



Sudan University of Science & Technology

College of Post Graduate Studies



Method of Cost Control in Construction Projects in Sudan

طرق التحكم في التكلفة بمشاريع التشييد في السودان

**A Thesis Submitted in Partial Fulfillment of the
Requirements Master Degree in School of Civil
(Construction Management)**

By:
ROWA MOHAMMED ABDELHALIM MUKHTAR

Supervisor:
Dr. AWAD SAAD HASSAN

Augusts 2014

قال تعالى :

(الرحمن (1) علم القرآن (2) خلق الإنسان
(3) علمه البيان)

سورة الرحمن – الآيات (4-1)

DEDICATION

To the big heart my dear father may Allah mercy on himwho taught me how to hold a pen, and how to notify words without remorse..

To each of the following in the presence of God and His Messenger, my mother dear..

To those who have demonstrated to me what is the most beautiful in life ,my brothers.

ACKNOWLEDGEMENT

First of all gives thanks to Allah

And a special thanks to supervisor

DR. AWAD SAAD

I cant forget giving thanks to everyone who helped us and gave new hope to successful .

I'm gratefully acknowledge the financial support of lectures and all staff of Sudan university's .

My heartfelt appreciation and gratefulness are dedicated to my father... he is the source of power inspiration , and confidence in me .

I wish to acknowledge the efforts of the auto work shop staff for their standing beside us the experimental work

List of Content

DEDICATION	III
ACKNOWLEDGMENT	IV
LIST OF CONTENTS	V
LIST OF FIGURES.....	VIII
LIST OF TABLES	X
ABSTRACT	XI
المستخلص.....	XII

Chapter (1)

Introduction

1.1 INTRODUCTION.....	2
1.2 Significant & Motivation of the research:.....	2
1.3Research questions:.....	4
1.4 Research hypothesis:	4
1.5 Research Methodology :.....	5
1.6 Scope and limitation:	5

Chapter (2)

Literature Review

2.1 Introduction	8
2.1.1 Project:	8
2.1.2 Project Management:	8
2.1.3 Project Management Life Cycle:.....	9
2.1.4 cost control:	9
2.1.4.1 Definitions:.....	11
2.1.4.2 Statement of facts in cost control :	13
2.1.5 Cost control among cost management cycle:	14
2.2 Components of cost control:	17
2.2.1 cost control: Inputs	18

2.2.1.1 Project Management Plan:	18
2.2.1.2 Project Funding Requirements:	19
2.2.1.3 Work performance data:	19
2.2.1.4 Organizational Process Assets:	20
2.2.2 Cost Control: Tools and Techniques:	20
2.2.2.1 Earned Value Management:	20
2.2.2.2 Forecasting:	23
2.2.2.3 To-Complete Performance Index (TCPI):	25
2.2.2.4 Performance Reviews:	25
2.2.2.5 Project Management Software:	28
2.2.2.6 Reserve Analysis:	28
2.2.3 costcontrol:outputs	29
2.2.3.1 Work Performance Information:	29
2.2.3.2 Cost Forecasts:	29
2.2.3.3 Change Requests:	29
2.2.3.4 Project Documents Updates:	29
2.2.3.5 Project Management Plan Updates:	30
2.2.3.6 Organizational Process Assets Updates:	30
2.3 The use of cost control:	30
2.3.1 Unit costs:	31
2.3.2 Reporting systems:	32
2.3.2.1 Reporting method for actual work-done:	32
2.3.2.2 Method of collecting data:	33
2.4 Control of Materials and Mechanical Plants :	34
2.4.1 Control of materials :	34
2.4.2 Standard Cost and Variance:	34
2.4.3 Labor Variances :	35
2.4.4 Overhead Variances:	36
2.4.5 Control of Mechanical Plant Costs:	37
2.4.6 Other Factors Influencing Costs:	39

Chapter (3)

Research methodology

3.1 Introduction:	41
-------------------------	----

3.2 Narrative of the data acquired:	41
3.2.1 Literature review and synthesis (secondary information):	43
3.2.2 Primary information:	44

Chapter (4)

Result And Data Analysis

4. 1 Introduction:.....	49
4.1.1 Cases studies:	49
4.1.1.1 Analysis of the cases:.....	49
4.1.2 A questionnaire:	68
4.1.2.1 SECTION (1) - Respondents classification:.....	68
4.1.2.2 SECTION (2) - Analysis of Cost control procedure (Tools & Effectiveness):	71
4.1.2.3 section (3) factors effecting the level of cost control.....	97
4.1.2.4 Section (4) – General Informations.....	108

Chapter (5)

summery, conclusions and recommendations

5.1 Study Summery:	111
5.2 Conclusion And Recomendations:	112
5.2.1 main Problem Faced By Sudanese Contractors In Controlling Cost Of Projects :.....	112
5.2.2 Method Of Construction Cost Control:	112
5.2.3 Factors Affecting Level Of Cost Control:	115
5.3 Recommendation For Future Study:.....	117
References.....	XIII
appendix	XIV

List of Figure

Figure 2-1: project cost management overview Project Management Institute,(2013)	16
Figure 2-2: Cost Control: Inputs, Tools & Techniques, and OutputsProject Management Institute,(2013).....	17
Figure 3- 1:Research methodology flow-char.....	42
Figure 3- 2:case study methodology flow-char	47
Figure 4-1: contribution of all items in total cost of construction for project	52
Figure 4-2: contribution of all items in total cost of construction for project	64
Figure 4-3 : difference between Cost estimated and Actual cost for Each Case Study.....	65
Figure 4-4: difference between Cost estimated and Actual cost for Each Case Study.....	66
Figure 4-5: sum total of difference between Cost estimated and Actual cost for Each Case Study	67
Figure 4- 6: How the company awarding new project:	72
Figure 4- 7:What is the percentage of subcontracted work in a given project: .	73
Figure 4- 8:What is the percentage of subcontracted work in a given project: .	76
Figure 4- 9:How are choice side study for initial costs	77
Figure 4- 10:Project at distance from company home office	78
Figure 4- 11:According to above question how the company establish an area/branch offices (site offices):	79
Figure 4- 12:Computerization of cost control procedures are in the form.....	80
Figure 4- 13:The method for work/breakdown structure for site use depends on	81
Figure 4- 14:Budgeting of project establishing depends on	82
Figure 4- 15 :The period for short term planning and control	83
Figure 4- 16 :Which is (are) utilized for site planning and control:-.....	84
Figure 4- 17:What is (are) the frequency of measuring actual performance during construction (frequency of cost statements) :.....	85
Figure 4- 18:Which of the following are using as reporting method for actual work-done	86

Figure 4- 19:In analyzing actual cost vs. estimated cost , which of the following system are done use:.....	87
Figure 4- 20: In costing the resources during construction, labor hours are allocated by:	88
Figure 4- 21:Plant (Equipment) hours are allocated by:.....	89
Figure 4- 22:Material consumed for construction is allocated by:.....	90
Figure 4- 23 In case of any cost deviation, which of the following is (are) utilized for investigating cost discrepancy:.....	91
Figure 4- 24 When comparing actual vs. - desired level of performance , in most project variance appear due to :	92
figure 4-25 case of any cost deviation, variance is calculated as case of any cost.....	93
Figure 4- 26:Mostly ,the result of Corrective action , is translated :.....	94
Figure 4- 27:During execution ,what's the most Opportunities for cost saving:	95
Figure 4- 28:Contingencies for areas of uncertainty or potential difficulty ... On your organization , whom are allowed and authorized for the use of it:	96
Figure 4- 29:Size of project:	99
Figure 4- 30: project document:	100
Figure 4- 31:labors:.....	101
Figure 4- 32:equipment.:	102
Figure 4- 33:company characteristics:	103
Figure 4- 34: Outside of influences	104
Figure 4- 35:frequency of reporting	105
figure 4-36: Degree of work break down structure	106
figure 4-37 Degree of Organization break down structure	107

List of Table

Table(2-1): Definition terms used in cost control procedures.....	11
Table 2- 2: Terms about Earned Value:.....	26
Table 2- 3: Formulas and interpretations to know:	27
Table 4-1: provides the increasing basic quantities executed at the site:.....	50
Table4-2: provides a summary of the terms of additional works	50
Table 4-3 : provide Cost estimated and The value of rise cost of construction for first case study:	51
Table 4-4: provides the increasing basic quantities executed at the site:.....	54
Table 4.5: provides a summary of the terms of additional works:	61
Table 4-6 : provide Cost estimated and The value of rise cost of construction for first case study:	63
Table 4-7 :Cost estimated and The value of rise cost of construction for two cases studies:.....	65
Table 4-8: difference between Cost estimated and Actual cost for Each Case Study:.....	66
Table 4-9:sum total of difference between Cost estimated and Actual cost for Each Case Study:.....	67
Table 4 -10: Characteristic of Grading of Respondents	69
Table 4- 11: Sample Size & Classification	70
Table 4-12: The size of project	100
Table 4-13:project document	101
Table 4-14:Labors	102
Table 4-15:Equipment	103
Table 4-16: company characteristics	104
Table 4-17: Outside of influences.....	105

Abstract

Cost control is an important issue in construction project management. It is widely practiced by contractors in Sudan and needs to be carried throughout the life of the project.

