched sample.

2- Are technical works in your company subjected to laboratory tests?

Table (7): Technical works are subject to laboratory tests.

T- Test

Item	Test Value = 2.04					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Are technical works in your company subjected to laboratory tests?	.344	79	.732	.035	-.17	.24

Since the significance is 0.732 that means The null hypotheses is reject, technical works are not subject to laboratory tests for the researched sample.

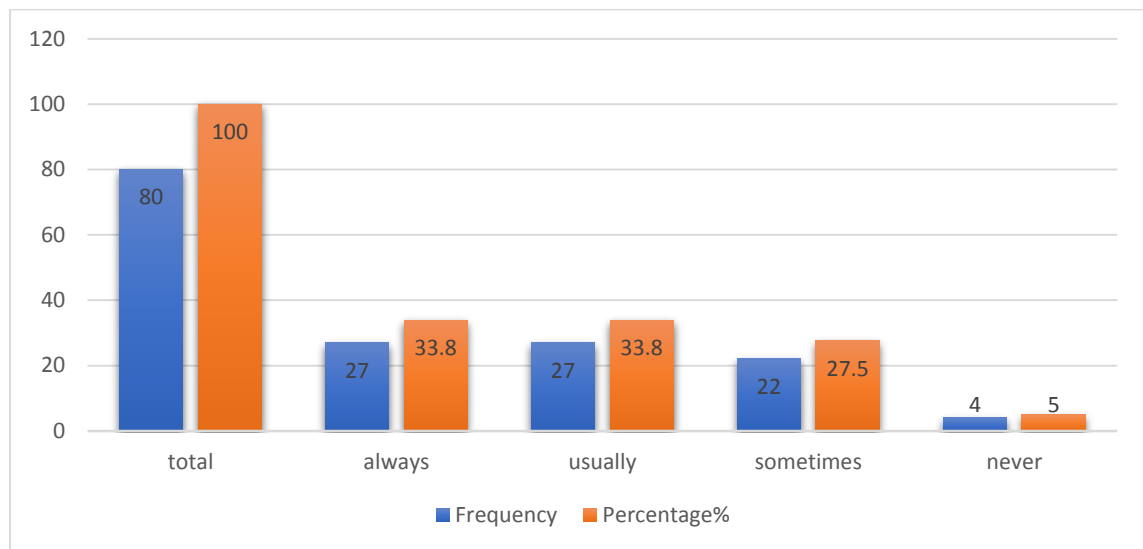


Figure (5): Technical works are subject to laboratory tests.

About Third (33.8%) of engineering company their technical work subjected to laboratory tests.

3- Adjusting and monitoring work in progress shall be made using planning and scheduling program.

Table (8): Adjusting and monitoring work in progress using planning and scheduling programs.

T- Test

Item	Test Value = 2.11					
	t	df	Sig. (2-tailed)	Mean Differenc e	95% Confidence Interval of the Difference	
					Lower	Upper
Adjusting and monitoring work in progress shall be made using planning and scheduling program	-.200	79	.842	-.022	-.25	.20

The null hypotheses is reject, planning and scheduling programs do not using when adjusting and monitoring work in progress.

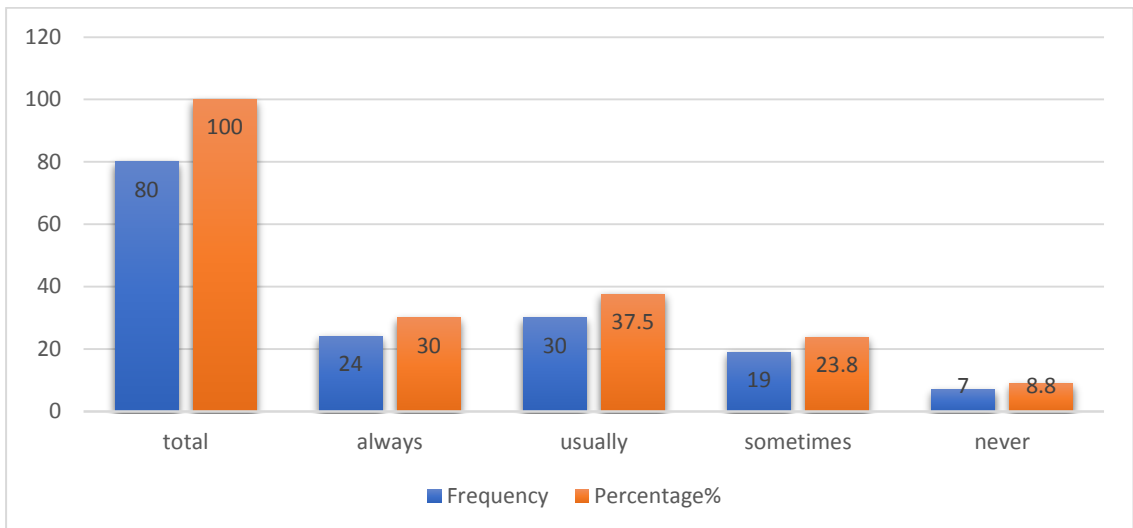


Figure (6): Adjusting and monitoring work in progress using planning and scheduling programs.

(8.8%) of engineering companies do not using Planning and scheduling programs when adjusting and monitoring work in progress.

4- The presence of quality control inspector.

Table (9): The presence of quality control inspector.

T- Test

Item	Test Value = 2.15					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
The presence of quality control inspector is essential.	-.610	79	.544	-.062	-.27	.14

The null hypotheses is reject, there is no quality control inspector.

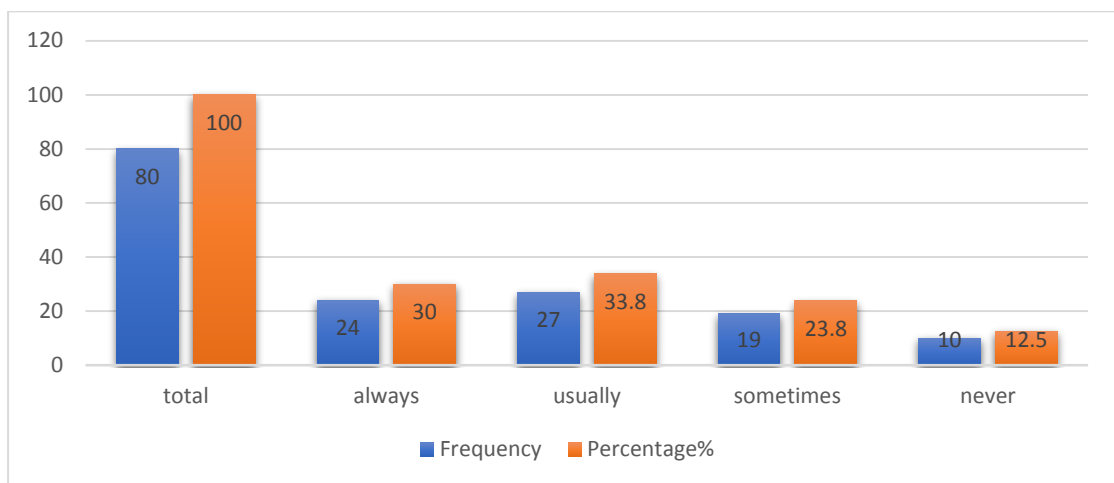


Figure (7): The presence of quality control inspector

About third (30%) of engineering company have a quality control inspector.

5- The importance of commitment to document work through construction records during the construction process.

Table (10): The importance of commitment to documenting work through construction records during the construction process.

T- Test

Item	Test Value = 1.34					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
The importance of commitment to document work through construction records during the construction process takes place.	5.370	79	.000	.485	.31	.66

Since the significance is 0.000 that means to accept the null hypotheses therefore, the work during the construction process has been documented.

