

# **1. Introduction**

## **1.1 Background of the Study:**

Sudan like other countries construction industry is one of major industry contributing significantly in the growth of socio-economic development.

Achieving project completion on time and within budget at specified quality standards is major criterion of success of project.

Although in Sudan a lot of money has been spent in construction, the industry is facing a lot of challenges such as the expenditure exceeding the budget, delay to complete the project in time, the building defects and over dependent of foreign workers The total cost of construction in normal circumstances is expected to be the sum of the following cost: materials, labor, site overheads, equipment/ plant, head office cost and Profit but in many parts of the world particularly in Sudan, there are other costs to be allowed for.

Many factors affect the accuracy of building construction projects cost estimating which should be considered in the early stage of the estimating process. Some factors can incorrectly increase the estimated costs and the possibility of contractual disputes between the various parties involved. Other factors can help the estimator to decrease the unnecessary cost of an item and hence lead to successful tendering in a very competitive market.

Costs have obvious negative implications for the key stakeholders in particular, and the industry in general. To the client, high cost

implies added costs over and above those initially agreed upon at the onset, resulting in less returns on investment. To the end user, the added costs are passed on as higher rental / lease costs or prices. To the consultants, it means inability to deliver value for money and could tarnish their reputation and result in loss of confidence reposed in them by clients. To the contractor, it implies loss of profit through penalties for non- completion, and negative word of mouth that could jeopardize his/her chances of winning further jobs, if at fault.

The proposed work will investigate and report the other costs to be allowed for, which are the basic factors affecting construction cost in Sudan and also proffer solutions to how construction cost can be minimized.

## **1.2 Importance of Research:**

The impact of inaccurate cost estimating on construction business is significant. Overestimated cost result in submitting a high tender price by the contractor, which could lead to the tender being unacceptable to client. On the other hand, an underestimated cost may lead to a situation where a contractor incurs losses on the contracts awarded by clients. Contractor needs to identify these factors and assign cost variance related it. This study is an attempt to identify the main factors affecting the accuracy of cost estimate in building construction. Such factors that the estimator should consider when preparing a cost estimating. Then, developing a model that assesses related cost variance so that it will lead to:

- 1- Minimize cost variance that is an indicator of accuracy of cost estimating.
- 2- Avoid the contractor's submission of an overestimated bid.
- 3- Enhance the effectiveness of the cost control process.

### **1.3 Research Questions:**

This research include a number of hypothesis related to the direct aim of study that have been identified to describe and understand the problem research topic, which are:

1. What the factors affect on the cost estimating lead to success cost estimating of the project?
2. How to controlling in the cost of the projects?
3. How to assess the level of cost practice in construction companies in Sudan?
4. What is the important factors affecting in construction project cost?

### **1.4 Research Objectives:**

The importance of the study is to find out the factors affecting construction cost in Sudan and find solutions to how construction cost can be minimized.

The objectives of the study are as follows:

1. To identify the main factors affecting construction cost in Sudan.
2. To find solutions on how to minimize construction cost in Sudan.
3. To determine How to control the cost of projects and to determine the severity rank of the factors amongst clients, consultants and contractors.

### **1.5 Research Limitation:**

The scope of this research is limited to identification of essential factors affecting construction cost and proffering solutions on how to reduce construction cost in Sudan.

The study is limited to projects in Khartoum state because there is easy access of information by the researcher.

This study plans to include several types of Sudanese construction project across the construction market, including but not limited to:

- Project categories, according to the type of the project that it taken by the company (general building construction, highway, bridge ... etc.
- High budget and low budget project.
- Project categories according to the level of complexity.

Due to the limited of recourses (time & money) this research will be limited to several aspect as per the following details:

- It has been done upon random samples of companies, which can represent the construction market in Sudan.

### **1.6 Time Limitation :**

From 2016 to 2018

### **1.7 Research Methodology:**

In this study, the research is approaching as an iterative philosophy process where the research has been initiated in light of prior knowledge as well as experiences from a pre-understanding of the research area.

This pre understanding in the basis for searching into the literature on the subject area, which it has in turn created a new understanding of the phenomena of cost control system. This new understanding has been used to guide an empirical research, and again generate a new understanding of the phenomena.

Understanding is generated not only through the stages of the research but also by preceding from the whole into its part and then back again.

We used statistical analysis program SPSS (Statistical Package for Social Science), The elements influencing the cost of construction projects were arranged on the basis of the importance index and the correlation and consensus between the participants in this research was discussed, a survey in the Khartoum state the capital of Sudan and it was conducted which included 50 companies as samples for this study. The procedure used in analyzing the results was aimed at determining and prioritizing the factors that influence construction costs. The score for each factor was calculated by summing up the scores assigned to it by the respondents. Therefore, the level of significance as indicated by the companies.in this thesis used the ‘relative importance index’ (RII) method to determine the relative ranking of the factors. RII was computed using the following equation:

$$RII = (\sum w) / (A \times N) \dots\dots\dots (0 \leq index \leq 1) \longrightarrow (1)$$

Where: w is the weight given by the respondents to each factor ranging from 1 to 5, A is the highest weight (i.e. in this case is 5), and

N is the total number of respondents. The factors were then arranged according to their descending order of RII values and were duly ranked. The highest RII indicates the most critical and important factor with rank 1 and the next indicates the second-most critical factor with rank 2, and so forth.

### **1.8 Thesis Structure:**

This thesis includes five chapters, references and appendices. They are presented as follow:

**Chapter (1)** presents an introduction to the research. It includes the problem statement, the objective, the scope and limitations, the significance and the methodology of the study.

**Chapter (2)** presents the literature review and the previous efforts and studies which have been made in the field of cost and the factors influence construction project cost in Sudan.

**Chapter (3)** discusses the research methodology which includes the information about the research design, research location, pilot study, questionnaire design.

**Chapter (4)** presents and discusses data analysis, statistical methods used, tables and information deduced from statistical analysis and statistical results.

**Chapter (5)** summarizes the results and major finding, to present the conclusions and recommendations of this research.

## **2. Literature Review**

### **2.1 Introduction:**

It is expected that the accuracy of cost estimating has a significant effect on construction industry. For instance, it may have a serious effect on contractor ability to compete successfully with other contractors. It also has an important effect on contractor's profit. Therefore, this research is an attempt to identify the most important factors affecting the accuracy of cost estimating in building construction projects in Sudan. Such factors should be taken into consideration when preparing cost estimating for any future project.

This chapter represents some cost estimating definitions. It also gives some details about cost estimating types, and finally it mentions previous work in order to get a predetermined list of factors that may affect building construction projects cost estimating

### **2.2 The Sudan Construction Industry:**

In the development of any country, the construction industry plays vital roles in transforming the aspirations and the needs of its people into reality by implementing various physical structures . A construction project is commonly acknowledged as successful when it is completed on time, within budget, and in accordance with specifications and to stakeholder's satisfaction. Functionally, profitability to contractor's absence of claims and court proceedings and "fitness for purpose" for occupiers has also been used as 1measures of project success. Performance planning is the usual

starting project point for an employee and manager to begin the performance management process. Manager and employee work together to identify what the employee should be doing for the period Global Journal of Accounting and Economic Research being planned, how well the work should be done, identify and plan to overcome barriers, and come to a common understanding about the work. Performance communication is the process by which the manager and employee work together to share information about work progress, potential barriers and problems, and how the manager can help the employee.

Cost and time are two major goals of a construction project which receive relatively more attention than quality. They further pointed out that between cost and time, formal planning effort of most construction companies has been primarily focused on time planning, and to a lesser extent on resource allocation and its cash-flow implications. Perhaps the emphasis in schedule planning of a construction projects because of the realization by the contractor and the owner of the severe implications of schedule overruns. Cost performance is the most important indicator of project success used by all parties. It presents not only the firm's profitability but Project Performance in Sudan construction industry: A case study also the productivity of organizations at any point during the construction processes. Poor cost performance of construction projects has been a major concern for both contractors and clients. Despite the large number of reported cases, it seems that construction ranging from



the simplest to more complex projects such as unclear plants, environment restoration, transport system and oil gas platforms have increasingly faced cost overrun.

Studied factors influencing cost performance on high-rise projects in Sudan and concluded that cost overruns were very frequent.

eight key management factors that affect budget performance; they are organizational levels between project manager and artisan, project manager experience, level of design completion at the start of the project, constructability program, project team workmanship rate, frequency of control meetings, frequency updates, and control system budget. Quality performance has been considered as a function of the procedures adopted during the construction process. Quality is an essential element for sustainability and customer satisfaction. In construction project, quality performance of contractors is considered as vital for client satisfaction. the quality in construction can be thought of as the satisfaction of a whole range of performance criteria held by an interacting host of stakeholders and mediated by a range of mechanisms. According to a quality improvement effort will lead to a higher product and service quality, which will lead to improved customer satisfaction.

In Sudan, like most developing countries, the construction industry plays a dominant role in the economic activities of the country.

construction industry accounts for about 60 percent of the Nation's capital investment and 30 percent of the gross domestic

product Furthermore, the construction industry is said to have contributed about half of the total stock of fixed capital investment in the Sudan economy. The industry also generates employment opportunities which place it second to the government in the employment of labors (Tasneem Ghanem,2015) .

### **2.3 project:**

Projects have become the new way of accomplishing and managing business activities. Projects are the temporary assemblage of key personnel designed to accomplish specific business objectives with identifiable customers in mind. A project has a beginning and an end. The project team dissolves once the objectives are met. It is fluid and driven by the specific needs of that business. The project approach to managing activities embraces change and complexity (Seely,1996).

Key characteristics of projects:

- A project has boundaries, so its extent is defined.
- A project is a one – time effort usually requiring finite resources
- There are distinct start and end dates for projects.
- You know when you have reached the end of project.

### **2.4 project management:**

Project management is a process of achieving project objectives (schedule budget and performance) through a set of activities that start and end at certain points in time and produce quantifiable and quantifiable deliverables successful project management is the art of bringing together the tasks, resources and people necessary to

accomplish the business goals and objectives within the specified time constraints and within the monetary allowance. Projects and programs are linked directly to the strategic goals and initiative of the organization supported (Okpala, Daniel C. 1998).

## **2.5 project management life cycle:**

The process manager follows during the life of project is called the project management life cycle. A proven methodical life cycle is the necessary to repeatedly implement and manage project successfully. During the life cycle of any project, proven and tested project management processes or best practices are should be initiated. The types and extent of process initiated depend on the nature of the project, i.e. size, probability of failure and consequences of failure. Strong and effective leaders apply process to protect all project (Ashwrth,2004).

## **2.6 The Roles of Construction:**

There are diverse interests in the construction industry. The principal interest or actors in the construction industry are (Elinwa,1993):

1. The Client
2. The Consultant
3. The Contractor

### **2.6.1 The Client:**

The Client is, by far, the single most important member of the construction team. He is the initiator and financier of all the projects. a lot of projects denote to the major contribution the client can make to the successful operations of the construction industry lies in his

skill in specifying his needs prior to the preparation of the design. It is also important for the client to set cost limits of the project at the briefing and should also ensure that adequate financial provisions are made prior to the commencement of any project (Elinwa,1993).