This study is conducted to study the cost control methods in construction projects, identify the cost control method used by Sudanese contractors during the construction stage , to identify the problem faced by Sudanese contractor in controlling the costs of projects ,and to identify factors that can affect the level of cost control and How it could be ranked.

The study of some cases taken difference projects in cost and specifications, and a survey questionnaire has been conducted by series of structured interviews with 30 contractors. The survey questionnaire included four areas of study: 1) Questions about the contractor's firm. 2) The procedure of cost control. 3) The level of cost control. 4) General evaluation for the situation of the construction companies in respect of their knowledge about the cost control.

A brief interview with a Sudanese contractor and cases studies found that in General the Contractors in Sudan have a good awareness level of cost control procedures. On the other hand, they suffer from the lack of knowledge in so many related areas such as risk allocating, preparing of breakdown structure, utilizing of coding system and integrating cost with other functions.

Finally, a set of recommendations and topics have been presented for further

Studies and suggested to improve the construction cost control practices in Sudan.

المستخلص

التحكم في التكلفة هي قضية هامة في إدارة مشروع التشييد، وهو يمارس بشكل واسع من قبل المقاولين في السودان ويحتاج للتنفيذ طوال عمر المشروع.

ولقد أجريت دراسة طرق التحكم في التكلفة في مشروع التشييد، وتحديد طريقة التحكم في التكاليف من قبل المقاول السوداني أثناء مرحلة البناء، وتحديد المشكلة التي يواجهها المقاول السوداني في التحكم على تكاليف المشاريع، وتحديد العوامل التي يمكن أن تؤثر على مستوى الحكم في التكلفة وكيف يمكن ترتيبها.

وشملت الدراسة على حالات دراسية عن مشاريع مختلفة التكلفة والمواصلات ، وقد أجرى استبيان استهدف 30 مقاول شخصية ، وشمل الاستبيان على أربعة أقسام دراسية:

- (1) أسئلة عن المؤسسة.
- (2) الطريقة المتبعة للتحكم بالتكلفة.
- (3) درجة التحكم بالتكلفة.
- (4) تقييم لدرجة الفهم للمقاولين السودانيين.

تم التوصل إلى أن درجة الفهم لدى المقاول السوداني لعملية التحكم بالتكلفة جيدة ولكن ينقصها الإلمام التام ببعض الجوانب المهمة مثل عملية تحليل المخاطر، عملية تقسيم مكونات المشروع وتنظيمه تبعاً للتكويد الألف بائي أو الرقمي ودمج عملية التحكم بالتكلفة مع عمليات إدارية أخرى كالتحكم في الزمن أو الجودة.

وقد تمت التوصية أيضاً بتنفيذ مشاريع بحثية أخرى من نفس النوع وذلك بهدف تطوير عملية التحكم بالتكلفة في السودان.



Chapter (1)

Introduction

1.1 Introduction

In construction almost all clients are interested in obtaining fully functional facilities completed in time, cost, quality and scope.

The cost control of the construction projects on the premise is not acceptable to wait until a job is finished to find out the job's gross profit or loss. There must be an on-going system in place to measure and control the expenditures incurred during construction and to report the findings to the management. Managers must have an access to accurate cost and scheduled data so the trend of the cost can be determined when possible, and correction actions taken if needed.

According to Dharwadker (1985), cost control can be achieved by selecting the right man for the right job, the right equipment and tools for the right work and the right quality of materials, in the right quantity, from the right source, at the right price and delivered at the right time.

1.2 Significant & Motivation of the research:

There has in recent years been a great need for an understanding of construction economics and cost control, particularly during the design stage of projects. The importance of this is due largely to the following:

- The increased pace in society in general has resulted in clients being less likely to tolerate delays caused by redesigning buildings when tenders are too high.
- The client's requirements today are more complex than those of their Victorian counterparts. A more effective system of control is therefore desirable from inception up to the completion of the final account, and thereafter during costs-in-use.
- The clients of the industry often represent large organisations and financial institutions. This is a result of takeovers, mergers and some public ownership. Denationalization has often meant that

these large organisations remain intact as a single entity. There has thus been an increased emphasis on accountability in both the public and the private sectors of industry. The efficiency of these organisations at construction work is only as good as their advisers.

- There has been a trend towards modern designs and new techniques, materials and methods of construction. The designer is able to choose from a far wider range of products and this has produced variety in construction. The traditional methods of estimating are unable to cope in these circumstances to achieve value for money and more balanced designs.
- Contractors' profit margins have in real terms been reduced considerably during the past decade. This has resulted in their greater cost-consciousness in an attempt to redress possible losses.

☒ The Statement of the topic:

One of the main objectives of any contractor is to realize an acceptable return from his project. The first step is to prepare an appropriate project estimate, yet is not enough to achieve such a desired return; that is why a firm control of cost must be applied.

In Sudan, no published study explores the methods has being utilized by Sudanese contractors. Due to this lack of knowledge, the need for such research has been existed to identify those methods, which have already been brought by a standard international system, and to optimize these methods to combine with the environment of the Sudanese construction mark.

The purpose of cost control to limit the client's expenditure to within the amount agreed. In simple terms this means that the tender sum and final account should approximately equate with the budget estimate. If the relative importance of the factors affecting the degree of control is well

known, then the practice of the control system can become more flexible, easier, effective and more efficient.

1.3 Research questions:

The purpose of this research is to find answers for the following questions:

- what are the main problem facing the Sudanese contractors in controlling the cost of projects?
- What are the methods followed by the Sudanese contractors to control the projects cost? Why do these methods are followed in particular?
- What factors that can affect the level of cost control and How Could it be ranked?

1.4 Research hypothesis:

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

- Controlling the cost of the projects will lead to success of the project.
- Apply scientific methods will to lead to cost control at construction projects.
- Know the factors effect the level of cost control lead to success cost control of the project.

1.5 Research methodology:

In this study, the research is approaching as an iterative philosophy process where the research has been initiated in light of a prior knowledge as well as experiences form a pre-understanding of the research area. This pre-understanding is 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 parts and then back again.

1.6 Scope and limitation:

This research is directed toward cost control during the project execution phases. The study plans to include several types of Sudanese construction projects across the construction market. including but not limited to:

- Projects categories, according to the type of the projects that it taken by the company; (General building construction, Highway, bridge etc)
- Projects categories according to the level of complexity
- High budget & low budget projects.
- Project located in Khartoum vs. projects outside Khartoum ... This sub division of
- Type and number of equipment used for executing the project, whether this equipment is leased or owned by the company.
- Number of labors and the skill that can be required in the project organization, whether they are in the permanent staff or not.
- Long & short duration project
- The way of awarding the project
- Type of technology / computer applied for the cost management system.

Due to the limited of resources (time & money), this research will be limited to Several aspects as per the following details:

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

.



Chapter (2)

Literature Review

2.1 Introduction

2.1.1 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 business activities embraces change and complexity

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 the project.

2.1.2 Project Management:

Project Management is the 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 qualifiable 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 initiatives of the organization supported. (<http://www.propertyserve.com.cy>)

2.1.3 Project Management Life Cycle:

The process each manager follows during the life of a project is called the Project Management Life Cycle. A proven methodical life cycle is necessary to repeatedly implement and manage projects 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 processes 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 projects.(<http://preciseinfosystems.com>)

2.1.4 cost control:

The term control has several meanings, according to Henri Fayol (1916) ,Control of an undertaking consists of seeing that everything is being carried out in accordance with the plan which has been adopted, the orders which have been given, and the principles which have been laid down. Its object is to point out mistakes in order that they may be rectified and prevented from recurring .

It is linked wrongly with the concept of authority. In the world of projects management, control has very little to do with telling people what to do, dictating their actions or thoughts, or trying to force them to behave in a certain way, all of which are mistakenly common interpretations of control.

In projects management, the term “control” is much more analogous to steering a ship. It is about continually making course adjustments with one main objective in mind—bringing the ship into a safe harbor, as promised at the start of the voyage.

Cost control is one element of the overall process of management of investment in the project or contract. It realizes in a careful planning of the allocation and commitment of resources linked to an appropriate

policy for the procurement of materials. The overall management process must take into account the agreed objective and the commercial requirements of the job.

The successful project voyage includes identifying a specific destination, carefully charting a course to get there, evaluating the location throughout the voyage, and keeping a watchful eye on what lies ahead.

The main aims of the cost control are probably:

a) To give the building client good value for money- a building which is soundly constructed, of satisfactory appearance and well suited to perform the functions for which it is required, combined with economical construction and layout.

b) To keep total expenditure within the amount agreed by the client, frequently based on an approximate estimate of cost prepared by the quantity surveyor in the early stages of the design process. There is a need for strict cost discipline throughout all stages of design and execution to ensure that the initial estimate, tender figure and final account sum

are all closely related. This entails a satisfactory frame of cost reference (estimate and cost plan), ample cost checks and the means of applying remedial action where necessary (cost reconciliation).

c) To achieved a balanced and logical distribution of the available funds between the various parts of the building

2.1.4.1 Definitions:

The following, table states the definitions of terms related to cost control procedures.