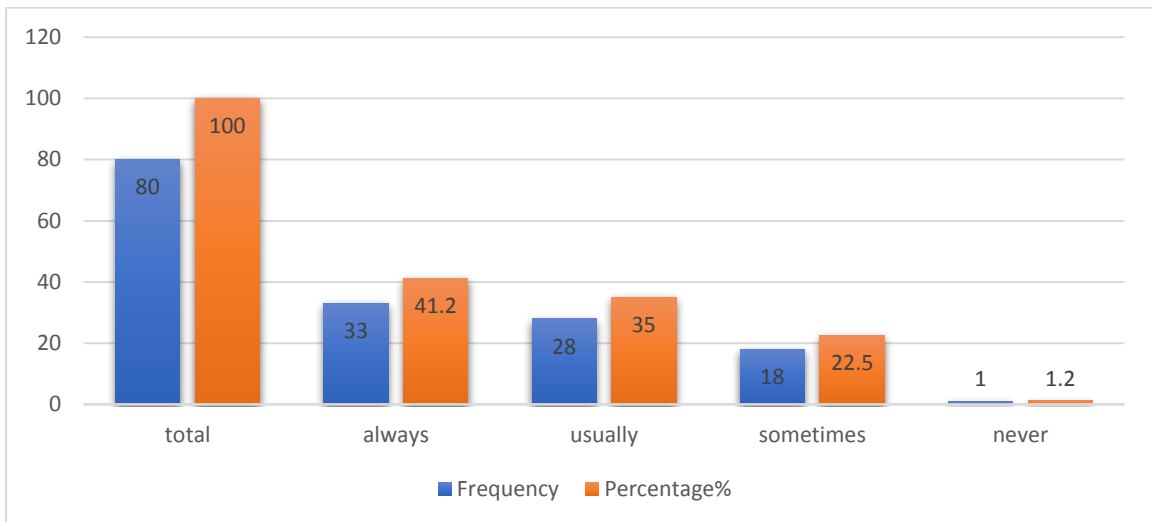


Figure (8): The importance of commitment to documenting work through construction records during the construction process.

(41.2%) of engineering company commitment to document work through construction records during the construction.

6-Do you think close and good supervision of project progress reduces the occurrence of conflicts in the project?

Table (11): close and good supervision of project progress reduces the occurrence of conflicts in projects.

T- Test

Item	Test Value = 1.74					
	t	df	Sig. (2-tailed)	Mean Differenc e	95% Confidence Interval of the Difference	
					Lower	Upper
Do you think close and good supervision of project progress reduces the occurrence of conflicts in the project?	-1.076	79	.285	-.090	-.26	.08

Since the significance is 0.285 that means to reject the null hypotheses, there isn't close and good supervision of project progress for the researched sample.

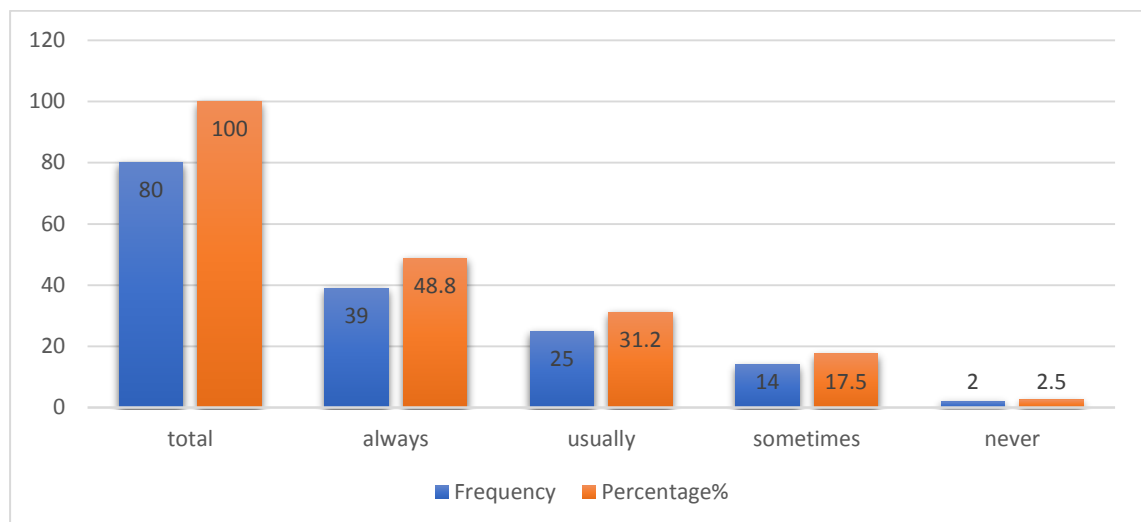


Figure (9): close and good supervision of project progress reduces the occurrence of conflicts in projects.

Almost half (48.8) of engineering see that close and good supervision of project progress reduces the occurrence of conflicts in the project.

The result revealed that, lack of engineering standers lead to technical problems.

Third hypotheses: the existing laws are not sufficient to regulate the profession

1- The existing laws are sufficient to regulate the profession.

Table (12): the existing laws are sufficient to regulate the profession.

T- Test

Item	Test Value = 1.70					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Existing laws are sufficient to regulate the profession.	2.101	79	.039	.150	.01	.29

Since the significance is 0.039 that means to accept the null hypotheses, Existing laws are sufficient to regulate the profession.

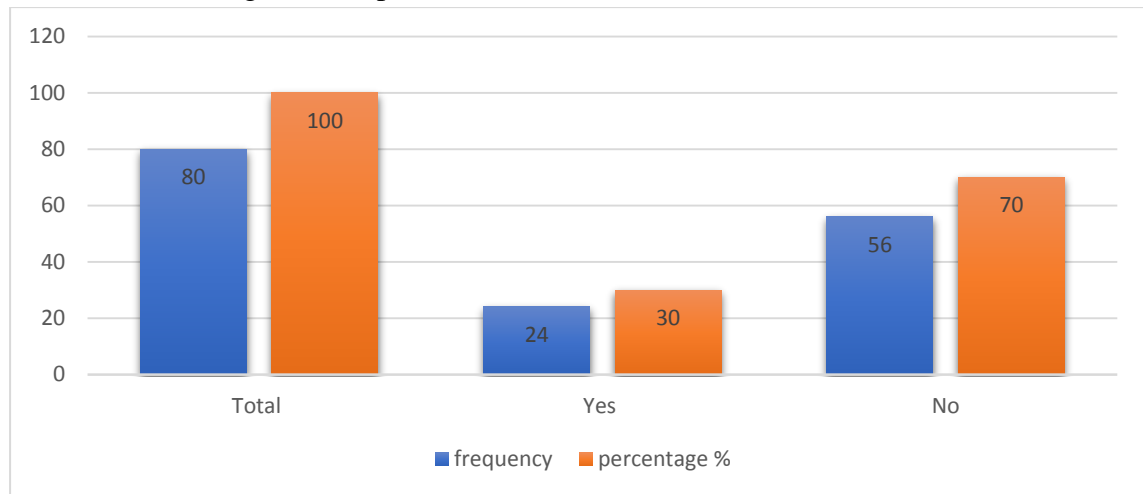


Figure (10-a): the existing laws are sufficient to regulate the profession.

The majority (70%) of engineers see that the existing laws are not sufficient to regulate the profession.