### **2.6.2 The Consultant:**

Cost considerations are among the most important and basic considerations that Consultants must deal with. It is essential to see that projects are contained within the client's budget and cost forecasts. Cost has the final control over virtually every project.

Accurate cost analysis and control is one of the necessary services the client requires (Elinwa,1993).

### **2.6.3 The Contractor:**

the major task of Contractors is to assemble and allocate the resources of labors, equipment and materials to the project in order to achieve completion at maximum efficiency in terms of time, quality and cost (Elinwa,1993).

## **2.7 Value for Money:**

It is not the cheaper things in life that we want to possess, but the expensive things that cost less Achieving value for money may be seen as being a balance between satisfying client needs and expectations and the resources required to achieve them. The code of Practice for project management summarizes typical expectations thus: "The client expects that effective project management will enable the projects completion, by the time when it

is wanted, of a standard and quality that is required and a price that is competitive". Standards and quality expectations are, however, constrained by cost and time and therefore objectives must be prioritized.

the business of building procurement invariably calls for some comprise or a consensus balancing of these priorities. This requires adequate thinking time and careful thought."(Seely,1996)

## **2.8 Construction cost estimate:**

The responsibility for compiling accurate estimates for a construction company normally falls onto the shoulders of the sales person. Some construction-related companies hire estimators to estimate, and sales people to sell. I personally believe this is a duplication of effort needed to get to the sale and it runs up the overhead expense. If possible, these two positions should be combined. If the salesperson/estimator is involved with the entire sales process, both the estimate and writing the contract, there will be fewer errors not only on the estimate sheet but also on the contract, the negotiating process, and the job .We are not going to "teach" estimating in this article. We have a class that teaches estimating, it can't be done in a short article. What we are going to do in this article is cover some estimating issues. Handling these issues properly can get you back in front of the customer quicker with more accurate estimates. That leads to a better presentation and more sales. (Seely,1996).

## **2.9 The objective of determining the cost of construction projects:**

The issue of the cost of construction work is one that is rarely far from the minds of construction clients, design teams, constructors and, of course, quantity surveyors.

The cost of constructing a building project is a primary concern for the vast majority of construction clients. Indeed one of the most common initial questions a client has “what is it going to cost me?” often followed closely by “can we do it any cheaper?” Providing answers to such questions is a key objective of quantity surveyors, whose task it is to predict the likely cost of building work and to manage the evolving project

design to ensure that the clients approved budget is not exceeded. This is a challenging task, which frequently involves one-off, unique, purpose made buildings.

Clients are often somewhat aware of what their building should cost. Indicative cost ranges for various types of development are regularly published by the larger quantity surveying practices and are also found in construction price-books. It is only natural for a client to question why their development cannot be budgeted at the lower end of the indicative cost range. In these situations the quantity surveyor will need to explain that the cost of construction work is influenced by a wide range of factors. These include the identity and priorities of the client, the nature of the project and who is responsible for developing its design, the choice of procurement options, the

prevailing market conditions and legislative constraints. Many of these factors are interlinked. Priorities directly influence the choice of procurement strategy and associated contractual arrangements, which regulate how the contract is to be operated and how risks are to be allocated between the contracting parties. These, in turn, impact on how the work is planned and carried out on site and influence the eventual level of productivity achieved. The aim of the quantity surveyor in this process will be to maximize the value for money of the client (Seely,1996).

### **2.10 Cost Estimating:**

Researchers and experts have different definitions for cost estimating.

Chartered Institute of Building (CIOB 2009) defines cost estimating as a technical process of predicting costs of construction. The Association for Advancement of Cost Engineering (AACE 2013) describes cost estimating as the basis for project management, business planning, budget preparation, and cost and schedule control. The Project Management Institute describes cost estimating as the development of an approximation (estimate) of costs of the resources needed to complete project activities. considers that cost estimation is the determination of quantity and the predicting or forecasting “within a defined scope” of the costs required to construct and equip a facility, to manufacture goods, or to furnish a service.

In conclusion, cost estimating is the means of forecasting and foreseeing the future costs of a construction project before it actually exists. However, the final project cost will not be known until the construction is finished and facility is operated. A project goes through different levels of estimates based on its development stage. Estimates are performed throughout the life of the project (Seely,1996).

Cost is beginning with the first estimate and extending to the various phases of design and into construction it is important to note that there are different types of cost estimating as the construction project advance. Detailed estimate cannot be made based on computed quantities at the concept, preliminary design stage, since the project is not yet defined. On the other hand, the estimates process will be more expensive as more detailed and accurate techniques are implementing, then we will list the most important cost estimates:

### **2.10.1 Feasibility Estimates:**

The owner will start with the definition or conception of the project. Regardless of size or type of project, the owner will perform an initial estimation. This is called feasibility estimation. There are two objectives of this estimation:

- 1- Determine whether to execute the project or not?
- 2- Help owner in obtaining funding for his project.



### **2.10.2 Conceptual Estimates:**

When the project is found to be feasible and funding is obtained, the owner will proceed in engagement of design firm in order to define project special requirements and the type and quality of construction. The design team will prepare approximate estimates of project cost at this stage. This type of estimate is known as parametric, range or conceptual estimates. The purpose of the conceptual estimates can vary depending on owner's demand and the type and size of the project (Alkhaldi, Zaitoun S. 1990).

### **2.10.3 Generally, the conceptual estimate is used to:**

- 1- Support the owner's feasibility estimate
- 2- To evaluate possible design modifications in order to meet the owner's budget
- 3- To evaluate contractor bids
- 4- To be an aid in budgeting cash flow needs throughout the project.

There are different kinds of conceptual estimates depending on the type and size of the construction project and owner's needs. In general, a number of things should be considered when selecting kind of conceptual estimate; some of them are the following:

- 1- The need of the owner, hence the purpose of the conceptual estimate.
- 2- The amount of resources available (time and money) from the owner to make an estimate.
- 3- The amount of design information and experiential information available.

- 4- The resources (information, data, skill) of the estimator.
- 5- The prevailing construction market (Barrie and Paulson 1992).

#### **2.10.4 Contractors' Detailed Estimates (Bid Estimates):**

If the conceptual estimate is judged to be within budget, the design firm will prepare the project contract documents, which will be the basis of preparing the cost estimates by contractors in order to bid for the project. The major contract documents include the project drawings, specifications, general conditions, special conditions, agreements, and addenda. Usually the project drawings and specifications play the most significant role in the preparation of bid estimate by the contractor.

The drawings indicate the quantity of work to be performed and the specifications indicate the quality of work to be performed.

After the owner invites contractors to bid, the contractors will prepare their detailed bid estimates. The purpose of these estimates is to determine the real cost of executing the project. The contractor should submit the lowest possible estimate, because the objective of the contractor is to win the bid (being lowest responsible bidder), and minimize the amount of money left on table and win his profit .

Detailed cost estimating is a time-consuming process. It is prepared when all documents of the construction project have been completed. Creativity and knowledge are essential for preparing a construction cost estimate. Different contractors use different processes, methods, and technologies during construction. Therefore,

estimators need knowledge, creativity and experience to execute the estimating task successfully (Alkhaldi, Zaitoun S. 1990).

### **2.10.5 Detailed cost estimating consists of the following steps:**

1- Dividing the project into individual work items and estimates. This is also known as quantity take off.

2- Determining of labor, equipment, and material needed for executing a work item based on the specification and the construction method.

3- Selection of the work items necessary for the element.

4- Productivity is defined as the amount of work a crew can perform in a unit of time.

5- Costs of labor, equipment and material must be decided after the work items have been determined for the elements.

6- Calculation of total cost for each work item by summing all work item costs.

7- Addition of taxes, overhead cost, and profit complete the estimate

8- Review and analysis by the estimator is also required to determine if the price of the assembly seems reasonable for the amount of work that has to be performed (Seely,1996).

### **2.10.6 Progress Estimates:**

The contractor's detailed bid estimate is not the last estimate prepared for construction project. Several types of estimates will be performed during construction phase. Progress estimate is one of these types of estimates. Several progress estimates will be done during construction. The main purposes of these estimates are:

1. Estimates of cost of work related to contract change order.
2. Estimates prepared by the owner or his agent during the construction to determine the contractor percentage of completion at a certain point of time and thus determine the contractor payments (Clamp, 2008).

### **2.10.7 Final Estimates:**

On the completion of the project, it is necessary to make a final estimate for the whole work executed. This estimate will be done to verify quantities executed. This estimate will determine the final payment for the contractor.

### **2.10.8 Stick Estimating:**

One of the biggest time-wasters is estimating by the old stick estimating method. For those new to the business, stick estimates involve a number of steps:

- ✓ List all the various parts of the job.
- ✓ List all the hours that it will take someone to complete each portion.
- ✓ List all the materials that will be used on each part of the job.
- ✓ List each sub-contractor that you will need.
- ✓ List all the other items you will have to purchase or rent to get the job completed, such as permits, rentals, port-a-potties, etc.
- ✓ Go back through your lists and put a cost on each item.
- ✓ Last, have a knowledgeable second party double-check your lists and your math (this step is the one few estimators bother to do).

These steps, properly followed, will result in an accurate job cost. Apply your markup, and you have a price. Unfortunately, because it is so time consuming, it is seldom done with care and the result is often a sales price that is inadequate to cover the cost of the job let alone the overhead and any profit required by the company.

Another major flaw with stick estimating is that it requires separate material and labor takeoffs (lists) before you can do the math. In reality, you don't need a material takeoff until you sell the job. Compiling one before you write a contract is a waste of time (Lawrence, J 1994).

### **2.10.9 Computerized Estimating Systems:**

One of the best improvements to estimating is the development of estimating software programs. The individual who insists on doing estimates longhand is open to errors. Doing estimates by hand is slow, out of date, inefficient and an irresponsible use of time. If I were the company owner or sales manager, I would not hire an individual for a sales and estimating position unless they were competent on an estimating software program or willing to learn and use one.

Regardless of the kind of work you do, today's customers want a quote in a timely manner. You can no longer take 10, 15 or 20 days to put an estimate together. The nice folks will go to another contractor to have the job done. Today's culture is "no, not tomorrow, I want it today!" Like it or not, that is the culture we operate in. If you want their business, comply with their time schedule (Liu, M. and Ling, Y 2005).

### **2.10.10 Unit Cost Estimating:**

Estimating should be done by unit cost only. It is much faster (as much as two times) than stick estimating, just as accurate, and gets you back in front of the customer sooner. You can't take three or four weeks with your quotation. You need to be back in front of your customers with a quote in 3-5 days, at most 7-10 days. Larger jobs may take a day or two longer because you need to get quotes from your subs, but no longer than that (Emory C. , 1980).

#### **Unit costing follows the following steps:**

1. Compile all the line items (assemblies) for that job.
2. Attach a unit cost to each line item (assembly).
3. Total your numbers and have them checked by a second party that knows what they are doing.

Apply your markup, and you have a price. Then get back to your customer with your quotation and move on with the sale

### **2.10.11 Other Types of Estimates:**

Between conceptual estimate and detailed estimate, other estimates are performed as the project becomes more defined and more information becomes available. Those estimates are required to assess most accurately the expected cost of the project at the time the estimate is carried out. They may be referred to as budget, appropriation, control, semi detailed, design or engineering estimates, and are carried out for the purpose of assigning project budgets, and to monitor and control project costs. In addition to the above listed preconstruction estimates, other estimates are also

performed during the project's construction phase or after the construction completion to assess the final actual cost of the project. The estimates in this stage are known as "definitive estimates". These estimates are updates of the detailed estimates with emphasis in actual rather than projected construction cost (Tony, 2013).