Table(2-1): Definition terms used in cost control procedures.

Terms	Definitions
Budget	A plan against actual results that can be measured
Cost	A value for purchaser to pay for goods and service
Cost analysis	Subdivision of costs under different elements of the contract or construction
Costing	Analysis of expenses so it can be allocated to different contracts, processes, or services with the aims of ascertaining cost.
Cost control	The process of controlling the expenses of cost in a project, from the starting of client's idea to the completion and final payment on-site
Standard cost	Costs of standard outputs for plant or labor under particular conditions of environment
Unit costing	Estimating the cost per unit, whether it is a square meter of plaster or a cubic meter of concrete meter of excavation
Baseline	The original approved plan plus or minus the approved scope changes.
Chart of Account	Any numbering system used to monitor project costs by category (e.g., labor, supplies, and materials). The project chart of accounts is usually based upon the corporate chart of accounts of the primary performing organization.

Contingency Planning	The development of a management plan that identifies alternative strategies to be used to ensure project success if specified risk events occur (used in Risk Management)
Control Account Plan (CAP)	A management control point where the integration of scope and budget and schedule takes place, and where the at selected management points of the work breakdown structure, previously referred to as a Cost Account Plan.
S-Curve	<p>A graphic display of cumulative costs, labour hours, percentage of work, or other quantities plotted against time.</p> <p>The name derives from the S-like curve of a project that starts slowly, accelerates, and then tails off. In addition, it is a term for the cumulative likelihood distribution that is a result of simulation. (see Risk Management)</p>
Reserve	The amount of money or time needed above, the estimation to reduce the risk of overruns of project objectives to a level acceptable to the organization
Reserve	It is a provision in the project plan to mitigate cost and/or schedule risk. Often used with a modifier (i.e., management reserve, contingency reserve) to provide further details on what types of risk are meant to be mitigated. The specific definition of the modified term varies by application area.
Working Capital	It is the current assets minus current liabilities.

2.1.4.2 Statement of facts in cost control :

The following, are the definitions Through different people:

According to Nunnally (1998),"cost control of a project involves the measuring and collecting the cost record of a project and the work progress. It also involves the comparison of actual progress with the planning. The main objective of cost control of a project is to gain the maximum profit within the designated period and satisfactory quality of work. A systematic procedure of cost control will give a good result in collecting important cost data in estimating and controlling of the costs of the coming projects in future".

Kwayke (1997)" explain that the cost control can define as a process where construction cost of a project is manage with the best method and systematic in order that the contractor would not suffering the loss when doing the activities of the project and the cost construction of a project would not be over-estimated by the developer".

Mueller (1986) " states that the cost control is the ability to influence the final cost of project positively with modifying negative performance trends".

According to Ritz (1994), "cost control though namely easy, but it gives a different meaning to different people. Some people engage it with engineering costs; some states that it is a cost report, value engineering, cost management etc. Cost control involves all the activities above in different time. All the parties involved in a project have their own responsibilities and roles in reducing and controlling the costs".

Austen and Neale (1984)" states the main purpose in cost controlling for a construction project should be active controlling of final costs for owner, and not just to record and registering the payment".

2.1.5 Cost control among cost management cycle:

Cost control, though namely easy, gives a different meaning to different people.

Some people engage it with engineering costs; others state that it is a cost report, value engineering, cost management...etc. The cost control involves all the activities above in a different time. All parties involved in a project have their own responsibilities and roles in reducing and controlling the costs.

Project cost management Includes processes required to ensure that the project is completed within the approved budget. Figure (2-1) provides an overview of the following four processes:

- **Plan Cost Management:** The process that establishes the policies, procedures, and documentation for planning, managing, expending, and controlling project costs.
- **Cost Estimating:** Developing an approximation (estimates) of the costs of the resources needed to complete project activities. Includes identifying and considering various costing alternatives.
- **Cost Budgeting:** Allocation of overall cost estimates to individual work items in order to establish a cost baseline for measuring project performances.
- **Cost Control :** The process of monitoring the status of the project to update the project costs and managing changes to the cost baseline.

These processes interact with each other and with the processes in the other knowledge areas as well. Each process may involve effort from one or more individuals or groups of individuals based on the needs of the project. Each process generally occurs at least once in every project phase if the project is divided into phases.

Project Cost Management should consider the stakeholder requirements for managing costs. Different stakeholders will measure project costs in different ways and at different times.

Project Cost Management is primarily concerned with the cost of the resources needed to complete project activities. Project Cost Management should also consider the effect of project decisions on the subsequent recurring cost of using, maintaining, and supporting the product, service, or result of the project. (PMBOK® Guide) – Fifth Edition

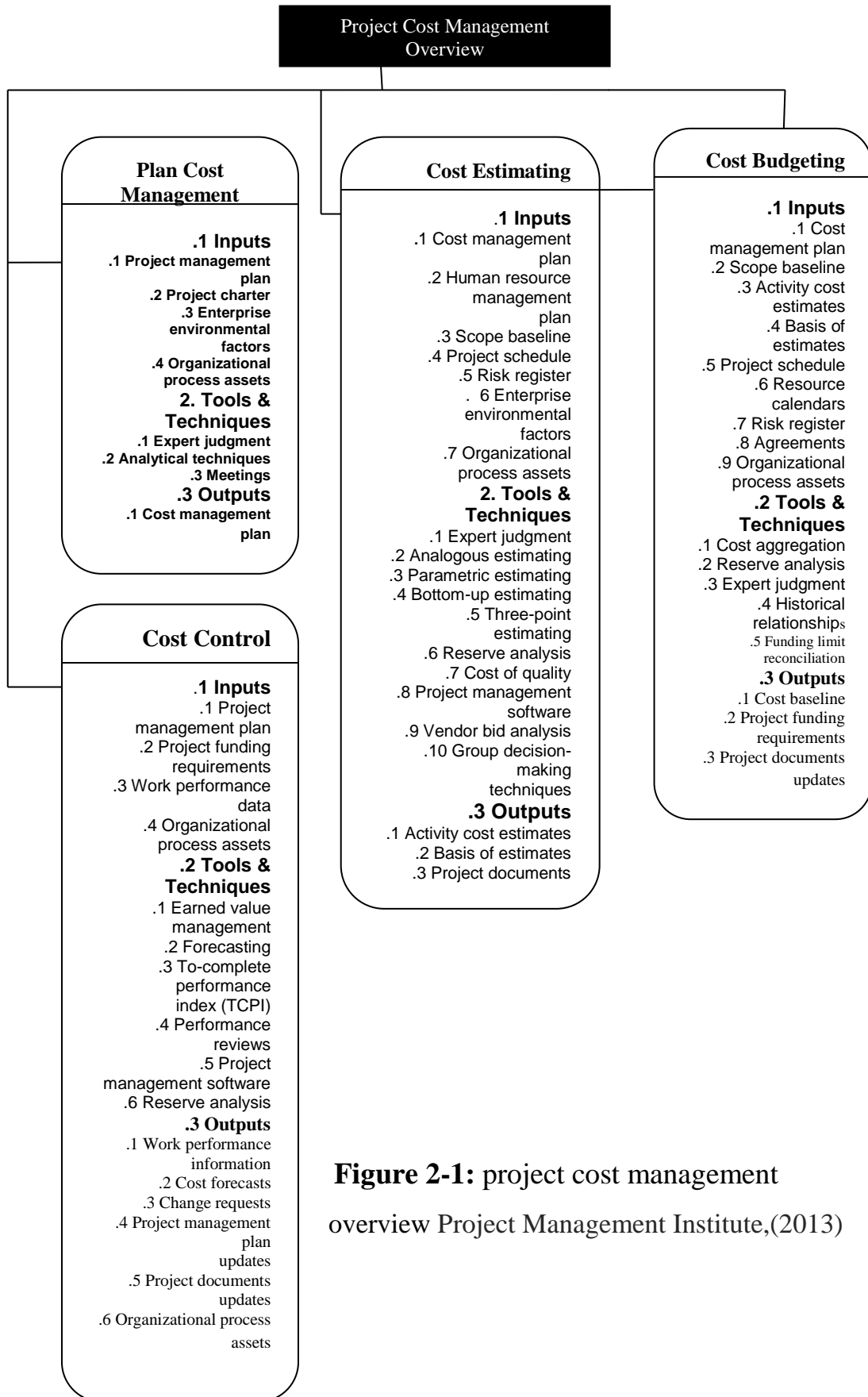


Figure 2-1: project cost management overview Project Management Institute,(2013)

2.2 Components of cost control:

Cost Control is the process of monitoring the status of the project to update the project costs and managing changes to the cost baseline. The key benefit of this process is that it provides the means to recognize variance from the plan in order to take corrective action and minimize risk. The inputs, tools and techniques, and outputs of this process are depicted in Figure 2-2. (PMBOK® Guide) – Fifth Edition