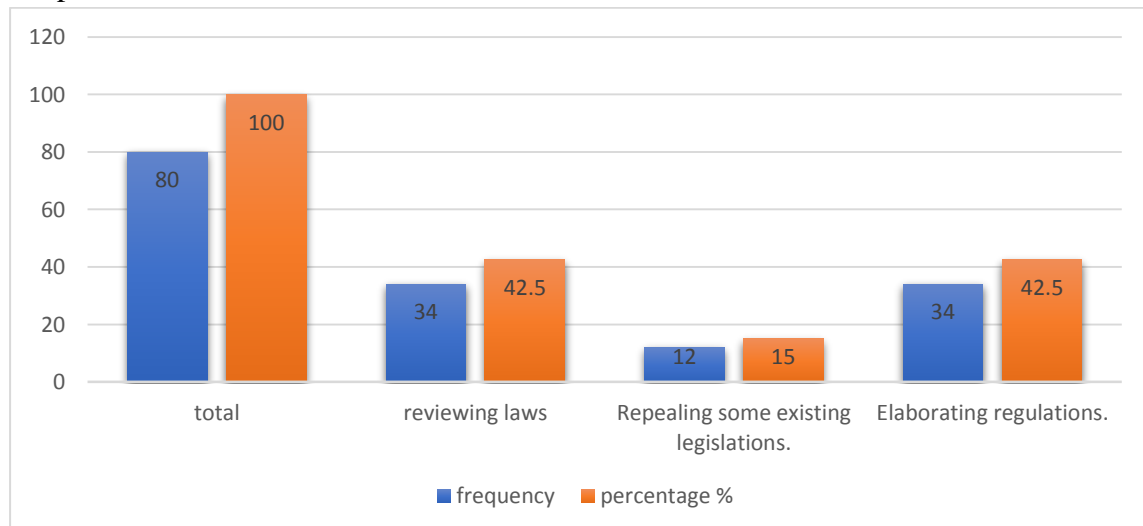


Figure (10-b): the existing laws are not sufficient to regulate the profession

42.5% see the solution in reviewing laws, 15% see the solution in repealing some existing legislations and 42.5% see the solution in Elaborating regulations.

The result revealed that the hypothesis is correct, the existing laws are not sufficient to regulate the profession.

Fourth hypotheses: signing contracts without referring to legal departments leads to contractual disputes.

1- Is there a legal department in your organization?

Table (13): legal department in organizations.

T- Test

Item	Test Value = 1.55					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Is there a legal department in your organization?	1.075	79	.286	.075	-.06	.21

Since the significance is 0.286 that means to reject the null hypotheses, there is no legal department for the researched sample.

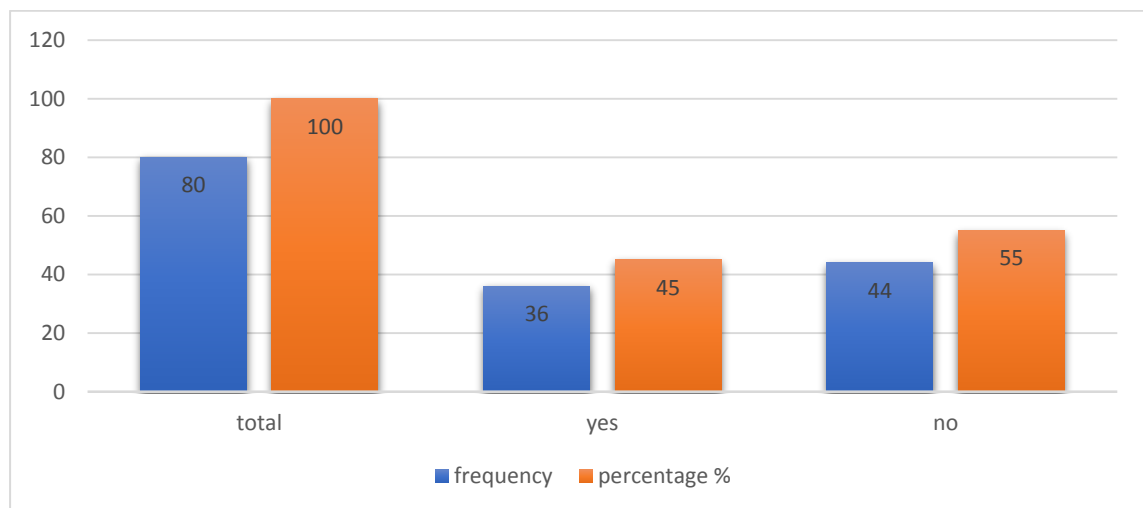


Figure (11): legal department in organizations.

More than half about (55%) doesn't have a legal department in there organization.

2- Contracts governing the relationship between the owner and supervisory authorities in projects.

Table (14): Contracts governing the relationship between the owner and supervisory authorities in projects.

T- Test

Item	Test Value = 2.22					
	t	df	Sig. (2-tailed)	Mean Differenc e	95% Confidence Interval of the Difference	
					Lower	Upper
Contracts governing the relationship between the owner and supervisory authorities.	-.398	79	.692	-.033	-.20	.13

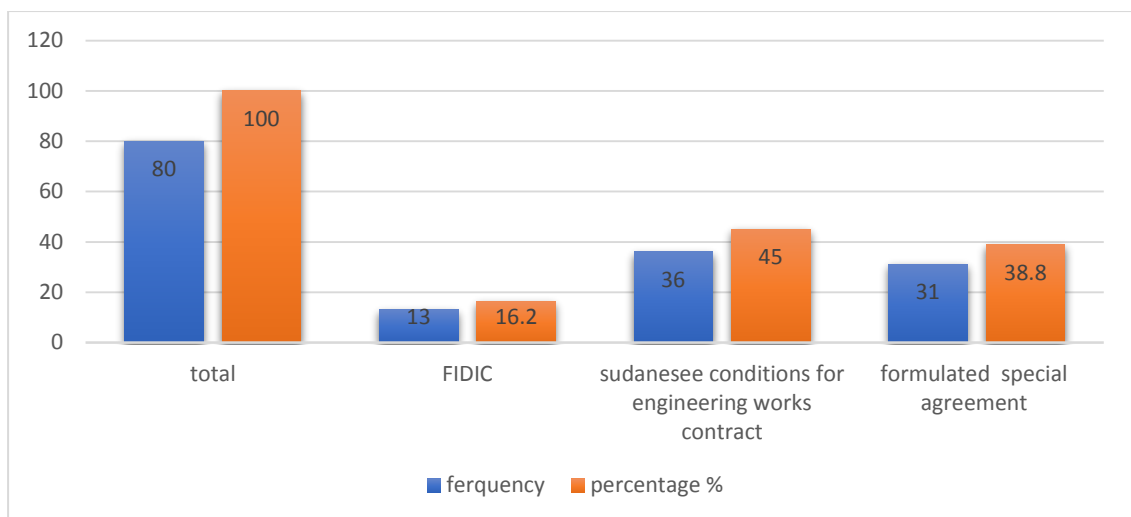


Figure (12): Contracts governing the relationship between the owner and supervisory authorities in projects.

16.2% of engineering companies there contracts according to FIDIC, 45% there contracts according to Sudanese conditions for engineering works contract, and 38.8% there contracts according to a special agreement.

3- Obstacles that faced negotiation contracts during the implementation of projects

Table (15): obstacles that faced negotiation contracts during the implementation of projects.

T- Test

Item	Test Value = 2.02					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Negotiation contracts face many obstacles during the implementation of projects.	-1.317	79	.192	-.133	-.33	.07

Since the significance is 0.192 that means the null hypotheses is rejected, negotiation contracts do not face many obstacles during the implementation of projects.