### **2.11 Estimating Starts with Good Plans:**

Any estimator must know how to read plans. And they must have a good set of plans to work from. Without a good set of plans, it is virtually impossible to know if the customer's idea of what they want done matches your understanding of what they want done. It is almost guaranteed that your concept of the job will differ from the customer's without a good set of plans (Al-Dulaijan, Salah U and James D. Steven, 1989).

### **2.12 Construction Cost Factors:**

A review of literature reveals that there are several factors affecting construction costs for large buildings.

In a studies of the Sudan Construction Industry, one of that sampled the opinions of Contractors, Consultants and Clients and they discovered many factors responsible for project delays and construction cost escalation in Sudan. Their survey revealed price fluctuation as the most severe cause of project cost escalation which is attributed to the limitation in exchange rate which in turn affects construction material prices and general price level.

In another study, identified 31 essential factors causing High Cost of Buildings with fraudulent practices and kickbacks ranking second (2<sup>Nd</sup>) most important factor in Sudan and it denoted that fraudulent practices and kickbacks occasioned by greed are perpetuated by some players in the construction industry.

In a review of developing countries identified some factors as underlying causes of delay and cost over runs in ground water construction projects. The five most important factors agreed by Clients, Consultants and Contractors were monthly payment difficulties from agencies, poor contract management, material procurement, poor technical performances and escalation of material prices.

Furthermore, a study of the relative weight of ten major causes of business failure in the United States of America revealed construction cost related factors as mostly contributing to business failure. They include: Bad profit, management incompetence, lack of experience, inadequate sales, loss of market and economic decline.

These factors are combined into one uniform list arranged alphabetically in the below points :

From previous researches, other researches and a field survey done among engineers from different experience, a predetermined list of factors that may affect the accuracy of construction projects cost estimating is collected in order to prepare them in a questionnaire. (Elinwa, Uchechukwu and Silas Bubo, 1993).



### **A. Design Issues :**

1. Design changes
2. Not enough drawings Review
3. Lack of technical advisory experience and lack of coordination in the design phase
4. Understanding of the executing agency of the structural design process

### **B. Financial Issues.**

1. Escalating prices of construction materials by inflation
2. Fluctuations in currency exchange rate
3. Tax increase
4. Bad Purchasing Department
5. Limited markets
6. The high cost of construction equipment
7. The high cost of skilled labor
8. the wrong way of cost calculation
9. Financiers policy choice of lowest price tenders
10. Non-completion cost calculations when applying for tender

### **C. Project Characteristics**

1. Lack of documentation specifications.
2. Weak organizational structure.
3. Lack of experience.
4. Weak materials management.

5. The planning process for the management of the project is not appropriate.
6. Additional work as a result of the request by the owner.
7. The lack of efficiency in the use of resources.
8. Difficulty in importing equipment and materials.
9. Introduction of new economic legislation.
10. Unexpected weather conditions.
11. Limited skilled labor.
12. Disorders and problems of workers.

**D. bidding situation:**

1. Pricing without properly studying tender documents.
2. Time between project announcement and bid opening day.
3. Number of competitors.
4. Level of competitors.

**E. Estimating Process**

1. Estimating method.
2. Availability of productivity standards.
3. Availability of cost indexes average.
4. Relevant experience of estimating team.
5. Ability of estimating team.
6. Standard procedure for updating cost information.
7. Method used in determining contingency.

Based on the previous literature review, cost estimating definitions, types of cost estimating and factors affecting building

construction projects' cost estimating discussed, a list of 40 factors was determined.

These factors were used as a base for a questionnaire survey. Such survey identifies the most important factors affecting the accuracy of the cost estimating process.

**2.12.1 Some of the factors are highlighted in the following paragraphs (Alkhaldi, Zaitoun S. 1990).:**

**1) Similar Construction Projects:** For the construction estimate, the best reference will be similar construction projects. The final cost of those similar projects can give the idea for the new construction project cost calculation. The final cost of past project needs to be factored with current construction cost indices.

**2) Construction Material Costs:** Construction material cost consists of material cost, shipping charges and taxes applicable if any. So, it is important consider all these variations while calculating construction material cost.

**3) Labor Wage Rates:** Labor wages varies place to place. So, local wage rate should be considered in calculation. If the project has to be started after several months of estimating the project cost, the probable variation in wage rates has to be considered in the calculation.

**4) Construction Site Conditions:** Project site conditions can increase construction costs. Site conditions such as poor soil conditions, wetlands, contaminated materials, conflicting utilities (buried pipe, cables, overhead lines, etc.), environmentally sensitivity area, ground

water, river or stream crossings, heavy traffic, buried storage tanks, archaeological sites, endangered species habitat and similar existing conditions etc. can increase the project cost during construction phase if these variations are not considered during estimation.

Temperature and humidity affect productivity of workers. If the temperature and humidity are high, workers feel lethargic and lose physical coordination .

**5) Inflation Factor:** A construction project can continue for years before completion. During the construction period, the cost of materials, tools, labors, equipment etc. may vary from time to time. These variation in the prices should be considered during cost estimation process.

**6) Project Schedule:** Duration of construction project is affects the cost. Increase in project duration can increase the construction project cost due to increase in indirect costs, while reduction in construction cost also increases the project cost due to increase in direct costs. Therefore, construction project schedules also need to be considered during project cost estimation.

**7) Quality of Plans & Specifications:** A good quality construction plans and specifications reduces the construction time by proper execution at site without delay. Any vague wording or poorly drawn plan not only causes confusion, but places doubt in the contractor's mind which generally results in a higher construction cost.

**8) Reputation of Engineer:** Smooth running of construction is vital for project to complete in time. The cost of projects will be higher

with sound construction professional reputation. If a contractor is comfortable working with a particular engineer, or engineering firm, the project runs smoother and therefore is more cost-effective

**9) Regulatory Requirements:** Approvals from regulatory agencies can sometimes be costly. These costs also need to be considered during cost estimate.

**10) Insurance Requirements:** Cost estimation for construction projects should also need to consider costs of insurance for various tools, equipment, construction workers etc. General insurance requirements, such as performance bond, payment bond and contractors general liability are normal costs of construction projects. In some special projects, there can be additional requirements which may have additional costs.

**11) Size and Type of Construction Project:** For a large construction project, there can be high demand for workforce. For such a requirements, local workmen may not be sufficient and workmen from different regions need be called. These may incur extra costs such projects and also for the type of construction project where specialized workforce is required.

**12) Location of Construction:** When a location of construction project is far away from available resources, it increases the project cost. Cost of transportation for workmen, equipment, materials, tools etc. increases with distance and adds to the project cost.

**13) Engineering Review:** Sometimes it is necessary to carry out technical review of construction project to make sure the project will

serve the required purpose with optimum operational and maintenance cost. This review cost shall also be added to the project cost.

**14) Contingency:** It is always advisable to add at least 10% contingency towards the total project costs for unforeseen costs and inflation.

**15) Inadequate production of raw materials by the country:**

that the reason for shortage of materials could be the defective supply of materials occasioned by general shortages in the industry, poor communication amidst sites and head office, poor purchasing planning and materials coordination. Sudan still imports cement when her cement production potentials surpass any other African country and that the 100 % raw materials required for cement production, is readily available in Sudan.

In another development observed that 90% of the aggregate components for production and delivery of electricity in the country still depends on other developed countries because of incessant supply of electricity.

Contractors know themselves and therefore an indirect cartel is formed. The contractors on tendering are in a vantage position to decide amongst themselves who gets which contract and at what price. What appears on tendering to be the lowest tender may be over 20% - 30% above the actual value of the job.

### **16) Supplier manipulation:**

The major reasons for this factor observed are monopoly control of the market by some suppliers, work stoppages in factories, lack of industrialized materials, fluctuating demands forcing suppliers to wait for accumulation of orders and difficulty in importing raw materials from other countries.

### **17) Government policies:**

Government deregulation policies aimed at liberalizing the economy are responsible for the instability in prices. It is therefore not surprising that fluctuation claims during these periods contribute significantly to additional cost.

### **18) Incorrect planning:**

Incorrect planning is one of the most important factors that affect cost of construction.

Contractors must be aware of all resources that he might need for any project. The contractors, also, should utilize all resources in an efficient manner. Proper scheduling is the key to utilizing project resources, if not, the project cost will increase.

### **19) Fraudulent practices and kickbacks:**

This factor was the second most important factor affecting construction cost in Sudan, that fraudulent practices and kickbacks occasioned by greed are perpetrated by some major players in the construction industry. The perpetrators of this act in the industry are predominantly found within the rank and file of contractors, consultants and public clients .

## **20) Design Change:**

This problem arose from inadequate project planning and management of the design process. A quite distinctive example is the progress of West African Gas Pipeline (WAGP). Some studies are reported that WAGP project has suffered a number of setbacks, culminating in the escalation of its cost from an initial US \$500 million. One of the problems includes the changing of the initial plans to lay the pipeline offshore to an onshore configuration.

## **21) Political Interference:**

80 percent of the contractors in Sudan are indigenous companies. The government agencies, in most cases are guided by the political heavy weight to award contract to party stalwarts at very high prices. The consultants estimates are disregarded in most cases when awarding contracts and where possible manipulated. It is a general knowledge that governments particularly during the last political era give a very short time to consultants to prepare contract document for tender purposes.

## **22) Relationship between management and labor:**

There is always a gap between the project management and labor. This gap should be kept as small as possible, so that the relationship between management and labor may be strengthened. They should work as a team to build a project with minimum cost. If the relationship between management and labor is bad the morale of the labors will decrease and production will decrease leading to increased project cost.



### **23) Contract Management:**

Poor contract could be attributed to the manner in which contracts are awarded. In most cases projects are awarded to the lowest bidder and some of these low bidders may lack management skills and have less regard for contract plans, cost control, over all site management and resource allocation. As we know in the case of Sudan, contracts are usually awarded to politicians and well-connected individuals irrespective of the apparent deficiencies in their relevant delivery potentials.

Accordingly, observed in other study that most contractors in African are entrepreneurs who are in the business of making money at the expense of good Management. Consequently, they pay low wages, submit very low bids and have very little, if any ability to plan and coordinate contracts.

### **24) Lack of coordination between designers and contractors:**

Contractors construct the project according to the project design. Normally, if the design has any mistakes, the contractors may apply the mistakes without knowing there are mistakes or without notifying and coordinating with the designer or the client.

Implementing designs with mistakes obviously costs a lot of money.

### **25) Cost of materials:**

Material price is subject to supply and demand and is affected by many other things, including quality, quantity, time, place, buyer and seller.

Other factors affecting material cost include: currency exchange, low or high demand, material specification, inflation pressure and availability of new materials in the country.

#### **26) Additional Work:**

Additional work is related to design changes, which is due to lack of detailed briefing on the functional and technical requirements of the projects by the clients

#### **27) Poor Financial control on site:**

Controlling the project financially on site is not an easy task .All resources need to be controlled: labor productivity, material availability, material waste, good and effective methods, using effective tools, equipment, good project planning and scheduling. Project management should therefore be aware of all those factors in order to achieve better financial control on site.