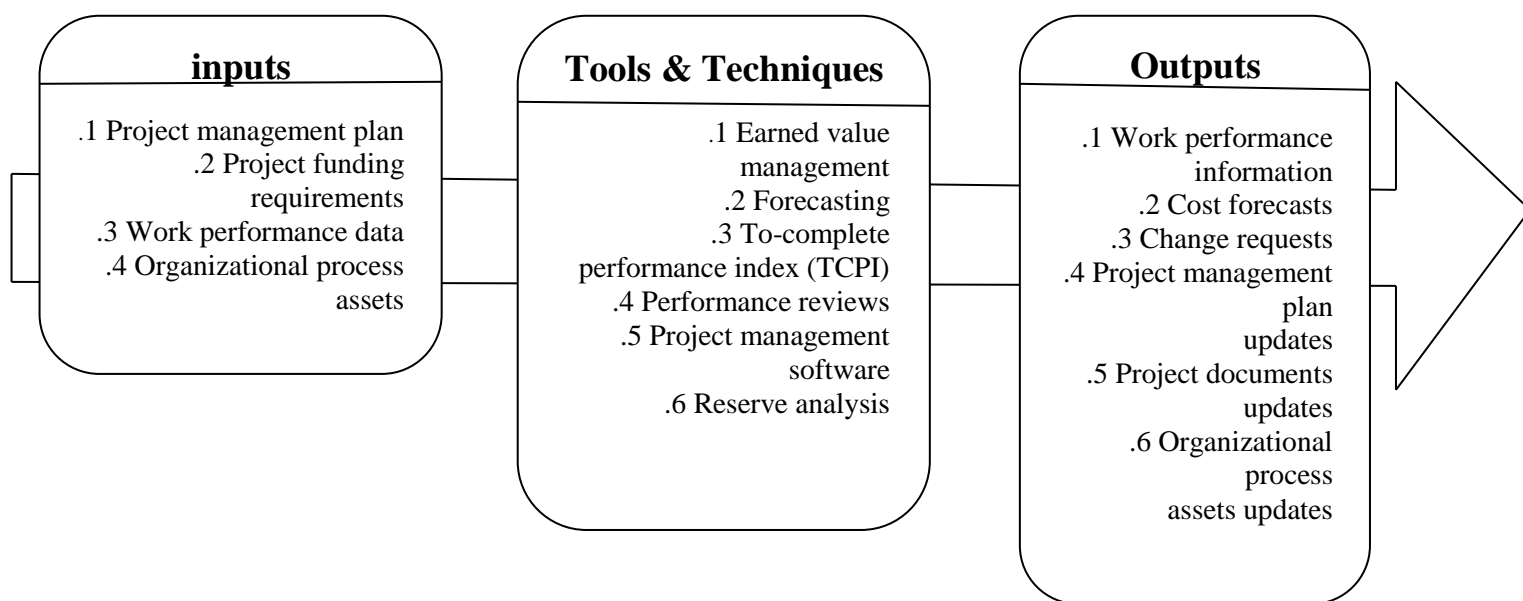


Figure 2-2: Cost Control: Inputs, Tools & Techniques, and Outputs

Project Management Institute,(2013)

2.2.1 cost control: Inputs

In order to have an effective & reliable cost control system, the below inputs should be gathered and analyzed in integration manner. The major input are as follow:

2.2.1.1 Project Management Plan

2.2.1.2 Project Funding Requirements

2.2.1.3 Work performance data

2.2.1.4 Organizational Process Assets

2.2.1.1 Project Management Plan:

the project management plan contains the following information that is used to control cost:

a. Cost baseline:

The cost baseline is compared with actual results to determine if a change, corrective action, or preventive action is necessary. It defined as a process where the construction cost of a project is managed with the best method and systematic in order that the contractor would not suffer the loss when doing the activities of the project and the cost construction of a project would not be over-estimated by the developer.

The cost control baseline should be established a considerations to the following tasks:

- Establish a Cost Management Team and cost reporting processes.
- Prepare a professional project estimate to establish the budget.
- Keep the estimates updated during the project designing stage.
- At critical stages, completely re-issue the project estimate.
- At all times, keep the management informed of the latest figures of budget.
- Prepare tender documents and review the bids against the budget.

b. Cost management plan:

The cost management plan describes how the project costs will be managed

and controlled. It has the following purposes:

- To present the costs and effort estimates of the project;
- To identify factors that will tend to increase the costs or effort; and
- To describe procedures that will be used to deal with increases to the cost and effort.

2.2.1.2 Project Funding Requirements:

The project funding requirements include projected expenditures plus anticipated liabilities. Total funding requirements and periodic funding requirements (e.g., quarterly, annually) are derived from the cost baseline. Funding requirements may include the source(s) of the funding.

2.2.1.3 Work performance data:

Work performance data includes information about project progress, such as which activities have started, their progress, and which deliverables have finished. Information also includes costs that have been authorized and incurred.

Work performance data are the raw observations and measurements identified during activities being performed to carry out the project work. Data are often viewed as the lowest level of detail from which information is derived by other processes. Data is gathered through work execution and passed to the controlling processes of each process area for further analysis.

2.2.1.4 Organizational Process Assets:

The organizational process assets that can influence the Control Costs process include, but are not limited to:

- Existing formal and informal cost control-related policies, procedures, and guidelines;
- Cost control tools; and Monitoring and reporting methods to be used.

2.2.2 Cost Control: Tools and Techniques:

Cost Control Tools and Techniques are as follow:

2.2.2.1 Earned Value Management

2.2.2.2 Forecasting

2.2.2.3 To-Complete Performance Index (TCPI)

2.2.2.4 Performance Reviews

2.2.2.5 Project Management Software

2.2.2.6 Reserve Analysis

2.2.2.1 Earned Value Management:

Earned value management (EVM) is a methodology that combines scope, schedule, and resource measurements to assess project performance and progress. It is a commonly used method of performance measurement for projects.

It integrates the scope baseline with the cost baseline, along with the schedule baseline, to form the performance baseline, which helps the project management team assess and measure project performance and progress. It is a project management technique that requires the formation of an integrated baseline against which performance can be measured for the duration of the project. The principles of EVM can be applied to all projects in any industry. EVM develops and monitors three key dimensions for each work package and control account:

- Planned value (PV): PV is the budgeted cost for the work scheduled to be completed on an activity or WBS component up to a given point in time.
- Earned value (EV): EV is the budgeted amount for the work actually completed on the schedule activity or WBS component during a given time period. Progress measurement criteria should be established for each WBS component to measure work in progress. Project managers monitor EV, both incrementally to determine current status and cumulatively to determine the long-term performance trends.
- Actual cost (AC) : AC is the actual cost incurred in accomplishing work on the schedule activity or WBS component during a given time period. This AC must correspond in definition and coverage to whatever was budgeted for the PV and the EV (e.g. direct hours only, direct cost only, or all costs including indirect costs).
- Variances from the approved baseline will also be monitored:
 1. Cost Variance (CV): CV equals earned value (EV) minus actual cost (AC). The cost variance at the end of the project will be the difference between the budget at the completion (BAC) and the actual amount spent.

Formula: $CV = EV - AC$

2. Schedule Variance (SV): SV equals earned value (EV) minus planned value (PV). Schedule variance will ultimately equal zero when the project is completed because all of the planned values will ultimately equal zero when the project is completed because all of the planned values will have been earned.

Formula: $SV = EV - PV$

These two values, the CV and SV, can be converted to efficiency indicators to reflect the cost and schedule performance of any project.

- **Schedule Performance Index (SPI) :** The schedule performance index (SPI) is a measure of schedule efficiency expressed as the ratio of earned value to planned value. It measures how efficiently the project team is using its time. It is sometimes used in conjunction with the cost performance index (CPI) to forecast the final project completion estimates. An SPI value less than 1.0 indicates less work was completed than was planned. An SPI greater than 1.0 indicates that more work was completed than was planned. Since the SPI measures all project work, the performance on the critical path also needs to be analyzed to determine whether the project will finish ahead of or behind its planned finish date.

Formula: $SPI = EV/PV$

- **Cost performance index (CPI):** A CPI value less than 1.0 indicate accost overrun of the estimates. A CPI value greater than 1 indicates a cost under-run of the estimates. CPI equals the ratio of the EV to the AC. The CPI is the most commonly used cost-efficiency indicator.

Formula: $CPI = EV/AC$

- **Cumulative CPI (CPIC):** the sum of periodic earned values (EVC) divided by the sum of the individual actual costs (ACC)"

Formula: $CPIC = EVC/ACC$.

The three parameters of planned value, earned value, and actual cost can be monitored and reported on both a period-by-period basis (typically weekly or monthly) and on a cumulative basis.

2.2.2.2 Forecasting:

As the project progresses, the project team may develop a forecast for the estimate at completion (EAC) that may differ from the budget at completion (BAC) based on the project performance. If it becomes

obvious that the BAC is no longer viable, the project manager should consider the forecasted EAC. Forecasting the EAC involves making projections of conditions and events in the project's future based on current performance information and other knowledge available at the time of the forecast. Forecasts are generated, updated, and reissued based on work performance data. The work performance information covers the project's past performance and any information that could impact the project in the future.