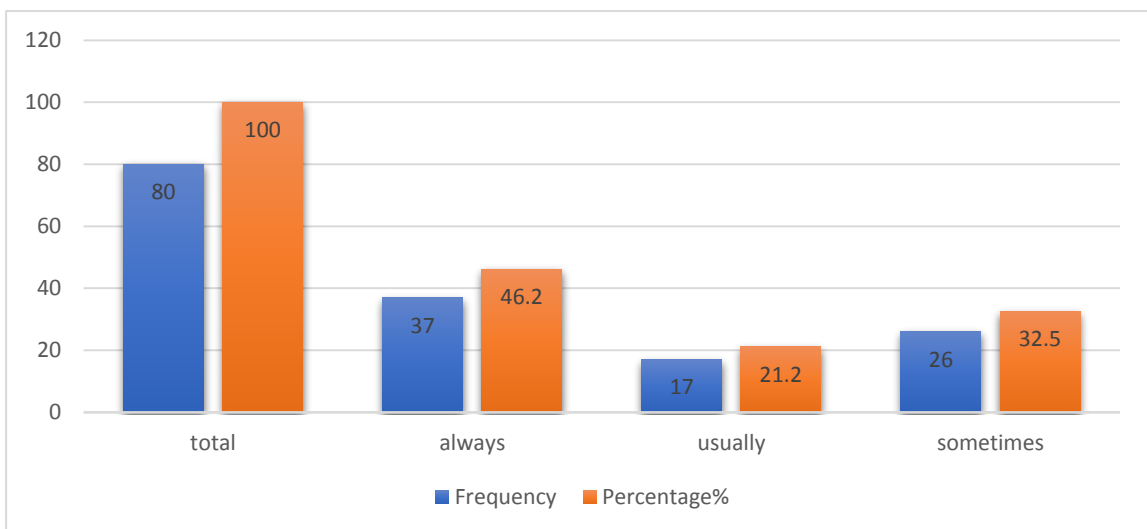


Figure (13): obstacles that faced negotiation contracts during the implementation of projects.

46.2% finds that negotiation contracts always face many obstacles during the implementation of projects.

4- Obstacles that faced competition contracts during the implementation of projects.

Table (16): obstacles that faced competition contracts during the implementation of projects.

T- Test

Item	Test Value = 2.05					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Competition contracts faced many obstacles during the implementation of projects.	-.123	79	.902	-.012	-.21	.19

Since the significance is 0.902 that means the null hypotheses is rejected, competition contracts doesn't faced many obstacles during the implementation of projects.

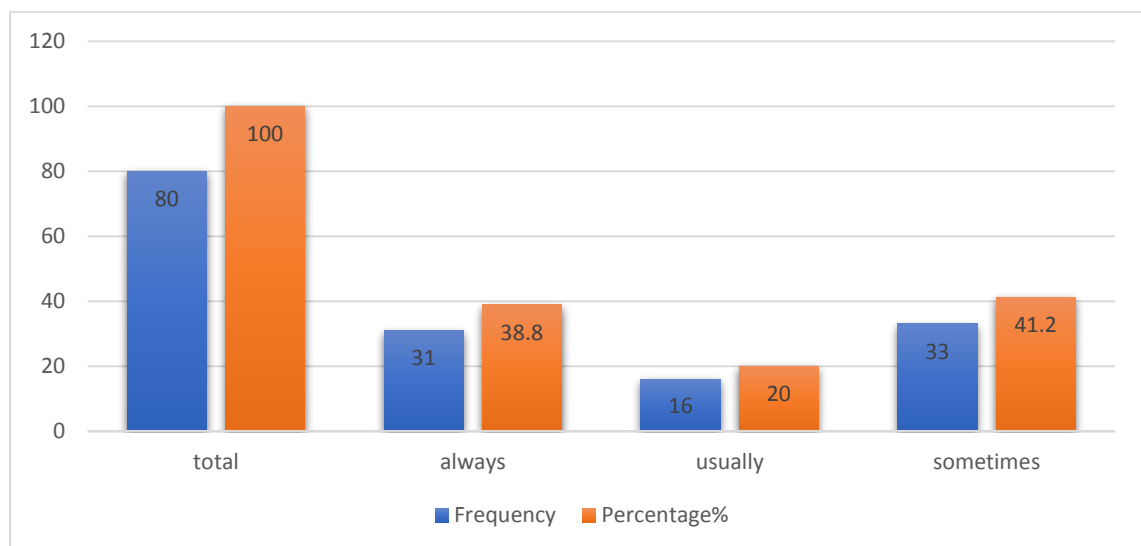


Figure (14): obstacles that faced competition contracts during the implementation of the project.

20% of engineers finds that competition contracts usually faced many obstacles during the implementation of the project.

The result above revealed that the hypothesis is correct, signing contract without referring to legal department leads to disputes.

Fifths hypotheses: misunderstanding of engineering contracts lead to contractual disputes.

1- The attention of construction contract get from both sides when preparing it.

Table (17): the attention of construction contract get from both sides when preparing it.

T-Test

Item	Test Value = 1.86					
	t	df	Sig. (2-tailed)	Mean Differenc e	95% Confidence Interval of the Difference	
					Lower	Upper
Construction contract finds enough attention from both sides when preparing it?	-2.356	79	.021	-.210	-.39	-.03

Since the significance is 0.021 that means the null hypotheses is accepted, the construction contract finds enough attention from both sides when preparing it.

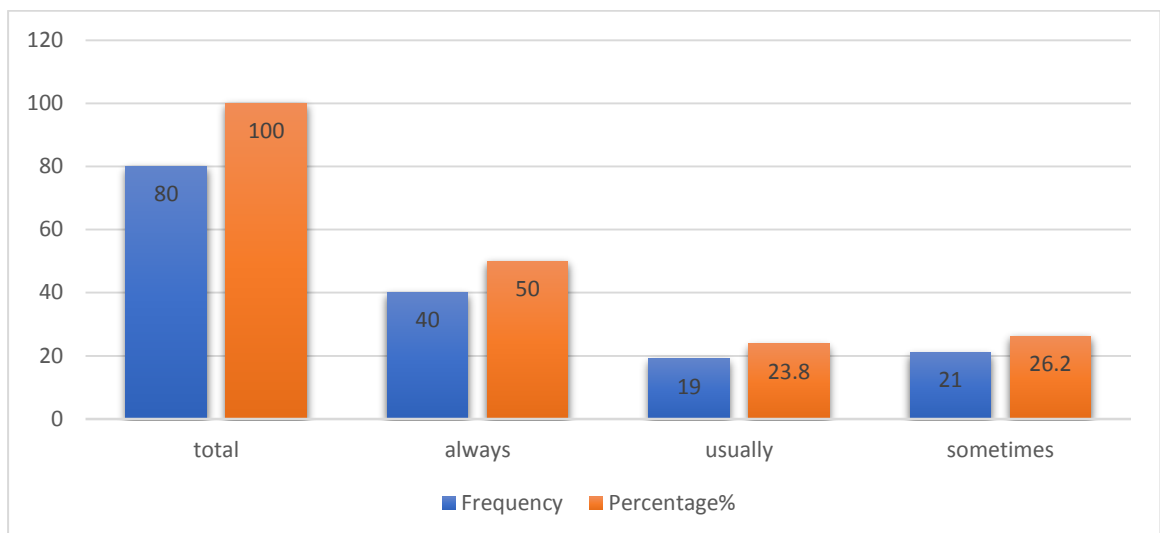


Figure (15): the attention of construction contract get from both sides when preparing it.

Of 80 engineers only 50% finds that the construction contract has enough attention from both sides when preparing it.

2- Contracts are not signed with a sub-contractor.

Table (18): contracts are signed with a sub-contractor.

T-Test

Item	Test Value = 2.18					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Contracts are signed with a sub-contractor.	-1.647	79	.103	-.155	-.34	.03

Since the significance is 0.103 that means the null hypotheses is rejected, there is no contract signed with a sub-contractor for the researched sample.