#### **29) Disputes on site:**

Dispute is a major obstacle for any project. Normally disputes will exist if work does not match the contract document or if work is not included in the contract document. Any dispute will eventually delay the project and increase project cost.

#### **30) Fluctuation of prices of materials:**

Contractors, consultants and public clients and revealed price fluctuation as the most severe cause of project cost escalation in Sudan.

This could be attributed to the limitation in exchange rate which in turn affects construction materials prices and the general price level.

Another factor is the unstable inflationary trend in Sudan which is a result of demand exceeding supply, creating a scarcity of goods which in turn leads to escalation of the goods.

### **31) Contract procedure:**

The contract document is the ground rule between all parties (contractors, consultants and clients). One part of the contract document is the contract procedure.

The contract procedure shows the type of contract, payment procedure constraints and regulations within the contract. The type of contract affects the projects because of the risk involved in some types of contract (i.e. lump sum). Unclear contract procedures will lead to disputes, project delay and cost overrun.

### **32) Wrong method of estimation:**

This factor could be attributed to the unpredicted inflationary trend, lack of adequate training and experience at the senior management level, and fraudulent practices .

### **33) Waste on site:**

It seems that the little waste of construction material on site should have a very minor effect on the total material cost. However, this minor effect can reach up to 50 % of the total material margin of a project. So waste on site has to be considered on tendering any project.

### **34) Transportation cost:**

As the government increases the price of fuel, transportation companies raise the cost of their services to cover the fuel increase and that obviously translates to an increase in transportation cost.

### **35) Duration of contract period:**

Usually the longer the duration of the contract the more resources will be put into the project. Any delay to a project will lead to an increase in the project cost. If the delay comes from the contractors, the project owner will lose the opportunity to invest in the project earlier. Also, if the cause of the delay is the client, the contractor may lose the opportunity to win other projects or suffer from the non – utilizing the full resources.

### **36) Equipment cost:**

Equipment cost becomes more expensive as new technology or special equipment is requested. Most heavy equipment run by diesel fuel and the price of diesel fuel has increased significantly.

### **37) Mode of financing bonds and payments:**

The financing and payment of completed works is responsible for cost escalation in Sudan. Generally, contractors are sometimes not paid in accordance with the contract conditions. There are cases where clients fail to honor Architect's certificate of payment for up to 6 months or more whereas the contract conditions, in most cases stipulates about 28 days .Most contractors when preparing their tenders make allowance for partial financing of the project. They charge the clients for payments of interests and bank charges on

moneys they anticipate to borrow from the banks to finance these projects.

The irregular financing of public projects is a major cause of liquidity problem for contractors: however, contractors can be paid in accordance with the contract agreement if clients can generate the availability of adequate funds before the project commences .

### **2.13 Tender Cost Analysis :**

The Tender Cost Analysis takes place at tender evaluation stage based on the preferred tenderer's price. Its purpose, during the tender evaluation stage, is to enable the comparison of the detailed tender costs under the relevant principal and subsidiary holding categories with those in the pre-tender budgeted costs as set out in the most recently developed cost plan.

For employer-designed projects, this will be the developed cost plan (building works) or outline cost Plan Revised (Civil Engineering Works);

■ For design-and-build projects, this will be the last cost plan developed in advance of the transfer of design risk to the Contractor – typically, the Outline Cost Plan.

### **2.14 Analysis of Outturn Costs :**

The Analysis of Outturn Costs takes place as part of the Post-project Review when the project has been completed. Its purpose is to compare the actual outturn costs of the project with the budgeted costs as set out in the Tender Cost Analysis It is structured in the same way as the

Tender Cost Analysis with adjusted costs (as a result of compensation events) for the principal and subsidiary categories (Clamp, 2008).

### **2.15 Ways of Minimizing of Cost:**

There are several ways in which cost of construction can be minimized. Two cost reduction measures:

The first is the application of a value engineering concept, which aims at a careful analysis of each function and the elimination or modification of anything that adds to the project cost without adding to its functional capabilities that by carefully investigating costs, availability of materials, construction methods, procurement costs, planning and organizing, cost / benefit values and similar cost influencing items, an improvement in the overall cost of project can be realized. The second is to provide comprehensive and error free designs and specifications to avoid misinterpretations by the contractor or delay due to missing details. Cost reduction measures the elimination or minimization of design / specification, delivery and site wastes through the formulation and implementation of effective material policy and material management. In addition, the profitable firms may be generating their revenues from the elimination of waste at both professional and trade practice levels.

- Cost reduction measures also include: establishing firmly the requirements and features of the project at the onset before getting started, preparing the project team to do its best by getting members to sign off on capabilities and responsibilities, staying

diligent about keeping the project the project on the right path through contract clauses that disallow significant changes once the project is underway, effective human resource management through effective motivation, and project tracking involving discerning early what area or paths are leading to dead ends and applying early corrective actions (Clamp, 2008).

### **2.16 Previous Works:**

Many researches were performed on factors affecting the accuracy of construction projects cost estimating. They tried to assess these factors and their severity. They used different procedures in order to determine those factors.

**(Neufville et al. 1977):** stated that estimating bias changes from year to year. The result of this analysis shows that estimates made in good years are generally lower than those made in bad years. The authors also claim that these differences lagged as estimators gradually become aware of the changes in construction activity and the resulting price levels.

**Collier (1987):** He stated that: "It would be wrong to give the impression that all estimates and bids for construction work are made up of costs of labors, materials, equipment, job overhead costs, and operating overhead costs. All estimated from determined facts and calculated probabilities, and with a profit margin precisely computed according to current economic indicators". He added; "there are other things that at times may have a greater influence on the amount of a

bid than any variations of those costs and the most important of these is the demand for construction work”.

**Koehn (1985)** emphasized climatic effects on construction. The relationship between overall construction productivity, and temperature and humidity are presented in his paper.

**Chimwaso (2001)** mentioned that design changes, inadequate planning, unpredictable weather conditions and fluctuations in the cost of building materials are common factors causing cost overruns.

Yaser Abdulla Al-Juwairah – paper in Factors affecting Construction Costs in Saudi Arabia



### **3. Research Methodology**

#### **3.1 Introduction:**

This chapter concentrates on development and execution of the research method used to test and present all the issues related to the methodology followed in chapter four to achieve the research objectives and in doing so, creates new theoretical insights.

The research methodology includes the method of approach and the sampling techniques used to measure the severity indices of the major factors affecting construction cost in Sudan.

The questionnaire judged by dr.Salaheldeen A.Alaziz Agban, Dr.Mudather Suliman and Dr.awad Saad

#### **3.2 Methodology:**

The method of approach used for the research is as follows:

- Literature review and personal interviews with some contractors, owners, and professionals in the construction and consulting industries.
- Development of a Questionnaire, which is the output of the literature review and personal interviews.

#### **3.3 Narrative of the data:**

In this study, the research is approaching as an iterative philosophy process where the research has been initiated in light of prior knowledge as well as experience from a pre-understanding of the research area. This pre-understanding is the basis for searching into the understanding of the phenomenon of cost control system. This

new understanding has been used to guide an empirical research, and again generate a new understanding of the phenomenon. Understanding is generated not only through the stage of the research but also by proceeding from the whole into its part and then back again. At this stage, the purpose of this study is to identify:

- i. What main problem faced by Sudanese contractors in estimating the cost.
- ii. What method do Sudanese contractors follow to estimating the project cost? Why these methods are followed in particular?
- iii. What factors that can affect the level of cost estimating? And how can it be ranking?

### **3.4 Questionnaire Design:**

The investigation is undertaken in two stages as follows:

**Stage I** - The first stage is the collection of data. This stage involves literature search, field visits and interviews.

**Stage II** - The second stage focuses on data analysis and identification of the most relevant factors influencing construction cost in building construction. The collection of data led to the formation of a questionnaire which was distributed to construction professionals (owner, contractors and consultants).

#### **There are three main parts in the Questionnaire:**

1. The first part is General Information
2. The second part Information of one type of contract and related issues.

3. The third part factors Influencing Construction Cost on specific terms.

### **3.5 Statistical Sampling:**

#### **3.5.1 Sample size:**

In the selection process of this research there are mainly two restrictions:

- 1) Restricted to construction projects.
- 2) Restricted to the company in Khartoum.

Considering the prevalent factors, sampling is considered desirable. (The logic behind sampling is that certain relevant characteristics describe the dimensions of the population. If the sample holds the same proportion of these dimensions as the population, then other information found from the sample members will also reflect the patterns in the population. Often it is viewed as the only practical method because of cost and time consideration) (Emory 1980).

In order to find the sample size the companies of contracting parties are divided into three parts:

Population I.....Contractors

Population II.....Consultants

Population III.....Owners

### **3.6 The Survey:**

This is research was conducted in Sudan and the questionnaire were distributed to cover the geographical location over Khartoum.

For this Survey a total of 50 copies of questionnaire were distributed. Questionnaires were received and analyzed. The percentage of respondent was about 100%.

### 3.7. DATA ANALYSIS

#### 3.7.1 Statistical Methods:

The following statistical methods were used for the analysis of the data collected:

- Ranking
- Statistical techniques
- Correlation
- Cross tabulation

The degree of impact is based on a five-point scale. These five points are (very high), (high), (moderate), (low), and (very low).

Level	Very high	High	Moderate	Low	Very low
Scale	1	2	3	4	5

To determine the relative ranking of the factors, these scores were then transformed to Relative Importance Index (RII) based on the formula:

**Formula Relative Importance Index** 
$$\frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

Where W is the weighting given to each factor by the respondent, ranging from 1 to 5, (n1= number of respondents for very high, n2=number of respondents for high, n3= number of respondents for

moderate,  $n_4$ = number of respondents for low,  $n_5$ = number of respondents for very low), A is the highest weight (i.e. 1 in the study) N is the total number of samples. The relative importance index ranges from 0 to 1.

Thus, the questions are in a standardized format and sequence. This guarantees that each question is asked the same way for each respondent, simple to administer and relatively easy to analyze and compile. The questionnaire was translated into Arabic to make it easy and clear for the respondent.

### **3.7.2 Statistical Manipulation:**

To achieve the research goal, research used the statistical package for the social science (SPSS commercially available for manipulating and analyzing the data. The analyzed data include the description analysis includes (frequencies, means, Relative Importance Index (RII))

### **3.7.3 Ranking:**

The Ranking of the main factors affecting the construction cost is done by severity index.

The questionnaire responses and the ranking of all professionals combined, contractors, consultants and clients are shown in the following tables.

The categories involved in the ranking tables are more or less the same for all the three parties. The combined ranking also involves almost the same top ten factors. Hence these factors are probably the most important factors of all the **40** factors.

#### **3.7.4 Statistical techniques:**

The statistical techniques include calculation of mean, standard deviation, standard error of mean, and coefficient of variation.

## **4. Analysis and results discussion**

### **4.1 Introduction:**

This chapter presents and discusses the analyses and results of the collected data. The chapter includes a description of respondents, the classification, experience, size and respondent companies. It also, includes the ranking of the factors influence construction project cost by using relative importance index (RII). However, before discussing the data analyses and results, the characteristics of construction contractors who participated in the survey are introduced.