EACs are typically based on the actual costs incurred for work completed, plus an estimate to complete (ETC) the remaining work. It is incumbent on the project team to predict what it may encounter to perform the ETC, based on its experience to date. The EVM method works well in conjunction with manual forecasts of the costs. The most common EAC forecasting approach is a manual, bottom-up summation by the project manager required EAC and project team.

The project manager's bottom-up EAC method builds upon the actual costs and experience incurred for the work completed, and requires a new estimate to complete the remaining project work. Equation: $EAC = AC + \text{Bottom-up ETC}$.

The project manager's manual EAC is quickly compared with a range of calculated EACs representing various risk scenarios. When calculating EAC values, the cumulative CPI and SPI values are typically used. While EVM data quickly provide many statistical EACs, only three of the more common methods are described as follows:

EAC forecast for ETC work performed at the budgeted rate:

This EAC method accepts the actual project performance to date (whether favorable or unfavorable) as represented by the actual costs, and predicts that all future ETC work will be accomplished at the budgeted rate. When actual performance is unfavorable, the assumption that future

performance will improve should be accepted only when supported by project risk analysis. Equation:

$$EAC = AC + (BAC - EV)$$

- EAC forecast for ETC work performed at the present CPI:

This method assumes what the project has experienced to date can be expected to continue in the future. The ETC work is assumed to be performed at the same cumulative cost performance index (CPI) as that incurred by the project to date.

Equation: $EAC = BAC / CPI$

- EAC forecast for ETC work considering both SPI and CPI factors:

In this forecast, the ETC work will be performed at an efficiency rate that considers both the cost and schedule performance indices. This method is most useful when the project schedule is a factor impacting the ETC effort. Variations of this method weight the CPI and SPI at different values (e.g., 80/20, 50/50, or some other ratio) according to the project manager's judgment. Equation: $EAC = AC + [(BAC - EV) / (CPI \times SPI)]$

Each of these approaches is applicable for any given project and will provide the project management team with an “early warning” signal if the EAC forecasts are not within acceptable tolerances.

2.2.2.3 To-Complete Performance Index (TCPI):

The to-complete performance index (TCPI) is a measure of the cost performance that is required to be achieved with the remaining resources in order to meet a specified management goal, expressed as the ratio of the cost to finish the outstanding work to the remaining budget. TCPI is the calculated cost performance index that is achieved on the remaining work to meet a specified management goal, such as the BAC or the EAC.

If it becomes obvious that the BAC is no longer viable, the project manager should consider the forecasted EAC.

Once approved, the EAC may replace the BAC in the TCPI calculation. The equation for the TCPI based on the BAC: $(BAC - EV) / (BAC - AC)$.

2.2.2.4 Performance Reviews:

Performance reviews compare cost performance over time, schedule activities or work packages overrunning and under running the budget, and estimated funds needed to complete work in progress. If EVM is being used, the following information is determined:

➤ **Variance analysis:**

Variance analysis, as used in EVM, is the explanation (cause, impact, and corrective actions) for cost ($CV = EV - AC$), schedule ($SV = EV - PV$), and variance at completion ($VAC = BAC - EAC$) variances. Cost and schedule variances are the most frequently analyzed measurements. For projects not using earned value management, similar variance analyses can be performed by comparing planned activity cost against actual activity cost to identify variances between the cost baseline and actual project performance. Further analysis can be performed to determine the cause and degree of variance relative to the schedule baseline and any corrective or preventative actions needed.

➤ **Trend analysis:**

Trend analysis examines project performance over time to determine if performance is improving or deteriorating. Graphical analysis techniques are valuable for understanding performance to date and for comparison to future performance goals in the form of BAC versus EAC and completion dates.

➤ **Earned value performance:**

Earned value performance compares the performance measurement baseline to actual schedule and cost performance. If EVM is not being

used, then the analysis of the cost baseline against actual costs for the work performed is used for cost performance comparisons.

Table (2- 2) : Terms about Earned Value:

Acronym	Term	Interpretation (as of
PV	Planned value	today...,) of the work planned to be Done
EV	Earned value	What is the estimated value of the work actually Accomplished
AC	Actual cost	What is the actual cost incurred for the work Accomplished
BAC	Budget at Completion	How much do we budget for the total project to cost
EAC	Estimate at Completion	what do we currently expect the total project to cos
ETC	Estimate to Complete	From this point on, how much more do we expect it to cost to finish the project
VAC	Variance at Completion	How much over, or under budget do we expect to be at the end of the project

Table 2- 3: Formulas and interpretations to know:

Name	Formula	Interpretation(as of today)
Cost variance (CV)	$EV - AC$	Negative is over budgeting, positive in under budgeting
Schedule variance (SV)	$EV - PV$	Negative is behind schedule, positive is ahead of schedule
Cost performance index	EV/AC	We are getting worth of

(CPI)		work out of every \$1 spent. Funds are, or are not, being used efficiently
Schedule performance index (SPI)	EV/PV	We are (only) progressing at percent of the rate originally Planned
Estimate at completion (EAC) Note : there are many ways to calculate EAC depending on the assumptions made	BAC/CPI AC + ETC	Now, how much do we expect the total project cost? (See formulas on the left). * Used if no variances from the BAC have occurred or you will continue at the same rate of spending. Actual plus a new estimate for remaining work is used when original estimate is fundamentally flawed
	AC + (BAC – EV)	Actual to date plus remaining budget used when current variances are thought to be typical of the future AC plus the remaining value of work to Perform

	AC + (BAC – EV) CPI	Actual to date plus remaining budget modified by performance used when current variances are thought to be typical of the future
Estimate to complete (ETC)	EAC – AC	How much more will the project cost
Variance at completion (VAC)	BAC-EAC	How much over, or under budget will we be at the end of the project

2.2.2.5 Project Management Software:

Project management software is often used to monitor the three EVM dimensions (PV, EV, and AC), to display graphical trends, and to forecast a range of possible final project results.

2.2.2.6 Reserve Analysis:

During cost control, reserve analysis is used to monitor the status of contingency and management reserves for the project to determine if these reserves are still needed or if additional reserves need to be requested. As work on the project progresses, these reserves may be used as planned to cover the cost of risk mitigation events or other contingencies. Or, if the probable risk events do not occur, the unused contingency reserves may be removed from the project budget to free up resources for other projects or operations. Additional risk analysis during the project may reveal a need to request that additional reserves be added to the project budget.

2.2.3 cost control: outputs

cost control outputs are as follow:

2..2.3.1 Work Performance Information

2.2.3.2 Cost Forecasts

2.2.3.3 Change Requests

2.2.3.4 Project Documents Updates

2. 2.3.5 Project Management Plan Updates

2.2.3.6 Organizational Process Assets Updates

2.2.3.1 Work Performance Information:

The calculated CV, SV, CPI, SPI, TCPI, and VAC values for WBS components, in particular the work packages and control accounts, are documented and communicated to stakeholders.

2.2.3.2 Cost Forecasts:

Either a calculated EAC value or a bottom-up EAC value is documented and communicated to stakeholders.

2.2.3.3 Change Requests:

Analysis of project performance may result in a change request to the cost baseline or other components of the project management plan.

2.2.3.4 Project Documents Updates:

Project documents that may be updated include, but are not limited to:

- Cost estimates
- Basis of estimates.

2.2.3.5 Project Management Plan Updates:

Elements of the project management plan that may be updated include, but are not limited to:

➤ Cost baseline:

Changes to the cost baseline are incorporated in response to approved changes in scope, activity resources, or cost estimates. In some cases, cost variances can be so severe that a revised cost baseline is needed to provide a realistic basis for performance measurement.

➤ Cost management plan:

Changes to the cost management plan, such as changes to control thresholds or specified levels of accuracy required in managing the project's cost, are incorporated in response to feedback from relevant stakeholders.

2.2.3.6 Organizational Process Assets Updates:

Organizational process assets that may be updated include, but are not limited to:

- Causes of variances,
- Corrective action chosen and the reasons,

- Financial databases
- Other types of lessons learned from project cost control

2.3 The use of cost control:

Amount of detail and the time interval between cost control reports must be considered, which is different according to the level of management for which they prepared. For a site manager, it is necessary to receive the cost report on weekly basis.

After preparing the reports based on the cost data collected, it is important to project the costs into future and to estimate or re-estimate the cost of the work yet to be completed. Any new information must take into account since the commencement of the contract.

Thus, a suitable reporting system is important part of a cost control system. The estimator would become more reluctant in the future to use cost data that have been fed back from the site if an adequate reporting system is used. In addition, the estimator can save some time to determine sufficient detail about the data and conditions they acquired.

Upper levels of management will usually paid attention to the contracts that show minimum or negative profitability. It is because they will have to investigate the costs in more detail to locate the particular operations through inefficiency or under pricing, are the cause of the problem. Nunnally, S.W. (1998). “ *Construction Methods and Managements*”,

2.3.1 Unit costs:

Unit cost is a noteworthy way of using cost information. The unit cost for any item or operation is the direct cost for one unit of measurement for that item. In this way, it is important to make sure that the actual work carried out directly and the quantity is measured accurately.