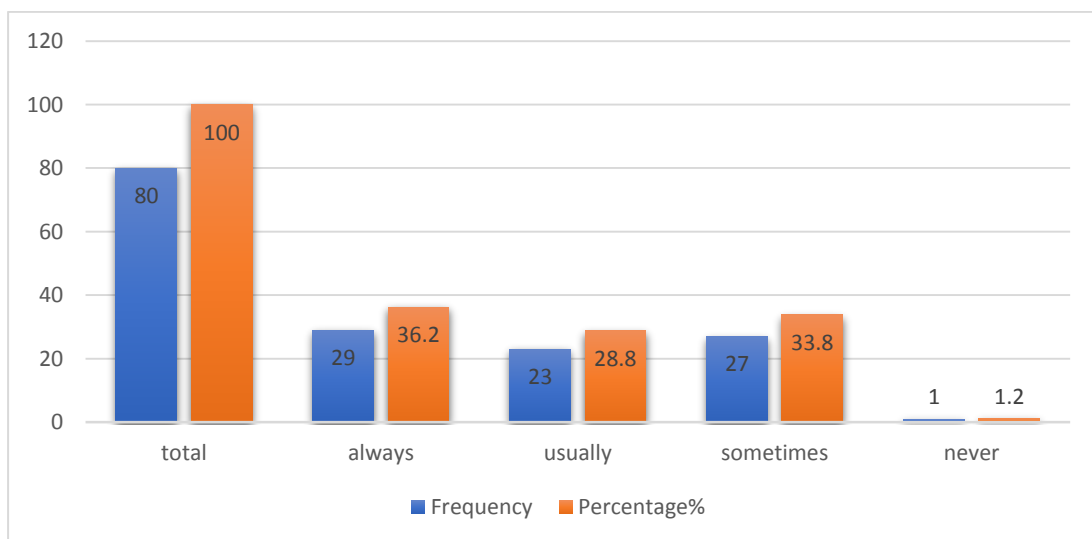


Figure (16): contracts are signed with a sub-contractor.

36.2% always signed a contract with a sub-contractor, 28.8% usually signed with a sub-contractor, 1.2% never signed a contract with a sub-contractor.

3- causes of conflict in stages of engineering project.

Table (19): causes of conflict in stages of engineering project.

Items	Test Value = 1.53					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Insufficient detailed drawing.	2.613	79	.011	.258	.06	.45
Unavailability of the necessary precautions for additional work.	-1.308	79	.195	-.120	-.30	.06
Lack of good study before signing the contract.	1.782	79	.079	.158	-.02	.33
Failure to formulate the contract in an integrated and good way.	.408	79	.684	.038	-.15	.22
Bad planning.	-1.002	79	.320	-.100	-.30	.10
Used material that does not meet specification.	.906	79	.367	.087	-.10	.28
Financial problems.	-.531	79	.597	-.048	-.23	.13
Administrative problems.	-7.057	79	.000	-.780	-1.00	-.56

Since the significance is 0.011 that means the null hypotheses is accepted, insufficient detailed drawing is one of the causes of the conflict in the stages of the engineering project for the researched sample.

Since the significance is 0.195 that means the null hypotheses is rejected, Unavailability of the necessary precautions for additional work aren't one of the causes of the conflict in the stages of the engineering project for the researched sample.

Since the significance is 0.079 that means the null hypotheses is accepted, Lack of accurate study before signing the contract is one of the causes of the conflict in the stages of the engineering project for the researched sample.

Since the significance is 0.684 that means the null hypotheses is rejected, Failure to formulate the contract in an integrated and good way aren't one of the causes of the conflict in the stages of the engineering project for the researched sample.

Since the significance is 0.320 that means the null hypotheses is rejected, bad planning isn't one of the causes of the conflict in the stages of the engineering project for the researched sample.

Since the significance is 0.367 that means the null hypotheses is rejected, Use of materials that don't meet specification aren't one of the causes of the conflict in the stages of the engineering project for the researched sample.

Since the significance is 0.597 that means the null hypotheses is rejected, financial problems don't one of the causes of the conflict in the stages of the engineering project for the researched sample.

Since the significance is 0.000 that means the null hypotheses is accepted, Administrative problems is one of the causes of the conflict in the stages of the engineering project for the researched sample.

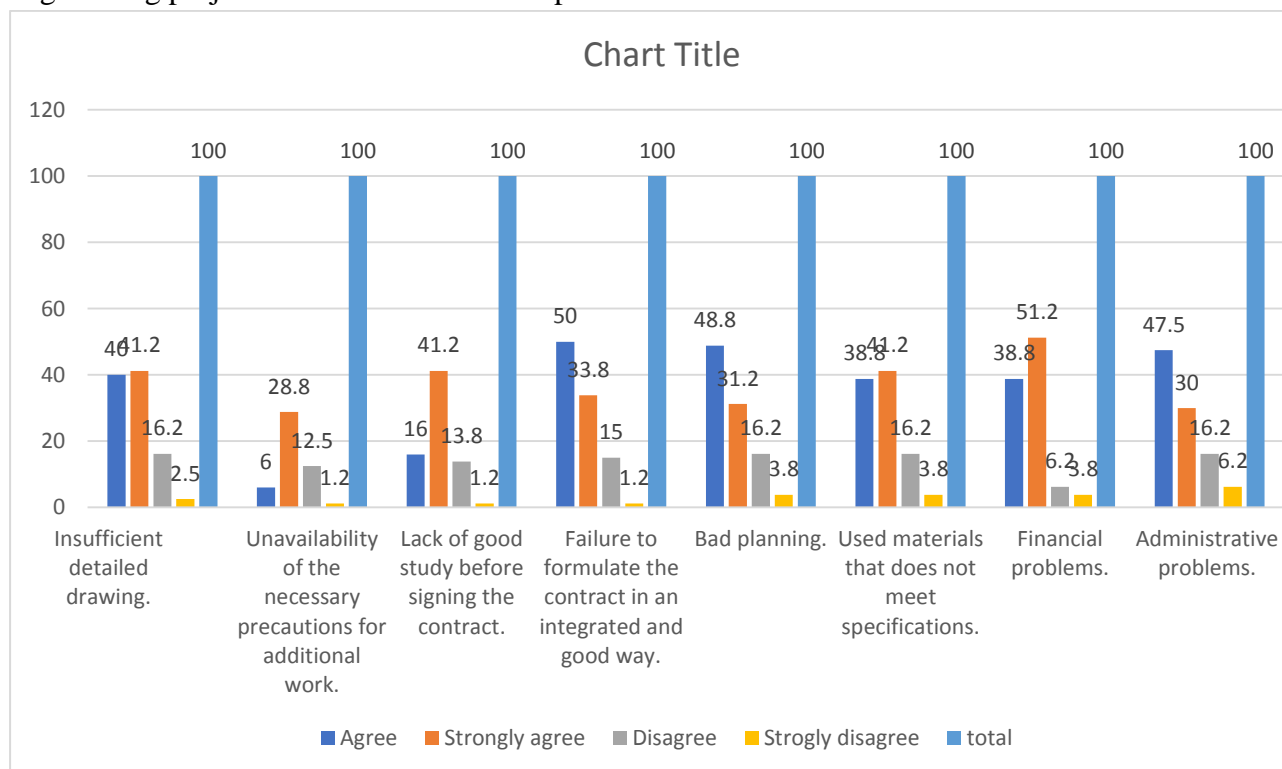


Figure (17): causes of conflict in stages of engineering project.

About (40%) agree that Insufficient detailed drawing cause conflict in the stages of the engineering project, more than half (57.5%) agree with Unavailability of the necessary precautions for additional work, (43.8%) see the cause in Lack of good study before signing the contract, half of the engineers see the cause of conflict in Failure to formulate the contract in an integrated and good way, and quarter (25%) strongly agree with Bad planning, (41.2%) strongly agree with The use of materials that do not meet specifications, (6.2%) dis agree with Financial problems, and third of them strongly agree with Administrative problems.