### **4.2 Description of the Respondents:**

This section presents the description of the respondents who participated in this study.

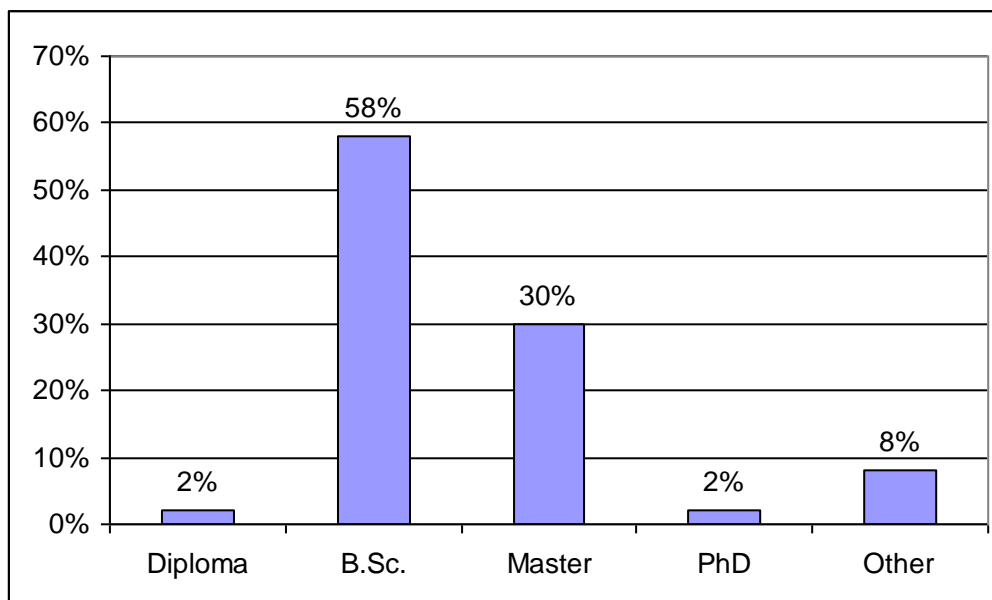
The results obtained from the questionnaire shows that, the companies participated in the study located in Khartoum-Sudan. The following section will describe the characteristics of the respondents that participated in this survey. These characteristics also include the companies' categories, experience and size of the companies.

### 4.2.1 Scientific qualification of Respondents:

Figure 4-1 shows that the 2% of respondents have Diploma degree, 58% have BSc degree, 30% have Master degree, 2% have a PHD degree and 8% have other degree:

	Frequency	Percent
Diploma	1	2%
B.Sc.	29	58%
Master	15	30%
PhD	1	2%
Other	4	8%

**Table 4.1 Qualification of Respondents**



**Figure 4.1 Qualification of Respondents**

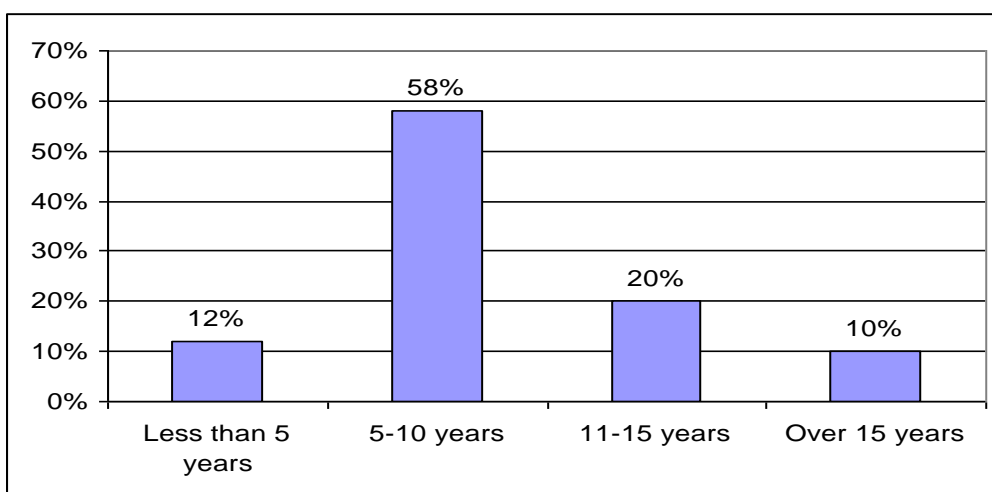


### 4.2.2 Working Experience in Field for Respondent:

The years of experience is measured in the number of years a company has been operating in the construction industry. It is vary from less than 5 years to more than 15 years. Most of the respondents are experienced , 12% from the sample have less than 5 years experience in the construction field, and 58% from the sample have experience in the construction field between 5 – 10 years , 30% from the sample over 10 years experience in the construction field . Figure 4-2 shows the working experience of respondents in the field.

	<b>Frequency</b>	<b>Percent</b>
Less than 5 years	6	12%
$5 \leq X \leq 10$ years	29	58%
$10 \leq X \leq 15$ years	10	20%
Over 15 years	5	10%

**Table 4.2: Work Experience for Company**



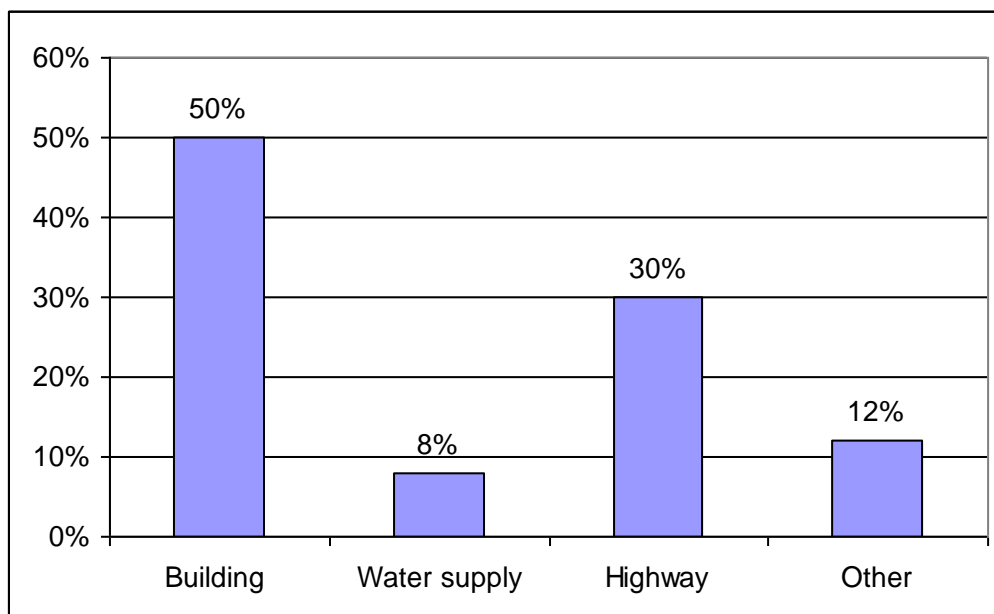
**Figures 4.2: Work Experience for Company**

### 4.2.3 Specialization of Construction Companies:

From the table and figure 4-3 below, we find that the majority of the sample had a specialization in construction is building at a rate of 50% and then who was the specialization of water supply at a rate of 8% and then who their specialization in highway accounted for 30% of the total sample researched and 12% of the sample is the other specialization.

	Frequency	Percent
Building	25	50%
Water supply	4	8%
Highway	15	30%
Other <sup>89</sup>	6	12%

**Table 4.3: Specialization of Construction Companies**



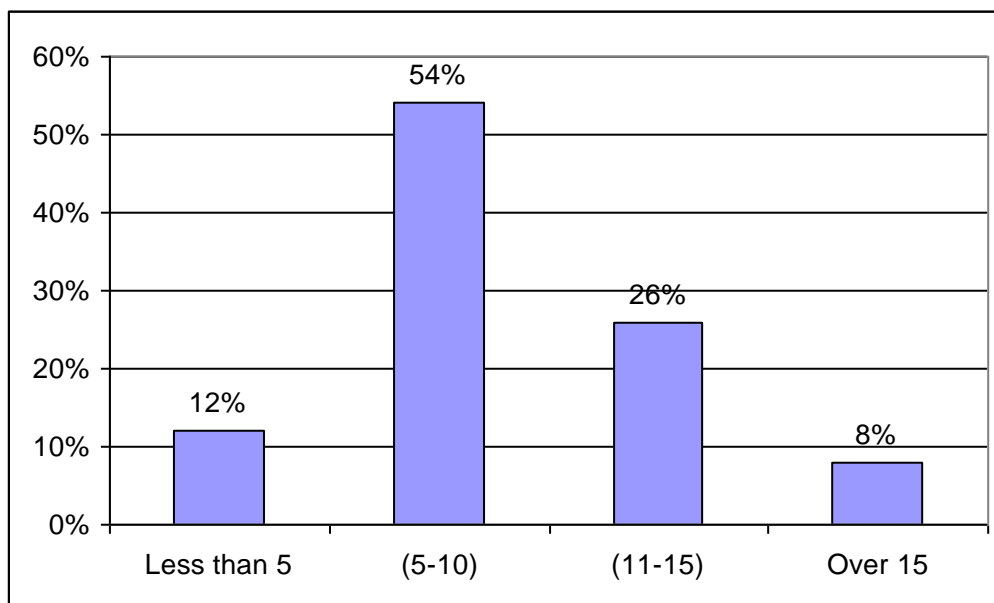
**Figure 4.3: Specialization of Construction Companies**

#### 4.2.4 The number of projects Implemented in the Last 10 Years:

From the table and figure below shows that 12% were less than 5 projects implemented during the last 10 years, 54% were between 5 – 10 projects and 34% have more than 10 projects.

	Frequency	Percent
Less than 5	6	12%
(5-10)	27	54%
(11-15)	13	26%
Over 15	4	8%

**Table 4.4: The number of projects**



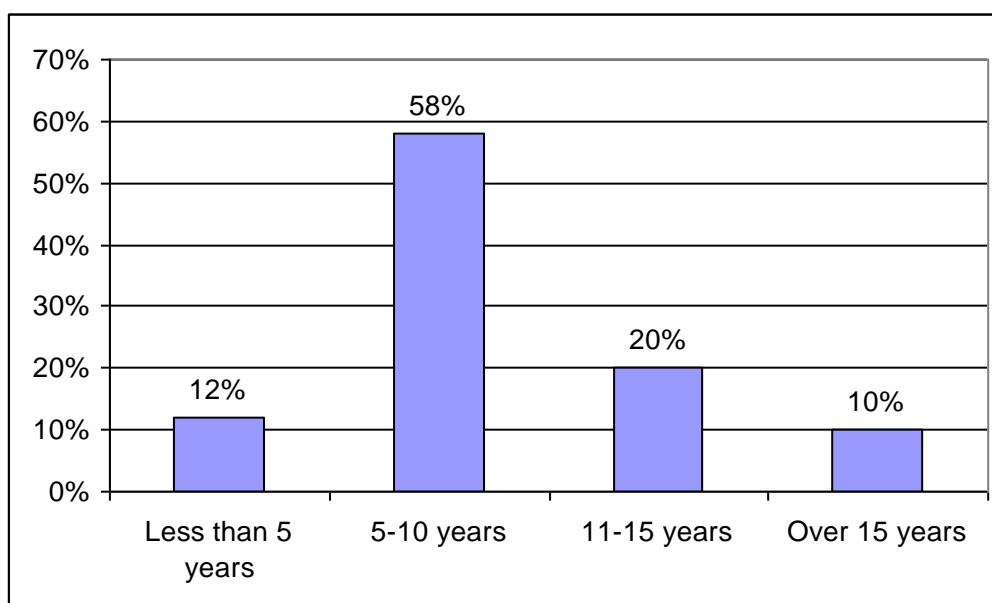
**Figure 4.4: The number of projects**

#### 4.2.5 Age of the Establishment of the Company:

From the table and figure 4-5 shows 12% are the age is less than 5 years, 58% are the age is between 5 to 10 years, 20% are the age is between 11 to 15 years and 10% are the age over 15 years.