It is important that the supervisory staff do not allocate the hours when their operatives are not properly and efficiently employed on productive work. It may result in unavoidable poor unit cost for that work if it is allocated.

Another problem is that to identify whether unit costs should be stored in term of money or man-hours. If in terms of money, it is always a risky and approximate business. In terms of man-hours will be remain constant with the same conditions over the years. For the managers involved in controlling the costs money has more impact than man-hours in measuring the efficiency of an operation in progress when the data are collected.

2.3.2 Reporting systems:

One of the most important registers to be maintained is the commitment register.

For equipment and materials, the sources of actual commitments are requisitions, purchase orders and letters of intent. One of the most preferable methods in this respect is to report the grossing commitments and these entails adding to the face value of document any packing and shipping charges, provision for escalation - if appropriate – as well as allowance for possible design changes.

2.3.2.1 Reporting method for actual work-done:

Each of the (reporting) methods requires current information on the state of work accomplishment for particular activities. There are several possible methods to develop such a method, including:

➤ Units of Work Completed:

For easily measured quantities the actual proportion of completed work amounts can be measured. For example, the linear feet of piping installed, can be compared to the required amount of piping in order to estimate the percentage of the completed piping work.

➤ Incremental Milestones:

Particular activities can be sub-divided or 'decomposed' into a series of milestones, and the milestones can be used to indicate the percentage of work completed based on historical averages.

➤ Opinion:

Inspectors, supervisors or project managers themselves can prepare subjective judgments of the percentage completed. Clearly, this estimated technique can be based by optimism, pessimism or inaccurate observations. Knowledgeable estimators and adequate field observations are required to obtain sufficient accuracy with this method.

➤ Cost Ratio:

The cost incurred to date can also be used to estimate the work progress.

2.3.2.2 Method of collecting data:

➤ Forms and Templates:

One of the most straightforward and reliable methods, it is simply to provide the team members with fill-in-blank forms and templates. The form should be designed with consideration to the following:

- make the expectations clear regarding the way of information that should be presented.
- mentioned above, provide forms and templates that the team members could easily understand and fill.

➤ MBWA:

Management By Walking Around, (MBWA) may seem a cliché, but for an effective project leadership it is absolutely vital.

➤ Team Meetings:

Project analysis consists of elements of the past, the present, and the future. The main conduit of current information is ordinarily the project team status meetings.

Project team meetings should be conducted regularly throughout the life of the project. Past information consists of recording actual results of the completed activities. This is the first order of business.

The second order of business and the main focus of most team meetings are a through review and analysis of the condition of each activity currently under way. Finally, it should always have an eye on the future by asking for information on the predicted outcome of each activity

2.4 Control of Materials and Mechanical Plants :

2.4.1 Control of materials :

Controls of materials are not highly considered in creating cost control systems. This is because that labor and plant are the areas that more variations exist, and most probably profit acquire or losses over the original estimated costs. Controls for materials should be in terms of unit measurement and not in terms of cost.

In cases of deficit, one cannot not be sure, if that the cost is basis, whether the materials bought at prices lower than estimate have a high wastage, or whether materials are used economically, with little wastage but bought in prices over the estimate. The cost comparison alone made for materials would only indicate no true quantity of the rate of usage for the materials.

One easy way in controlling materials is to draw a graph of the quantities of various materials that should have been used, which is calculated from present measurement of the quantities of work carried out. A graph like this would be drawn for major items only. Against this

graph for each individual material can draw a second graph, indicates the quantities of materials that have been delivered to the site.

2.4.2 Standard Cost and Variance:

To provide useful analyses of cost data that has collected, there must be a 'standard' available. Estimating possible outcome from historic performance and experience usually sets standards in construction, or in special cases from the use of work measurement techniques.

From estimated costs the initial budget can be ascertain and the variances between actual and estimated is calculated. The variance is negative or unfavorable if the actual cost is greater than the standard and in reverse situation the variance is favorable.

➤ Variance can occur in two reasons:

- a) the actual price paid for resources is greater or less than estimated in the standard.
- b) the actual quantity of resource used is greater or less than estimated in the standard.

➤ Then the variance can be calculated as follows:

Actual cost (AC) = actual quantity (AQ) x actual price (AP)

Standard cost (SC) = standard quantity (SQ) x standard price (SP)

Total cost variance = standard cost (SC)- actual cost (AC)
= (SQ x SP) - (AQ x AP)

Variance analysis will first of all be applied to the purchase and use of materials.

There will usually be either a material price variance or materials usage variance.

Material price variance = AQ (SP-AP)

Material usage variance = SP (SQ-AQ)

Material cost variance = SC-AC = (SQ x SP)-(AQ x AP)

Q= Quantity S= Standard A= Actual C= cost P=price

2.4.3 Labor Variances :

There are two variances in labor costs. There are 'labor rate' and 'labor efficiency' variances. The labor rate variance occurs from the difference between the standard wage rate and the actual wage rate paid.

$$\begin{aligned}\text{Labor rate variance} &= \text{actual time worked (standard-actual rate)} \\ &= AH(SR-AR)\end{aligned}$$

The labor efficiency variance occurs from the difference between the actual time and the standard time to do a job, which is measured at the standard rate.

$$\begin{aligned}\text{Efficiency variance} &= \text{standard rate (standard time – actual time)} \\ &= SR(SH-AH)\end{aligned}$$

Therefore,

$$\begin{aligned}\text{Labor cost variance} &= \text{standard cost- actual cost} \\ &= SC-AC \\ &= \text{labor rate variance} + \text{labor efficiency variance} \\ &= AH(SR-AR) + SR(SH-AH) \\ &= (\text{standard hours} \times \text{standard rate}) - (\text{actual hours} \times \text{actual rate})\end{aligned}$$

2.4.4 Overhead Variances:

The overhead cost variance is a variance that is acquired from calculating the difference between the actual overhead costs acquired on an operation and standard overhead cost set for that operation related to the production funds to be accomplished.

There are fixed and variable costs need to be recognized when starting the overheads. Fixed costs do not alter with changing levels of production, but they might alter after a certain level of production has been achieved, for example the overhead of the site supervision.

However, if the levels of production have reached or the numbers of operatives exceed a maximum level, then the second foremen are needed.

An overhead budget variance is the difference between the actual cost of overhead incurred and the overhead cost budgeted for that level of production. An overhead efficiency variance is the difference between the hours actually worked to achieve a specific production target and the standard hours budgeted to be used to achieve that production target.

2.4.5 Control of Mechanical Plant Costs:

The total costs of the owning and operating mechanical equipment must be recovered from the valuation of the work carried out and if the plant is unoccupied, allowance must be made. To achieve all these, obtaining a comprehensive hire rate per unit of time is necessary, applied whether the plant is used internally or externally for the owning company. The factors influence the cost of owning and operating a mechanical plant in the construction activity are:

- a) Cost of capital
- b) Tax allowances
- c) The use of the equipment and obsolescence
- d) Residual or resale value or scrap value
- e) Capital cost
- f) Fuel
- g) Erection and dismantling, where it can be used
- h) Operator's wages
- i) Transport to and from site of work
- j) Insurance and license where payable
- k) Site maintenance and overhead costs
- l) Grease and oil for lubrication and other consumables

- m) Return on capital that is wanted
- n) Depot repair, overhaul costs and overheads.
- The advantage of owning the plant:
 - a) Plant can be transferred from one site to another without great difficulty.
 - b) Plant is readily available at all times.
 - c) In emergency situations, machines can be taken off less important work as the contractor has a complete control of the plant.
 - d) Plant may be retained on a particular site if necessary.
- The factors needed to be considered when deciding of buying or hiring plant:
 - a) sufficiency of capital available for purchase
 - b) accessibility of personnel for controlling and operating plant holdings
 - c) forecasts of commitments to assess plant requirements
 - d) cost of transporting plant to sites
 - e) availability of workshop facilities for servicing plant; and
 - f) length of time for which plant will be required; if it is only required for a short period of time with little prospect of use in the foreseeable future then it is better to hire than purchase
- The principal methods of charging for plant:
 - a) Hire charge is the most usual whereby the plant is charged to the site by the unit of time employed. The primary advantages are ease of control over economic use of plant, adequate information accessible for estimating purposes and for providing a check on plant operations.
 - b) Percentage of the contract price, whereby total plant costs are allocated to each contract in proportion to the overall cost of the