4- The phenomenon of conflicts in construction industry in Sudan.

Table (20): the phenomenon of conflicts in construction industry in Sudan.

T- Test

Item	Test Value = 1.81					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Conflicts in the construction industry in Sudan have become a growing phenomenon.	2.179	79	.032	.228	.02	.44

Since the significance is 0.032 that means the null hypotheses is accepted, conflicts in construction industry in Sudan have become a growing phenomenon.

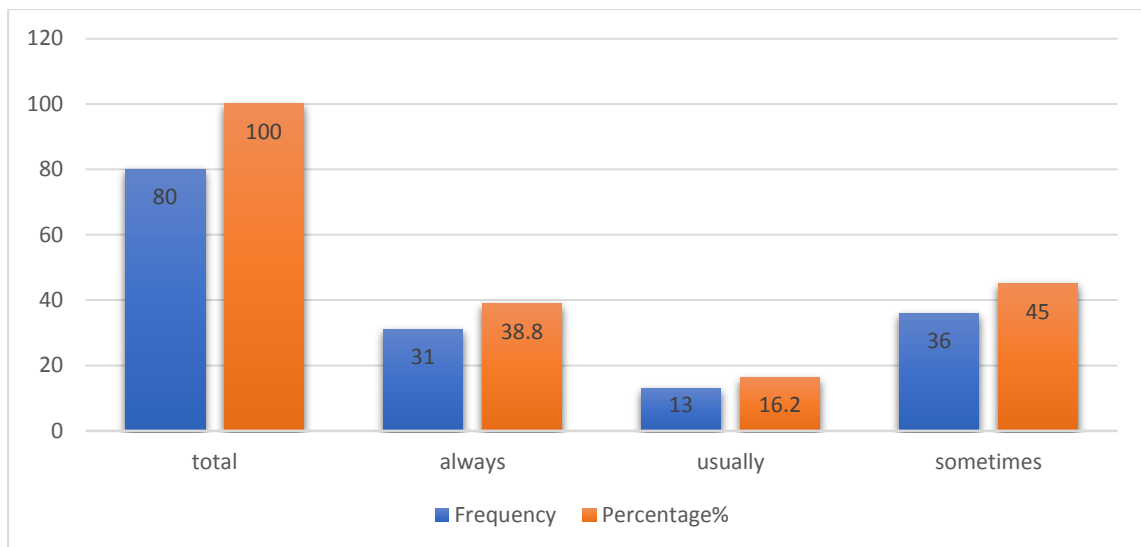


Figure (18): the phenomenon of conflicts in construction industry in Sudan.

Conflicts in construction industry in Sudan have always become a growing phenomenon in the perspective of 38.8% of the researched sample.

Due to output the result revealed that, misunderstanding of engineering contracts leads to contractual disputes.

		Items	Insufficient detailed drawing.				Total
			agree	Strongly agree	Disagree	Strongly disagree	
qualification	Diploma degree	Count	1	3	2	0	6
		% of Total	1.4%	4.3%	2.9%	.0%	8.6%
		Total					
	Bachelor degree	Count	14	15	8	1	38
		% of Total	20.0%	21.4%	11.4%	1.4%	54.3%
		Total					
	Master degree.	Count	13	7	2	1	23
		% of Total	18.6%	10.0%	2.9%	1.4%	32.9%
		Total					
	PhD degree.	Count	3	0	0	0	3
		% of Total	4.3%	.0%	.0%	.0%	4.3%
		Total					
Total	Count	31	25	12	2	70	
	% of Total	44.3%	35.7%	17.1%	2.9%	100.0%	
	Total						

Table (21): association between qualification and Insufficient detailed drawing.

P value=0.09

There is no relationship between the qualification and insufficient detailed drawings.

Table (22): association between years of experience and Insufficient detailed

		Items	Insufficient detailed drawing.				Total
			agree	Strongly agree	Disagree	Strongly disagree	
Experience	< 5 years	Count	10	13	6	0	29
		% of Total	14.3%	18.6%	8.6%	.0%	41.4%
		Total					
	5-10 years	Count	7	6	3	2	18
		% of Total	10.0%	8.6%	4.3%	2.9%	25.7%
		Total					
	11-15 years	Count	8	4	1	0	13
		% of Total	11.4%	5.7%	1.4%	.0%	18.6%
		Total					
	More than 15 years	Count	6	2	2	0	10
		% of Total	8.6%	2.9%	2.9%	.0%	14.3%
		Total					
Total	Count	31	25	12	2	70	
	% of Total	44.3%	35.7%	17.1%	2.9%	100.0%	
	Total						

drawing.

P value =0.29

There is no relation between the Experience and Insufficient detailed drawing.

Table (23): association between qualification and Failure to formulate the contract

qualification	Items		Failure to formulate the contract in an integrated and adequate way.				Total
			agree	Strongly agree	Disagree	Strongly disagree	
Diploma degree	Count		2	3	1	0	6
		% of Total	2.9%	4.3%	1.4%	.0%	8.6%
	Count		21	11	6	0	38
		% of Total	30.0%	15.7%	8.6%	.0%	54.3%
Master degree.	Count	8	10	4	1	23	
	% of Total	11.4%	14.3%	5.7%	1.4%	32.9%	
PhD degree.	Count	3	0	0	0	3	
	% of Total	4.3%	.0%	.0%	.0%	4.3%	
Total	Count	34	24	11	1	70	
	% of Total	48.6%	34.3%	15.7%	1.4%	100.0%	
	Total						

in an integrated and adequate way.

P value= 0.04

There is a relationship between the qualification and Failure to formulate the contract in an integrated and adequate way.

Table (24): association between qualification and Administrative problems.

qualification	Items		Administrative problems.				Total
			Agree	Strongly agree	disagree	Strongly agree	
Diploma degree	Count		1	3	2	0	6
		% of Total	1.4%	4.3%	2.9%	.0%	8.6%
	Count		18	9	8	3	38
		% of Total	25.7%	12.9%	11.4%	4.3%	54.3%
Master degree.	Count	10	8	3	2	23	
	% of Total	14.3%	11.4%	4.3%	2.9%	32.9%	
PhD degree.	Count	3	0	0	0	3	
	% of Total	4.3%	.0%	.0%	.0%	4.3%	
Total	Count	32	20	13	5	70	
	% of Total	45.7%	28.6%	18.6%	7.1%	100.0%	
	Total						

P value= 0.21

There is no relationship between the qualification and Administrative problems.

Table (25): association between years of experience and Failure to formulate the contract in an integrated and adequate way.

Crosstab		Items	Failure to formulate the contract in an integrated and adequate way.				Total
			agree	Strongly agree	Disagree	Strongly disagree	
Experience	< 5 years	Count	13	12	4	0	29
		% of Total	18.6%	17.1%	5.7%	.0%	41.4%
		Total					
Experience	5-10 years	Count	5	8	4	1	18
		% of Total	7.1%	11.4%	5.7%	1.4%	25.7%
		Total					
Experience	11-15 years	Count	7	3	3	0	13
		% of Total	10.0%	4.3%	4.3%	.0%	18.6%
		Total					
Experience	More than 15 years.	Count	9	1	0	0	10
		% of Total	12.9%	1.4%	.0%	.0%	14.3%
		Total					
Total		Count	34	24	11	1	70
		% of Total	48.6%	34.3%	15.7%	1.4%	100.0%
		Total					%

P value =0.07

There is a relation between the Experiences and not to draft a contract in an integrated and adequate way.

Table (26): association between years of experience and Administrative problems.