	Frequency	Percent
Less than 5 years	6	12%
5-10 years	29	58%
11-15 years	10	20%
Over 15 years	5	10%

**Table 4.5: Respondent Age**



**Figure 4.5: Respondent Age**

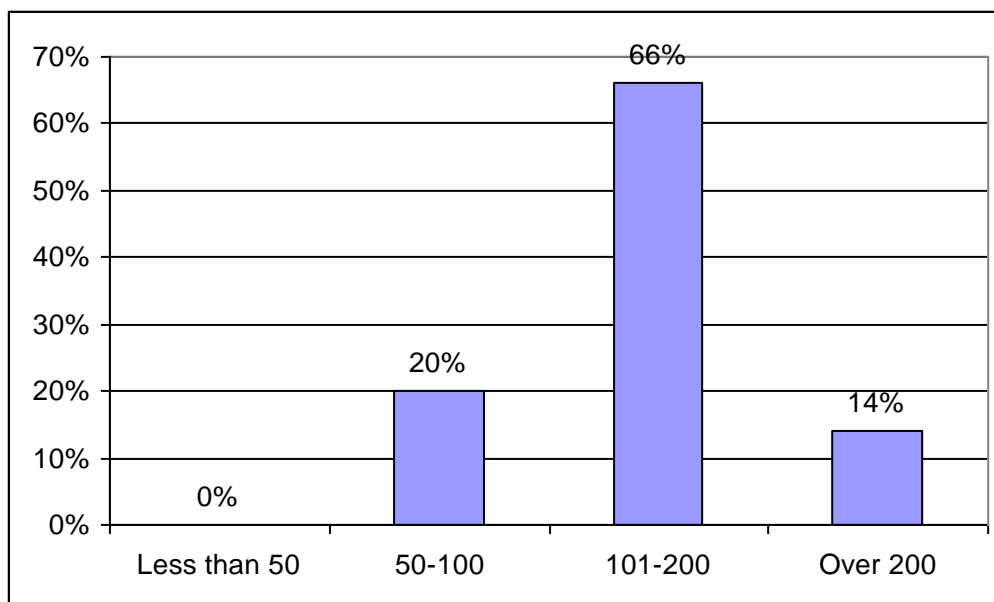
#### 4.2.6 Company Size:

Company size measured by the number of workers in a company. The companies that have less than 50 workers represent 0% of the total participated companies and that which have more than 50 to 200 employees represent 86 %. And that which have more than 200 employees represent 14 %.

Figure 4-6 shows the size of company in terms of Number of workers

	Frequency	Percent
Less than 50	0	0%
50-100	10	20%
101-200	33	66%
Over 200	7	14%

**Table 4.6: Company Size**



**Figure 4.6: Company Size**

**Part B : Information of one type of contract and related issues :**

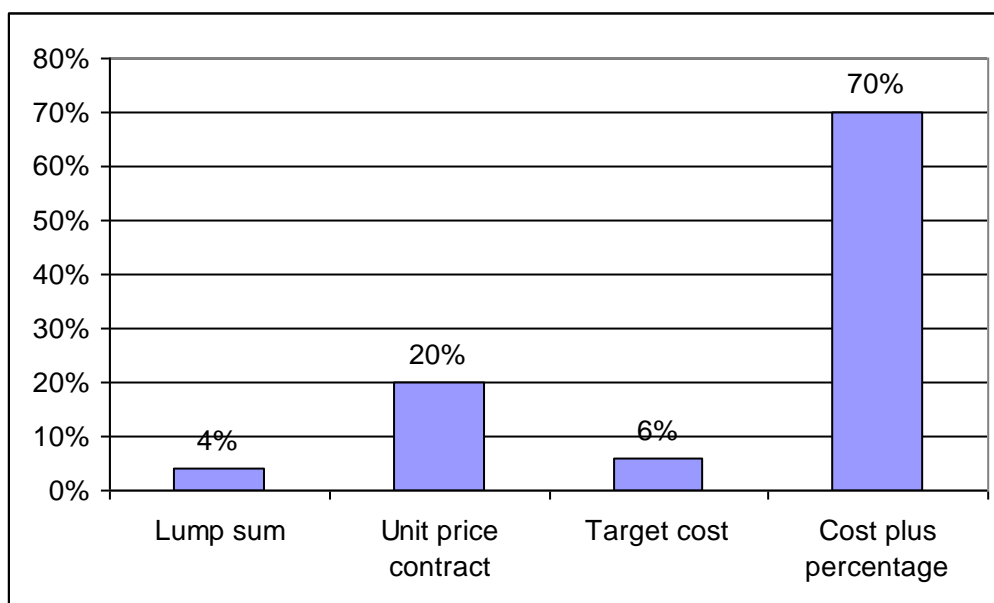
**4.2.7 Type of contract and related issues:**

Figure 4-7 shows that the majority of respondents 4% were using lump sum, 20% are of the company use unit price contract, 6% using the target cost contract and 70% using cost plus percentage.

I notice that the biggest percentage was to use a cost plus percentage contract

	<b>Frequency</b>	<b>Percent</b>
Lump sum	2	4%
Unit price contract	10	20%
Target cost	3	6%
Cost plus percentage	35	70%

**Table 4.7: Type of contract**



**Figure 4.7: Type of contract**

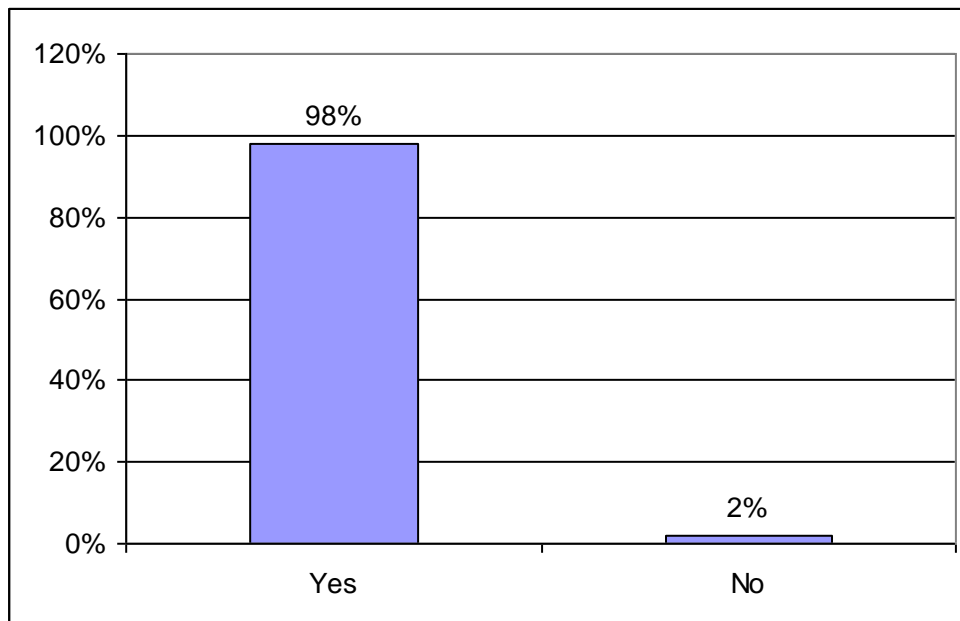
#### 4.2.8 Availability of Costing Professional:

The respondents were asked if their companies have a costing professional. 2% of the respondents did not have a costing professional while the remaining 98% had. The results of the questionnaire are presented in Figure 4-8.

I noticed that most companies have a responsible engineer of cost and this is normal

	Frequency	Percent
Yes	49	98%
No	1	2%

**Table 4.8 : Availability of costing professional**



**Figure 4.8 : Availability of costing professional**

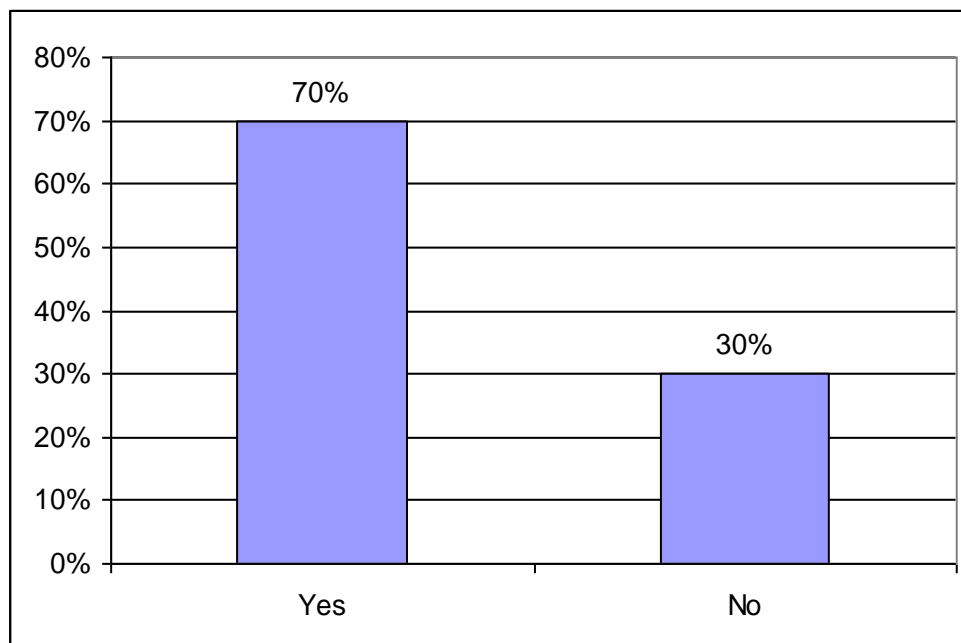
#### 4.2.9 Availability of cost estimation department:

The respondents were asked if their companies have a cost estimation department. 30% of the respondents did not have an estimation department while the remaining 70% had. The results of the questionnaire are presented in Figure 4-9.