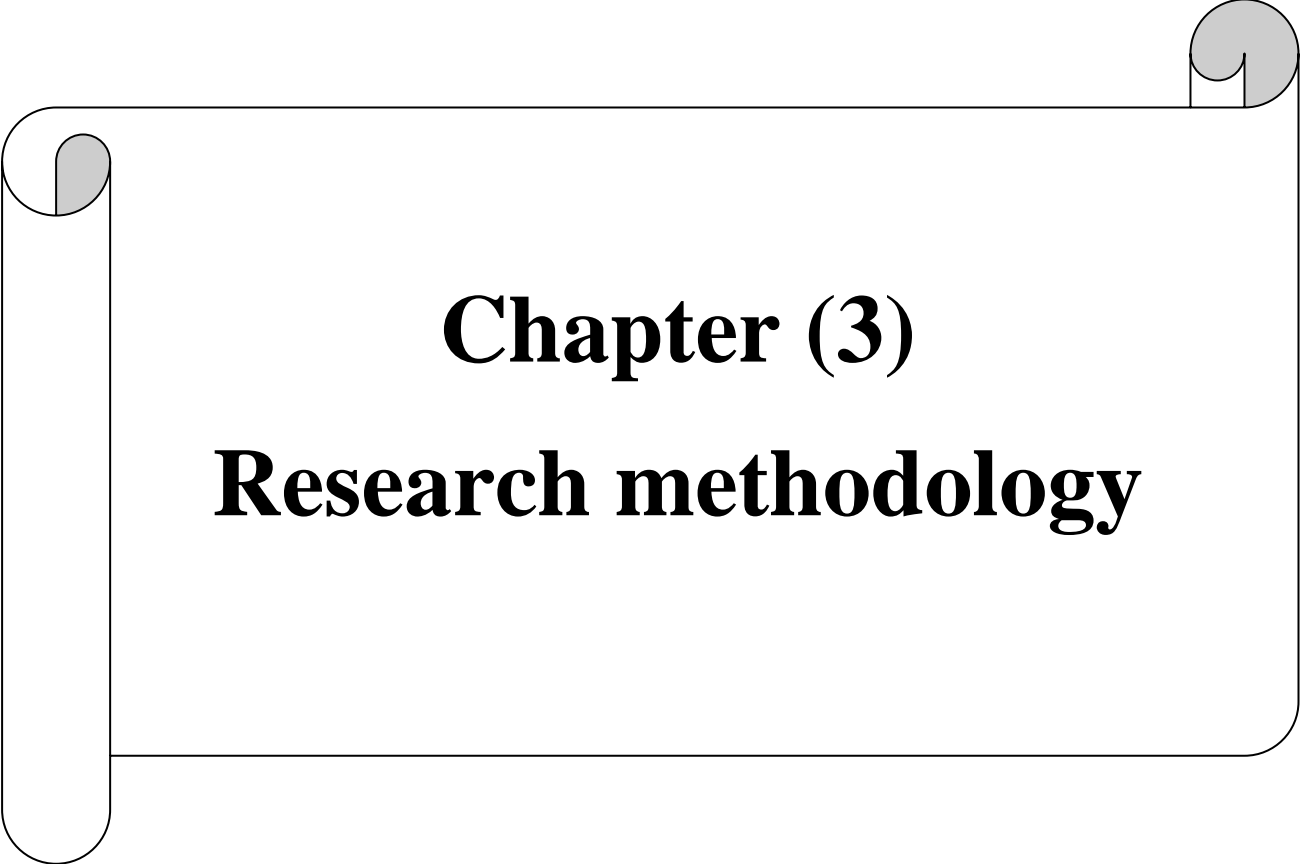
job. It is simple in calculation but it is lack of comparative information for preparing tenders

- c) and costing, lack of incentive to obtain maximum use of plant and lack of information to use as a check on plant operations as a whole.
- d) Direct cost to contract, where the size and nature of the job and expected use of the plant justifies charging an item of plant completely to the job. This method is also easy to apply but runs into difficulties if the plant is used on other contracts.

2.4.6 Other Factors Influencing Costs:

A contractor can influence the cost of a job by his selection of constructional methods and by adjusting these methods to increase the efficiency of the resources used. The free choice of method is however inhibited by the design of the building, the accessibility of the numbers and types of resources needed for each method and by the comparative cost of employing each one of these sets of resources.

Quantity of materials wasted on building sites is also another important cost aspect. Cost of wastage is generally in excess of the allowances made by estimators and the total wastage could reduce to half by effective supervision (Abbott, 1970).

A decorative graphic of a scroll with a light gray background and a black outline. The scroll is partially unrolled, with the top and bottom edges curled up. The text is centered on the unrolled portion.

Chapter (3)

Research methodology

3.1 Introduction:

The previous chapter has set out the research domain and described the research questions and hypothesis. 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.

A theory presents a systemic view of phenomena by specifying relations among variables, with the purpose of explaining or predicting, where research methodology represents the logic of development of the research process used to generate theory; Therefore, it refers to the procedural framework within which the research is conducted.

3.2 Narrative of the data acquired:

In this study, the research is approaching as an iterative philosophy process where the research has been initiated in light of a prior knowledge as well as experiences form a pre-understanding of the research area. This pre-understanding is 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 parts and then back again.

At this stage, the purpose of this study is to identifying:

- what main problem faced by Sudanese contractors in controlling cost of projects?
- What methods do Sudanese contractors follow to control the projects cost? Why these methods are followed in particular?
- what factors that can affect the level of cost control and How can it be ranking?

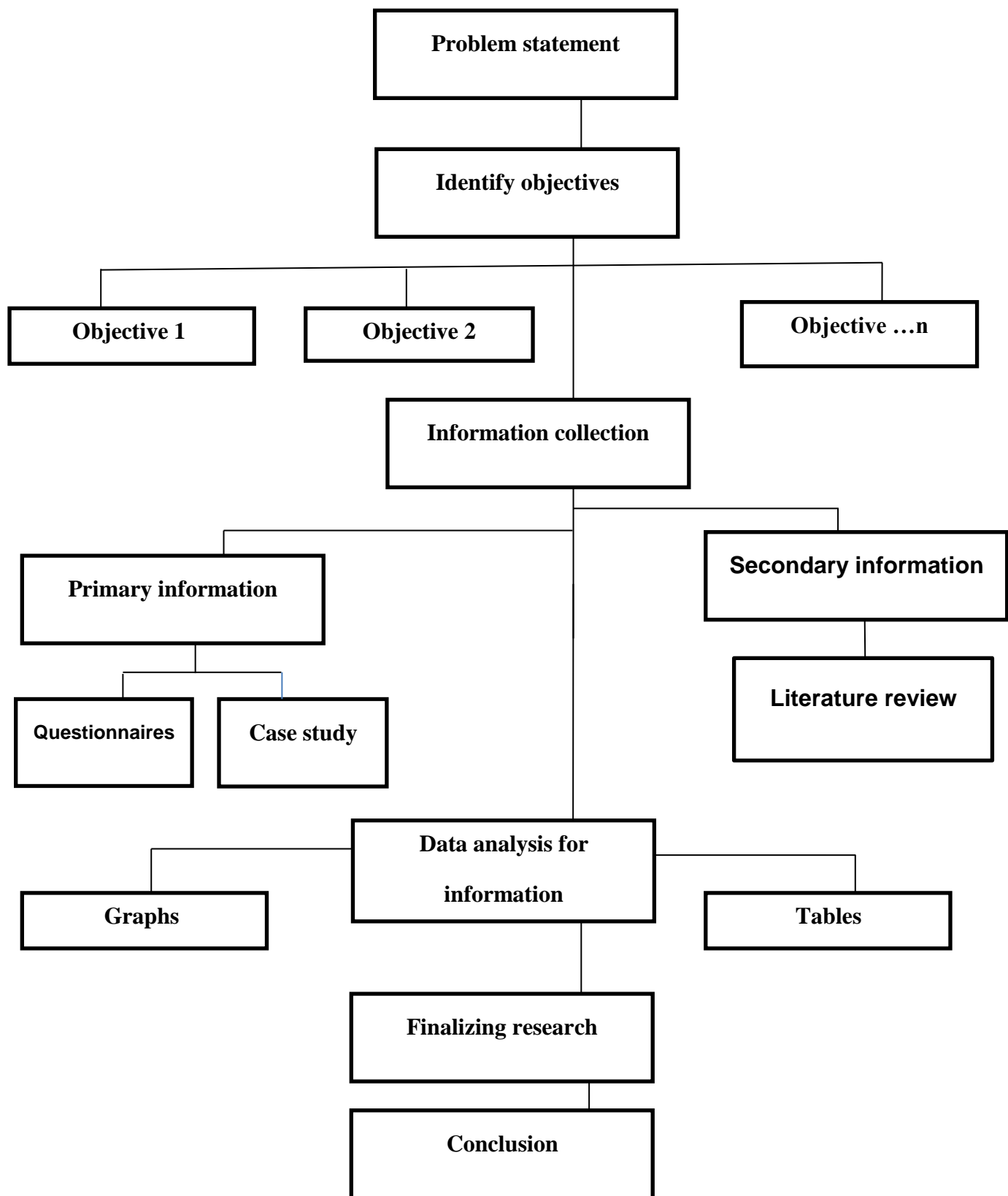


Figure 3- 1:Research methodology flow-char

3.2.1 Literature review and synthesis (secondary information):

The preliminary stages of the research project involve the review of the literature pertinent to the topic under analysis. Literature is reviewed at the outset and throughout the work, during the systematic development of conceptual analysis. The literature review provides a description and critical analysis of the current state of knowledge in the subject area. A broad review of primary and secondary twenty-nine sources of data was carried out in this research. The aim was to:

- To provide with the opportunity to discover what was already known about the cost control.
- It has allowed building on previous experiences of both academics and practitioners as well as to give a standardizations base to compare the collected primary information (interview session) with.
- The research conducted an extensive literature study. The key objectives of this literature survey were to acquire deep understanding and immense knowledge regarding the cost control aspects. The Literature survey encircled the abilities and qualities conventionally perceived, which an efficient contractor is expected to prevail integrally.