Crosstab		Items	Administrative problems.				Total
			Agree	Strongly agree	disagree	Strongly agree	
Experi ence	< 5 years	Count	11	8	7	3	29
		% of Total	15.7%	11.4%	10.0%	4.3%	41.4%
		Total					
Experi ence	5-10 years	Count	8	7	1	2	18
		% of Total	11.4%	10.0%	1.4%	2.9%	25.7%
		Total					
Experi ence	11-15 years	Count	6	3	4	0	13
		% of Total	8.6%	4.3%	5.7%	.0%	18.6%
		Total					
Experi ence	More than 15 years.	Count	7	2	1	0	10
		% of Total	10.0%	2.9%	1.4%	.0%	14.3%
		Total					
Total		Count	32	20	13	5	70
		% of Total	45.7%	28.6%	18.6%	7.1%	100.0%

P value=0.71

There is no relationship between the Experience and the Administrative problems.

Table (27): association between years of experience and use of materials that do not meet specifications.

Crosstab		Use of materials that do not meet specifications.					Total
Items		Agree	Strongly agree	Disagree	Strongly disagree		
Experience	< 5 years	Count	11	15	2	1	29
		% of Total	15.7%	21.4%	2.9%	1.4%	41.4%
	5-10 years	Count	8	5	3	2	18
		% of Total	11.4%	7.1%	4.3%	2.9%	25.7%
	11-15 years	Count	3	7	3	0	13
		% of Total	4.3%	10.0%	4.3%	.0%	18.6%
	More than 15 years.	Count	7	2	1	0	10
		% of Total	10.0%	2.9%	1.4%	.0%	14.3%
	Total	Count	29	29	9	3	70
		% of Total	41.4%	41.4%	12.9%	4.3%	100.0%

P value =0.43

There is no relationship between the Experience and the use of materials that do not meet specifications.

5- Conclusion and recommendations

5-1 Conclusion:

Disputes are common in construction project because of the complexity of the construction process, if not addressed and solved in a timely manner, become very time consuming and costly, therefore this research aimed to evaluate the impact of disputes on project cost during the project phases, to reduce the outbreak of disputes between the contracting parties that could devolved into a conflict. Based on the finding this study concluded that:

1. Lack of accurate feasibility study with insufficient detailed drawings before signing the contract ,technical works in engineering institutions which are not done in standardized ways according to the technical terms and conditions, In terms of the completion of engineering drawings approved by the parties to the contract, which are applicable to the implementation, and the completion of the initial documents required, from the tender stage to the final delivery of project, in order to achieve its objectives within the framework of the specified time, specifications, and cost.
2. Lack of a mechanism to check the quality of engineering work, and Failure to monitor and control work in progress according to pre-established scheduling and planning programs, insufficient considerations of the variables that can occur during the implementation period, all that leads to conflicts during the project stages.
3. Avoid pre-planning of work and do not rely on scientific techniques, but rather rely on oral methods in the follow-up and supervision processes, as well as relying on personal experience only without Observance of modern scientific methods.
4. The result revealed that there is a great impact when signing contracts without referring to the legal departments, failure to sign the contract with subcontractors is a reason for the emergence of problems in project stages.
5. Failure to formulate the contract in accurate and good manner, with the emergence of financial problems, especially in the implementation phase, and the unavailability of the necessary precautions for additional work with parties not being aware of laws Lead to contractual disputes.

5-2 Recommendation:

The study's recommendations will provide guidance to project decision makers, helping them proactively plan how to effectively address disagreements in project lifecycle.

Based on finding the researcher recommends that:

1. The necessity of using scientific engineering management methods before starting the implementation process.
2. Performing all necessary tests during implementation, and not relying only on tests at the end of the project.
3. Work during the construction process should be documented.
4. The necessity of scrutinizing the preliminary study of project, in terms of accurately describing the project, and defining the requirements related to it, especially the legal requirements and full compliance with terms and specifications of agreed work.
5. Construction contracts must receive adequate attention from both parties when preparing.
6. The necessity for engineering companies to allocate a special section in them, to study project plans, and all its documents and study engineering contracts and requirements.
7. Protection the rights of all parties, prices set in US dollars, reviewing all laws of taxes, duties and customs on construction companies.

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6-Annexes

6-1 Annex 1:

Questionnaire about Impact of disputes on project cost.

Sudan University for science and technology
College of Graduate Studies - (Construction Engineering)
Measuring professional opinion on:
Impact of disputes on project cost
By: wiaam kamal abuzaid

This research deals with the impact of disputes on the cost of the engineering project, from the initial idea stage until the completion of the project. This questionnaire has been prepared for the purpose of scientific study and all the information contained will be confidential in order to reach recommendations, suggestions and solutions in order to reduce the impact of disputes on project cost during the stages of the engineering project for the advancement of the construction industry in Sudan.

Instructions for filling out the questionnaire:

- Before filling in the questionnaire, please read it carefully.
- The questionnaire consists of three interviews:
 1. The first axis (general), and it contains a set of preliminary data, and the nature of the moves that were put in place to help understand and clearly address the topic through the characteristics of the research sample.
 2. The second axis (technical), which is to clarify the depth of the study, the relevant and branched aspects of it, and the knowledge of those involved in it, the causes and places of weakness and shortcomings.
 3. The third axis (legal), which contains a set of data that reflects the nature of the legal relationship between the parties to the contract, from the initial stage to the handover stage.
- After understanding the question, it is required to put a check (✓) in the box for the appropriate answer.
- Please do not place more than one mark in front of a single answer.
- Please answer all questions.

Sector one (general):

- 1. Year of experience:**
 - a) Less than 5 years.
 - b) 5-10 years.
 - c) 11-15 years.

- d) More than 15 years.
- 2. Age:**
 - a) Less than 30 years.
 - b) 30-40 years.
 - c) 41-50 years.
 - d) More than 50 years.
- 3. Level of qualification:**
 - a) Diploma degree.
 - b) Bachelor degree.
 - c) Master degree.
 - d) PhD degree.
- 4. Your specialty:**
 - a) Architecture.
 - b) Civil.
 - c) Else.
- 5. Your company field:**
 - a) Contracting.
 - b) Consulting.
- 6. In which sector do you work:**
 - a) General.
 - b) Private.
- 7. Nature of your work:**
 - a) Office.
 - b) Field.
 - c) Both.

Sector two (technical):

- 1. Is there a mechanism to check the quality of engineering work?**
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
- 2. Are the technical works in your organization subject to laboratory tests?**
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
- 3. Adjusting and monitoring work in progress shall be made using planning and scheduling programs.**
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
- 4. The presence of a quality control inspector.**
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
- 5. The importance of commitment to documenting work through construction records during the construction process.**
 - a) Always.
 - b) Usually.

- c) Sometimes.
 - d) Never.
6. **Is there is a feasibility study for any project?**
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
 7. **The oral method is used in the supervision process to provide amendments and suggestions to the project.**
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
 8. **Do you think that close and good supervision of the project progress reduces the occurrence of conflicts in the project?**
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.

Sector three (legal):

1. In your opinion, the authorities concerned with placing engineering contracts in Sudan are more aware of the obligations and requirements of the parties to the contract.
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
2. Is there a legal department in your organization?
 - a) Yes.
 - b) No.
3. Contracts that govern the relationship between the owner and the supervisory authorities in projects are according to:
 - a) FIDIC.
 - b) Sudanese conditions for engineering works contract.
 - c) Formulated a special agreement.
4. Do you think the existing laws are sufficient to regulate the profession?
 - a) Yes.
 - b) No.
 If your answer is no. Do you see the solution in?
 - a) Reviewing laws.
 - b) Repealing some existing legislations.
 - c) Elaborating regulations.
5. Is there a contract that signed with a sub-contractor?
 - a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
6. Do you think that Sudanese engineers familiar with laws related to construction projects?