I noticed that most companies have an estimation department and this is normal

	Frequency	Percent
Yes	35	70%
No	15	30%

**Table 4.9 : Availability of cost estimation department**



**Figure 4.9 : Availability of cost estimation department**



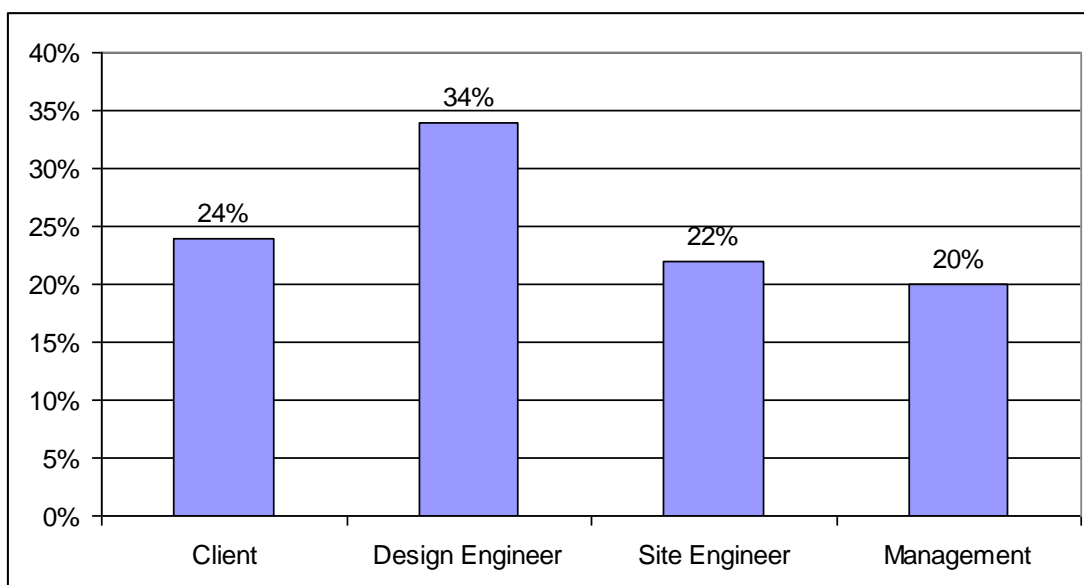
#### 4.2.10 The Responsibility For Increasing of The Project Cost:

Figure 4-10 shows that the majority of respondents 24% were believing the client affecting in the cost , 34% were believing the design engineer affecting in the cost , 22% were believing the site engineer affecting in the cost and 20% were believing the management affecting in the cost .

Through the results I noticed that the first official is the designer engineer followed by the owner

	Frequency	Percent
Client	12	24%
Design Engineer	17	34%
Site Engineer	11	22%
Management	10	20%

**Table 4.10: responsibility for increasing of the project cost**



**Figure 4.10: responsibility for increasing of the project cost**

### **4.3 Evaluation of Factors Influence Construction Project Cost in Sudan**

#### **4.3.1 Degree of influence in general terms of each of the following factors on project Design issues:**

From Table 4-11, it shows the factors influence construction project cost in general terms that indicate the nine most important factors (very high, high, moderate, low, very low size construction firm). From the relation mentioned in chapter 3 we calculated Relative Importance Index (RII), then, we arranged the factors according to their influence in the group and then were arranged relative to other factors starting from the most important.

<b>Factors</b>	<b>V. high</b>	<b>High</b>	<b>Moderate</b>	<b>Low</b>	<b>V. low</b>	<b>Mean</b>	<b>RII</b>	<b>Rank within this group</b>	<b>Rank within overall</b>
Access to Project site	24	76	0	0	0	1.76	0.352	4	17
Project area	14	86	0	0	0	1.86	0.372	5	20
Labor wage rates	58	42	0	0	0	1.42	0.284	2	4
Construction site condition	56	44	0	0	0	1.44	0.288	3	5
Inflation rate	96	4	0	0	0	1.04	0.208	1	1
The degree of technology used in construction process	24	60	16	0	0	1.92	0.384	6	22
Project schedule	16	60	24	0	0	2.08	0.416	8	27
Size of construction project	18	58	24	0	0	2.06	0.412	7	25
Type of construction project	16	64	14	6	0	2.1	0.42	9	28
<b>Total</b>						<b>1.74</b>	<b>0.348</b>		

- Access to Project site, with a RII of (0.352), the factor was ranked in the 17<sup>th</sup> position for overall groups.
- Project area, with a RII of (0.372), the factor 20<sup>th</sup> position for overall groups.
- Labor wage rates, with a RII of (0.284), the factor 4<sup>th</sup> position for overall groups.
- Construction site condition, with a RII of (0.288), the factor 5<sup>th</sup> position for overall groups.
- Inflation rate, with a RII of (0.208), the factor 1<sup>st</sup> position for overall groups.
- The degree of technology used in the construction process, with a RII of (0.384), 22<sup>nd</sup> position for overall groups.
- Project schedule, with a RII of (0.416), the factor 27<sup>th</sup> position for overall groups.
- Size of construction project, with a RII of (0.412), the factor 25<sup>th</sup> position for overall groups.
- Type of construction project, with a RII of (0.42), the factor 28<sup>th</sup> position for overall groups.
- I also noticed that inflation rate is the most influential factor ever

### **4.3.2 Factors Influencing Construction Cost on specific terms:**

#### **1. Design Issues:**

From Table 4-12, it shows the factors influence construction project cost in specific terms that indicate the nine most important factors very high, high, moderate, low, very low size construction firm. From the equation 3.1 mentioned in chapter 3 we calculated Relative Importance Index (RII), then, we arranged the factors according to their influence in the group and then were arranged relative to other factors starting from the most important as shown in column 9&10.

<b>Factors</b>	<b>V. high</b>	<b>High</b>	<b>Moderate</b>	<b>Low</b>	<b>V. low</b>	<b>Mean</b>	<b>RII</b>	<b>Rank within this group</b>	<b>Rank within overall</b>	
Design changes	78	22	0	0	0	1.22	0.244	1	2	
Not enough drawings review	48	46	6	0	0	1.58	0.316	2	11	
Lack of technical advisory experience and lack of coordination in the design phase	44	40	16	0	0	1.72	0.344	3	15	
Understanding of the executing agency of the structural design process	18	60	22	0	0	2.04	0.408	4	24	
<b>Total</b>							<b>1.64</b>	<b>0.328</b>		

## 2. Financial Issues:

From Table 4-13 below, it shows the factors influence construction project cost in specific terms that indicate the eleven most important factors (very high, high, moderate, low and very low) size construction firm.

From the equation 3.1 mentioned in chapter 3 we calculated Relative Importance Index (RII), then, we arranged the factors according to their influence in the group and then were arranged relative to other factors starting from the most important as shown in column 9 &10.

Factors	V. high	High	Moderate	Low	V. low	Mean	RII	Rank within this group	Rank within overall
Lack of documentation for the project	14	64	20	2	0	2.1	0.42	10	29
Escalating prices of construction materials by inflation	52	48	0	0	0	1.48	0.296	3	7
Fluctuations in currency exchange rate	46	54	0	0	0	1.54	0.308	6	10
Tax increase	68	32	0	0	0	1.32	0.264	1	3
Bad purchasing department	60	36	4	0	0	1.44	0.288	2	6

Limited markets	30	50	20	0	0	1.9	0.38	8	21
The high cost of construction equipment	48	52	0	0	0	1.52	0.304	4	8
the high cost of skilled labor	26	54	20	0	0	1.94	0.388	9	23
The wrong way of cost calculation	30	58	12	0	0	1.82	0.364	7	18
Financers policy choice of lowest price tenders	50	48	2	0	0	1.52	0.304	5	9
Non-completion cost calculations when applying for tender	18	58	24	0	0	2.06	0.412	10	26
<b>Total</b>						<b>1.68</b>	<b>0.336</b>		

- Tax increase, with a RII of (0.264), the factor was ranked in the 3rd position within overall groups.
- Bad purchasing department, (0.288), the factor was ranked in the 6th position within overall groups.
- Escalating prices of construction materials by inflation, with a RII of (0.296), the factor was ranked in the 7th position within overall groups.
- The high cost of construction equipment, with a RII of (0.304), the factor was ranked in the 8th position within overall groups.

- Financers policy choice of lowest price tenders, with a RII of (0.304), the factor was ranked in the 9th position within overall groups.
- Fluctuations in currency exchange rate, with a RII of (0.308), the factor was ranked in the 10th position within overall groups.
- The wrong way of cost calculation, with a RII of (0.364), the factor was ranked in the 18th position within overall groups.
- Limited markets, with a RII of (0.38), the factor was ranked in the 21st position within overall groups.
- The high cost of skilled labor, with a RII of (0.388), the factor was ranked in the 23rd position within overall groups.
- Non-completion cost calculations when applying for tender, with a RII of (0.412), the factor was ranked in the 26th position within overall groups.
- Lack of documentation for the project, with a RII of (0.42), the factor was ranked in the 29th position within overall groups.

### 3. Project characteristics:

From Table 4-13, it shows the factors influence construction project cost in specific terms that indicate the twelve most important factors (very high, high, moderate, low and very low) size construction firm. From the equation 3.1 mentioned in chapter 3 we calculated Relative Importance Index (RII), then, we arranged the factors according to their influence in the group and then were arranged relative to other factors starting from the most important as shown in column 9 &10.

Factors	V. high	High	Moderate	Low	V. low	Mean	RII	Rank with this group	Rank within overall
Lack of documentation specifications	4	60	36	0	0	2.32	0.464	6	31
Weak organizational structure	6	56	38	0	0	2.32	0.464	7	32
Lack of experience	0	42	44	14	0	2.72	0.544	8	33
Weak materials management	0	26	48	26	0	3	0.6	9	35
The planning process for the management of the project is not appropriate	2	6	74	18	0	3.08	0.616	10	36
Additional work as a result of the request the owner	30	58	12	0	0	1.82	0.364	4	19



The lack of efficiency in the use of resources	2	4	76	18	0	3.1	0.62	11	37
Difficulty in importing equipment and materials	40	50	10	0	0	1.7	0.34	3	14
Introduction of new economic legislation	42	52	6	0	0	1.64	0.328	1	12
Unexpected weather conditions	40	54	6	0	0	1.66	0.332	2	13
Limited skilled labor	22	40	38	0	0	2.16	0.432	5	30
Disorders and problems of workers	2	6	70	22	0	3.12	0.624	12	38
<b>Total</b>						<b>2.39</b>	<b>0.477</b>		

- Introduction of new economic legislation, with a RII of (0.328), the factor was ranked in the 12<sup>th</sup> position with overall groups.
- Unexpected weather conditions, with a RII of (0.332), the factor was ranked in the 13<sup>th</sup> position with overall groups.
- Difficulty in importing equipment and materials, with a RII of (0.34), the factor was ranked in the 14<sup>th</sup> position with overall groups.
- Additional work as a result of the request the owner, with a RII of (0.364), the factor was ranked in the 19<sup>th</sup> position with overall groups.
- Limited skilled labor, with a RII of (0.432), the factor was ranked in the 30<sup>th</sup> position with overall groups.

- Lack of documentation specifications, with a RII of (0.464), the factor was ranked in the 31<sup>st</sup> position with overall groups.
- Weak organizational structure, with a RII of (0.464), the factor was ranked in the 32<sup>nd</sup> position with overall groups.
- Lack of experience, with a RII of (0.544), the factor was ranked in the 33<sup>rd</sup> position with overall groups.
- Weak materials management, with a RII of (0.6), the factor was ranked in the 35<sup>th</sup> position with overall groups.
- The planning process for the management of the project is not appropriate, with a RII of (0.616), the factor was ranked in the 36<sup>th</sup> position with overall groups.
- The lack of efficiency in the use of resources, with a RII of (0.62), the factor was ranked in the 37<sup>th</sup> position with overall groups.
- Disorders and problems of workers, with a RII of (0.624), the factor was ranked in the 38<sup>th</sup> position with overall groups.