- a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
7. Do you think that the construction contract finds enough attention from both sides when preparing it?
- a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
8. Negotiation contracts face many obstacles during the implementation of project?
- a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
9. Competition contracts faced many obstacles during the implementation of the project?
- a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
10. In your opinion, conflicts in the construction industry in Sudan have become a growing phenomenon.
- a) Always.
 - b) Usually.
 - c) Sometimes.
 - d) Never.
11. The causes of conflict in the stages of the engineering project.
- a) Insufficient detailed drawing.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - b) Unavailability of the necessary precautions for additional work.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - c) Lack of accurate study before signing the contract.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - d) Failure to formulate the contract in accurate way.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - e) Bad planning.
 - Agree.

- Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
- f) Use of materials do not meet specifications.
- Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
- g) Financial problems.
- Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
- h) Administrative problems.
- Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.

6-2 Annex 2:

Final Questionnaire about Impact of disputes on project cost.

Sudan University for science and technology
College of Graduate Studies - (Construction Engineering)
Measuring professional opinion on:
Impact of disputes on project cost
By: wiaam kamal abuzaid

This research deals with the impact of disputes on the cost of the engineering project, from the initial idea stage until the completion of the project. This questionnaire has been prepared for the purpose of scientific study and all the information contained will be confidential in order to reach recommendations, suggestions and solutions in order to reduce the impact of disputes on project cost during the stages of the engineering project for the advancement of the construction industry in Sudan.

Instructions for filling out the questionnaire:

- Before filling in the questionnaire, please read it carefully.
- The questionnaire consists of three interviews:
 1. The first axis (general), and it contains a set of preliminary data, and the nature of the moves that were put in place to help understand and clearly address the topic through the characteristics of the research sample.
 2. The second axis (technical), which is to clarify the depth of the study, the relevant and branched aspects of it, and the knowledge of those involved in it, the causes and places of weakness and shortcomings.
 3. The third axis (legal), which contains a set of data that reflects the nature of the legal relationship between the parties to the contract, from the initial stage to the handover stage.
- After understanding the question, it is required to put a check (√) in the box for the appropriate answer.
- Please do not place more than one mark in front of a single answer.
- Please answer all questions.

Sector one (general):

1. Year of experience:
 - e) Less than 5 years.
 - f) 5-10 years.
 - g) 11-15 years.
 - h) More than 15 years.
2. Age:
 - e) Less than 30 years.

- f) 30-40 years.
 - g) 41-50 years.
 - h) More than 50 years.
3. Level of qualification:
 - e) Diploma degree.
 - f) Bachelor degree.
 - g) Master degree.
 - h) PhD degree.
 4. Your specialty:
 - d) Architecture.
 - e) Civil.
 - f) Else.
 5. Your company field:
 - c) Contracting.
 - d) Consulting.
 6. In which sector do you work:
 - c) General.
 - d) Private.
 7. Nature of your work:
 - d) Office.
 - e) Field.
 - f) Both.

Sector two (technical):

1. Is there a mechanism to check the quality of engineering work?
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
2. Are the technical works in your organization subject to laboratory tests?
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
3. Adjusting and monitoring work in progress shall be made using planning and scheduling programs.
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
4. The presence of a quality control inspector.
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
5. The importance of commitment to documenting work through construction records during the construction process.
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.

6. Do you think that close and good supervision of the project progress reduces the occurrence of conflicts in the project?
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
7. Is there a feasibility study for any project?
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.

Sector three (legal):

1. Do you think the existing laws are sufficient to regulate the profession?
 - c) Yes.
 - d) No.
 If your answer is no. Do you see the solution in?
 - d) Reviewing laws.
 - e) Repealing some existing legislations.
 - f) Elaborating regulations.
2. Is there a legal department in your organization?
 - c) Yes.
 - d) No.
3. Contracts that govern the relationship between the owner and the supervisory authorities in projects are according to:
 - d) FIDIC.
 - e) Sudanese conditions for engineering works contract.
 - f) Formulated a special agreement.
4. Negotiation contracts face many obstacles during the implementation of project?
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
5. Competition contracts faced many obstacles during the implementation of the project?
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
6. Do you think that the construction contract finds enough attention from both sides when preparing it?
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
7. Is there a contract that signed with a sub-contractor?
 - e) Always.
 - f) Usually.
 - g) Sometimes.

- h) Never.
- 8. In your opinion, conflicts in the construction industry in Sudan have become a growing phenomenon.
 - e) Always.
 - f) Usually.
 - g) Sometimes.
 - h) Never.
- 9. The causes of conflict in the stages of the engineering project.
 - a) Insufficient detailed drawing.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - b) Unavailability of the necessary precautions for additional work.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - c) Lack of accurate study before signing the contract.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - d) Failure to formulate the contract in accurate way.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - e) Bad planning.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - f) Use of materials do not meet specifications.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - g) Financial problems.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.
 - h) Administrative problems.
 - Agree.
 - Strongly agree.
 - Dis Agree.
 - Strongly dis agree.

مستخلص البحث:

تعتبر النزاعات شائعة في صناعة التشييد نسبة لعلاقتها بالكثير من الصناعات و الاختصاصات المختلفة و تعقيد عملية البناء يحدث النزاع أيضًا من خلال الحوادث (الإصابة) أو سوء الإدارة أو الخطأ البشري أو الخلاف أو عدم التواصل بين الأطراف المتعاقدة، تؤثر النزاعات على التدفق النقدي للمشروع ، إذا لم تتم معالجتها وحلها في الوقت المناسب ، تصبح مضيعة للوقت ومكلفة للغاية.

الهدف: يهدف هذا البحث إلى تقييم تأثير النزاعات على تكلفة المشروع ، للحد من الخلافات بين الأطراف المتعاقدة التي يمكن أن تتطور إلى نزاع.

المنهجية: تم تقسيم الدراسة الي إطارين، الإطار النظري ويتضمن دراسة شاملة عن مراحل تنفيذ المشروع من مرحلة دراسة الجدوى إلى مرحلة التسليم والنزاعات و أسبابها وأنواعها وطرق تلافئها و المطالبات وتكاليفها ومتطلبات تسعيرها وأنواع التكاليف و تقديراتها ، أما الإطار الثاني و هو الإطار العملي و تم فيه إعداد إستبيان يحتوى على اسئلة البحث و فرضياتة ثم تحليل البيانات ومناقشتها للوصول إلى النتائج لتقليل تأثيرالنزاعات في صناعة التشييد والتوصل الى توصيات لدعم الدراسة.

النتائج: من أهم النتائج لهذه الدراسة عدم وجود دراسة جدوي كافية للمشروع و كذلك الأعمال الهندسية لا تتم بطرق معيارية حسب الشروط والأحكام الفنية، عدم وجود إعتبارات كافية للمتغيرات التي يمكن أن تحدث خلال فترة التنفيذ هناك تأثير كبير عند توقيع العقود دون الرجوع إلى الإدارات القانونية ، كما أن عدم توقيع العقد مع مقاولي الباطن هو سبب لظهور المشاكل في مراحل المشروع.

الخلاصة: بناء علي النتائج خلصت هذه الدراسة الي أن المهندسين غير ملمين بقوانين تنظيم المهنة مع عدم التخطيط الجيد قبل البدء بالمشروع وعدم وجود دراسة جدوى كافية للمشروع وعدم وجود الية للتدقيق في جودة الأعمال الهندسية.

التوصيات:بناء علي نتائج هذه الدراسة أوصي بضرورة استخدام الأساليب العلمية الحديثة وبرامج الجدولة و التخطيط قبل البدء بالمشروع و توثيق الأعمال خلال مراحل المشروع، تحدد التكلفة بعملى ثابتة لحماية حقوق جميع الأطراف ومراجعة جميع قوانين الضرائب والرسوم والجمارك على شركات المقاولات، كما يجب إجراء المزيد من الدراسات لسد ثغرات هذه الدراسة.