### Bidding situation:

From Table 4-14, it shows the factors influence construction project cost in specific terms that indicate the four most important factors (very high, high, moderate, low and very low) size construction firm. From the equation 3.1 mentioned in chapter 3 we calculated Relative Importance Index (RII), then, we arranged the factors according to their influence in the group and then were arranged relative to other factors starting from the most important as shown in column 9 &10.

Factors	V. high	High	Moderate	Low	V. low	Mean	RII	Rank within this group	Rank within overall
Pricing without properly studying tenders document	38	52	10	0	0	1.72	0.344	1	16
Time between project announcement and bid opening day	6	20	54	20	0	2.88	0.576	2	34
Number of competitors	2	6	40	48	4	3.46	0.692	3	39
Level of competitors	2	4	38	52	4	3.52	0.704	4	40
<b>Total</b>						<b>2.90</b>	<b>0.579</b>		

- Pricing without properly studying tenders document, with a RII of (0.344), the factor was ranked in the 16<sup>th</sup> position with overall groups.

- Time between project announcement and bid opening day, with a RII of (0.576), the factor was ranked in the 34<sup>th</sup> position with overall groups.
- Number of competitors, with a RII of (0.692), the factor was ranked in the 39<sup>th</sup> position with overall groups.
- Level of competitors, with a RII of (0.704), the factor was ranked in the 40<sup>th</sup> position with overall groups.

#### 4.4 Summary Ranks of Groups influence Construction Project

##### Cost :

The analysis showed that the financial factor took the highest proportion of the relative importance index (RII) , so it must be taken into consideration.

Table 4.15 shows the summarizes of the factors influence in the cost of project in specific terms.

<b>Groups of factors</b>	<b>Mean</b>	<b>RII</b>	<b>Rank</b>
Design issues	1.74	0.348	2
Financial Issues	1.68	0.336	1
Project characteristics	2.39	0.477	3
Bidding situation:	2.90	0.579	4
<b>Total</b>	<b>2.18</b>	<b>0.435</b>	

#### 4.5 Summary or Ranks for Factors:

\* Significant factors ranked by all groups of respondents. The results present several underlying factors that can influence construction project cost. They should be deemed as significant since the data was gathered from the personnel directly and intimately involved in the execution of cost of construction cost. Most significant factors influence construction project cost, and with some fine tuning, these can replicated in many other developing countries of comparable socio-economic traits.

Table 4.16 show the rank of the factors related with their group.

The rank were arranged from high affecting to low.

<b>Factors</b>	<b>Mean</b>	<b>RII</b>	<b>Rank overall</b>
Inflation rate	1.04	0.208	1
Design changes	1.22	0.244	2
Tax increase	1.32	0.264	3
Labor wage rates	1.42	0.284	4
Construction site condition	1.44	0.288	5
Bad purchasing department	1.44	0.288	6
Escalating prices of construction materials by inflation	1.48	0.296	7
The high cost of construction equipment	1.52	0.304	8
Financers policy choice of lowest price tenders	1.52	0.304	9
Fluctuations in currency exchange rate	1.54	0.308	10

Not enough drawings review	1.58	0.316	11
Introduction of new economic legislation	1.64	0.328	12
Unexpected weather conditions	1.66	0.332	13
Difficulty in importing equipment and materials	1.7	0.34	14
Lack of technical advisory experience and lack of coordination in the design phase	1.72	0.344	15
Pricing without properly studying tenders document	1.72	0.344	16
Access to Project site	1.76	0.352	17
The wrong way of cost calculation	1.82	0.364	18
Additional work as a result of the request the owner	1.82	0.364	19
Project area	1.86	0.372	20
Limited markets	1.9	0.38	21
The degree of technology used in the construction process	1.92	0.384	22
the high cost of skilled labor	1.94	0.388	23
Understanding of the executing agency of the structural design process	2.04	0.408	24
Size of construction project	2.06	0.412	25
Non-completion cost calculations when applying for tender	2.06	0.412	26
Project schedule	2.08	0.416	27

Type of construction project	2.1	0.42	28
Lack of documentation for the project	2.1	0.42	29
Limited skilled labor	2.16	0.432	30
Lack of documentation specifications	2.32	0.464	31
Weak organizational structure	2.32	0.464	32
Lack of experience	2.72	0.544	33
Time between project announcement and bid opening day	2.88	0.576	34
Weak materials management	3	0.6	35
The planning process for the management of the project is not appropriate	3.08	0.616	36
The lack of efficiency in the use of resources	3.1	0.62	37
Disorders and problems of workers	3.12	0.624	38
Number of competitors	3.46	0.692	39
Level of competitors	3.52	0.704	40



## **5. Conclusion and Recommendations**

### **5.1 Introduction:**

The research study is presented in five chapters encircling the whole research essence. This Chapter, which presents the summary of the study, ultimately reveals the digest of major findings drawn from the study. The research findings are presented while considering the final model, and their interpretations are also briefly mentioned. The chapter also cites the appropriate current recommendations, which the researcher developed based on the conclusions of the research study. Some recommendations for further studies in the same area are also presented and suggested according to the perception of the researcher.

### **5.2 Conclusion:**

1- Through literature review, potential factors that affect the accuracy of the cost for construction projects were identified. forty factors are identified. The top ten factors were:

- Inflation rate
- Design changes
- Tax increase
- Labor wage rates
- Construction site condition
- Bad purchasing department
- Escalating prices of construction materials by inflation
- The high cost of construction equipment

- Financers policy choice of lowest price tenders
- Fluctuations in currency exchange rate

2- Measurements of the forty factors show that improvement of the quality of firm's project planning and management, relevant experience of estimating team, availability of management and finance plans, ability of estimating team, availability of labor and equipment required, estimating method, project location, periodical payments, accuracy of bidding documents provided by client and competence and leadership of project manager can greatly reduce the average cost variance. While economic instability and impact of project schedule "expected to delay" are found to have a bad effect on the average percentage of cost variance.

### **5.3 Recommendations:**

Through research and conclusions Reached have found the need to develop a number of recommendations to overcome the cost of risk and to reduce its impact, namely:

1. Consider economic instability and project location when defining contingency value.
2. Assign qualified project manager, estimating team and planners.
3. Applying good management and finance plans.
4. Provide sufficient numbers of labor and efficient equipment.
5. Use detailed estimates if possible.
6. Use accurate bidding documents.

#### **5.4 Recommendation for future study:**

The research has produced several outlines which can be a strong base for several extensive studies, this including but not limited to:

1. Development of a database to prepare an engineering system to assess the control over the management and planning of the cost of construction projects.
2. Studying the laws, regulations and official instructions affecting the process of controlling the management and planning of the cost of projects.
3. Conduct a study to evaluate the use of related computer applications that will help the employer make appropriate decisions such as giving deviation and variation in time.

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Dear Sir / Madam

**Participation in filling out a questionnaire**

Referring to the above subject I am a post-graduate student following MSC research in construction engineering at Sudan University of Science & Technology. The title of my thesis is:

“Factors Influence Construction Project Cost In Sudan”

This questionnaire intends to clarify the factors effect in the cost construction projects in Sudan.

As you are one of the organizations working in this field in Sudan, we are kindly inviting you to participate in filling this questionnaire with the required data which will form an important element in this study.

Please let your project manager/s provide the required Information requested in this questionnaire. The information provided by you will be analyzed as whole, and we ensure you that this information will be held in strict confidence and used for scientific research purpose only without mentioning the name of your organization.

We realize that there are numerous demands on your time. However your involvement is a vital requisite for this study. We appreciate your anticipated cooperation in answering this questionnaire, which may take`` less than 15 minutes of your valuable time.

Thank you for your anticipated cooperation.

**Best regards.**

**Name :** Suhair Siddig A.Alhafeez

**Phone number :** 0121669126 **Email :** soher202@hotmail.com

### **Part A: General Information**

1. company Name : ..... (optional)

2. What is your scientific qualification?

Diploma    B.Sc.    Master    Other,(please specify .....

3. How many years have you been in the field of construction ?

Less than 5 years    5 – 10    over 10 – 15    over 15

4. What is your company specialization in the field of construction?

Building    Sanitation    Highway    Other,.....

5. The number of projects carried out by your company during the last ten years :

Less than 5    5 – 10    over 10 – 15    over 15

6. Duration of the company's age in the construction :

Less than 5 years    5 – 10    over 10 – 15    over 15

7. Number of the force work in the company :

less than 50    50 to 100    100 to 200    Over 200

### **Part B: Information of one type of contract and related issues :**

1. Contract type :

Lump sum    unit price contract    Target cost    cost plus percentage

2. Does your company have cost estimation department / section ?

Yes    No

3. Does your company have costing professional?

Yes    No

4. In your opinion who should be responsible for increasing of the project cost?

Client       design engineer       site engineer       management

5. Degree of influence in general terms of each of the cost following factors on project :

<b>Factor description</b>	<b>V.high</b>	<b>high</b>	<b>moderate</b>	<b>Low</b>	<b>V.low</b>
Access to project site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
project area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Labor wage rates	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Construction site conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Inflation rate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The degree of technology used in the construction process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Size of construction projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Type of construction projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**Part C: factors Influencing Construction Cost on specific terms:**

The list below includes the factors influencing construction projects cost in construction industry:

For each of these factors you are kindly requested to indicate your option by answering the following question and placing (X) in the appropriate box what is the degree of impact of each factors on projects cost in construction project:

NO.	Factor description	Degree of compact				
		V.high	high	moderate	Low	V.low
1.	<b>Design Issues</b>					
1.1	Design changes					
1.2	Not enough drawings Review					
1.3	Lack of technical advisory experience and lack of coordination in the design phase					
1.4	Understanding of the executing agency of the structural design process.					
2.	<b>Financial Issues</b>					
2.1	Escalating prices of construction materials by inflation.					
2.2	Fluctuations in currency exchange rate.					
2.3	Tax increase.					
2.4	Bad Purchasing Department .					
2.5	Limited markets.					
2.6	The high cost of construction equipment.					

2.7	The high cost of skilled labor					
2.8	the wrong way of cost calculation					
2.9	Financiers policy choice of lowest price tenders					
2.10	Non-completion cost calculations when applying for tender					
<b>3.</b>	<b>Project Characteristics :</b>					
3.1	Lack of documentation specifications					
3.2	Weak organizational structure					
3.3	Lack of experience					
3.4	Weak materials management					
3.5	The planning process for the management of the project is not appropriate					
3.6	Additional work as a result of the request by the owner					
3.7	The lack of efficiency in the use of resources					
3.8	Difficulty in importing equipment and materials					
3.9	Introduction of new economic legislation					
3.10	Unexpected weather conditions					
3.11	Limited skilled labor					
3.12	Disorders and problems of workers					
<b>4.</b>	<b>Bidding Situations :</b>					

4.1	Pricing without properly studying tender documents					
4.2	Time between project announcement and bid opening day					
4.3	Number of competitors					
4.4	Level of competitors					