The necessary information in this research was collected from the following areas:

- 1- International research, books and journals associated with Construction Engineering & Management.
- 2- International transactions and conference proceedings.
- 3- Previous researches in this field, masters and PhD dissertations.

4- Publications and research reports prepared by various organizations like Government Ministries, Chamber of Commerce, and Sudanese contractors association.

5- From numerous sources on Internet.

3.2.2 Primary information:

This is one of the most important phases of the research methodology, as it incorporated a detailed corroboration of the developed potential model based on the expert opinions from selected and different group of Construction Company in Sudan, and two cases studies.

Experts' opinion included Questionnaires from (thirty) prominent industry Experts were approached based on their personnel expediency. Perfect slices of the responses were obtained through delivering the questionnaire and collecting back the same, personally, E-mail and Fax.

Cases studies included two different projects in the cost and specifications.

➤ Questionnaire:

A questionnaire survey was carried out to gather information from technical professionals who are involved in the construction industry. It is to get the opinion and understanding from the experienced respondents regarding the cost control.

The questionnaire is categorized into four sections as shown below:

1- The first section is related to the respondent's organizations, their size and fields of activities.

2- The second section explores the actual construction cost control practice. Each question of this section is divided into two parts:

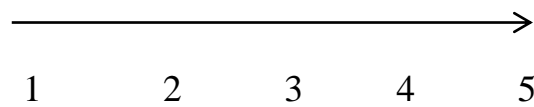
The first part involves multiple-choice questions, where each question reflects one tool of the cost control practice.

The second for evaluating the effectiveness of the tools in conducting the project cost control, which analyzed based on the

statistical criteria, which will be illustrated in the next chapter. In this part a scale from 1 to 5 has been used where:

1= not effective and 5 = very effective.

Ordinal scale 1 to 5 in decreasing order



Decreasing degree of effectiveness

3- The third section explores the importance of the 29 potential factors on the level exerted for cost control, this level has been identified through three parameters:

- a) Frequency of reporting,
- b) Work breakdown structure,
- c) Organization breakdown structure.

4- The fourth section includes a key question about the interviewee's opinion in respect of knowledge of cost control. In addition, the section includes an open-ended question about weakness / mistake or any additional comment. The (weakness / mistake) comment, which is stated by the interviewees, was used for re-generating process for the structure of the questionnaire.

➤ Case studies:

Has been chosen two different projects in the cost and specifications, to know the reasons for the increase in financial cost of these projects and Was obtained the estimated cost of the basic contracts for these projects, also the cost of completion Final payment.

Then I make comparison between what has been agreed upon in the basic contract and what has been implemented in the site Based on the analysis and the study of each project (case study) separately.

Method and research methodology for these case studies:

- Interview consultant and the contractor, and obtain a copy of the basic contract, final payments, maps, and preliminary information about the background to the project.
- Monitor works in the bills of quantities and final payments tables (Separately),then statistical review (re-calculation).
- Analysis between the basic contract and final payments.
- Summarize the reasons and factors of high construction cost for each case, With determining the percentages of each factor.

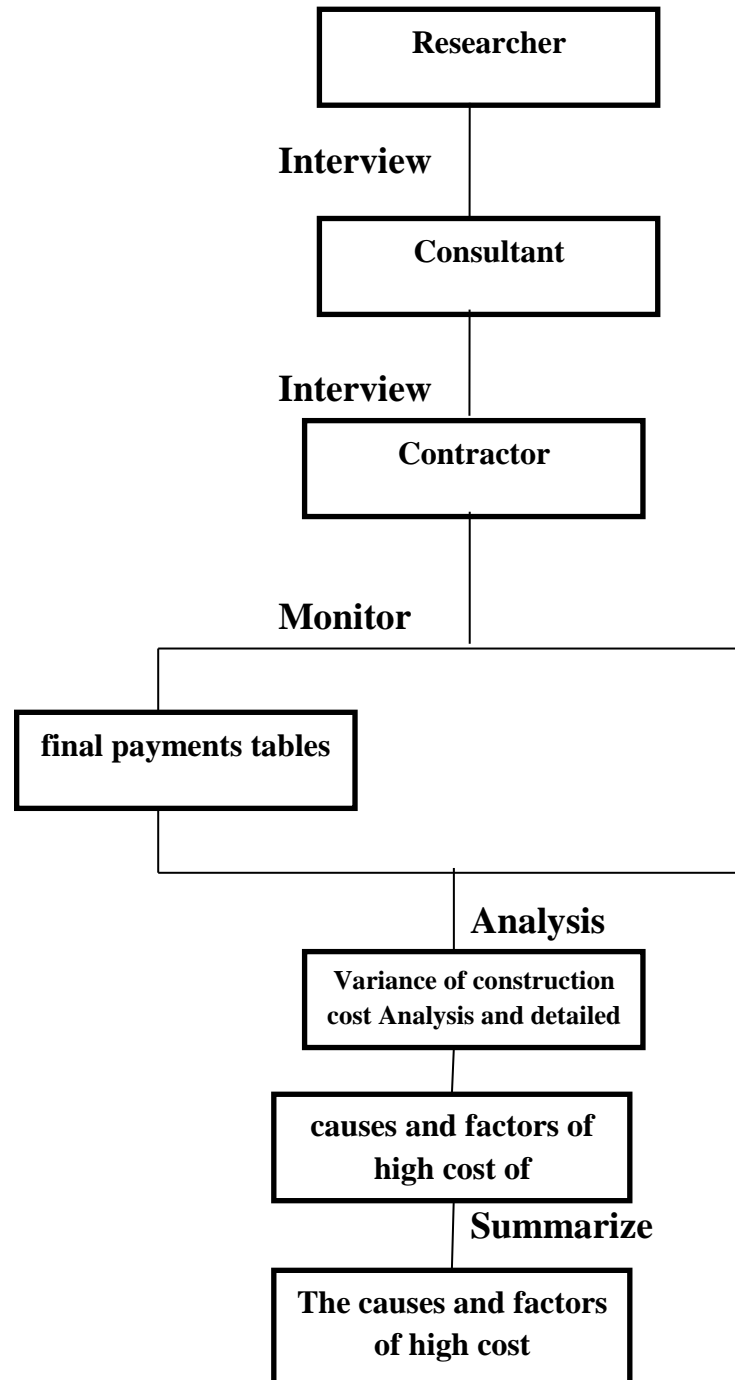


Figure 3- 2:case study methodology flow-char

A decorative border resembling a scroll, with a vertical strip on the left and rounded corners on the right, all in a light gray color.

Chapter (4)

Result And Data Analysis

4. 1 Introduction:

This chapter reports the analysis of the research. The major topic in this chapter includes the cost control method carried by the contractor and the factors that affect the exerted level of cost control, stage and identify by the contractor in controlling the costs. This analysis will focus on contractor party during construction phase and can be related to other parties –consultant, client- of construction industry to some extend.

4.1.1 Cases studies:

Two different projects in cost and specifications were chosen , to know the reasons behind the increase in financial cost of these projects.

➤ case study No (1) :

Olympic swimming pool with an area of 2500 m², which is owned by management of sports and cultural activities, Ministry of Interior.

Originated 2001, was contracted with Royal Engineering and Contracting in 2002 as a contractor for the construction of this project, the estimated cost which (178,939,13) SDG.

➤ case study No (2):

Quraysha Dam located in Gedaref state , in the context of water harvesting projects implemented by the Dams Implementation Unit. A capacity of 2 million m³ of water.

4.1.1.1 Analysis of the cases:

Was viewing basic contract and final payments for each case, And has been studied and analyzed as will explain below, taking into account the different circumstances and problems that led to the high cost of these projects, are as follow:

➤ case study No (1) :

Swimming pool in police club , in the area of Khartoum North, to practice the sport of swimming.

The size of the project: The project contains terraces basin dimensions of 76.17×45.5 m², and addition to the accessories (such as bathrooms).

Table(4-1): provides the increasing basic quantities executed at the site:

specification	contract (SDG)	Actual executed (SDG)	Cost difference (-/+)	The percentage of rise-cost
Excavation and backfill	9,795,000	30,272,969	20,477,969	77.1%

Table(4-2): provides a summary of the terms of additional works

Item	specification	Total(SDG)
1	breakage and removal works	296,400
2	Concrete works	27,499,290
3	Building works	3,745,800
4	Isolators works	1,081,750
Total Cost difference		32,623,240

Details Appendix Table 4-2:

Accordingly, the:

total of additional Works	32,623,240
----------------------------------	-------------------

1. The cost of the project :

The total estimated cost of the project (178,939,130 SDG) without (VAT) while the actual cost of completion (232,040,339 SDG), where the cost difference (53101209 SDG), and can illustrate the factors that increase the cost as follows:

- Increase the size of the project as a result of adding substantial amendments.
- error in calculations when preparing the final payments.
- re-pricing of some items
- variation in quantities executed from estimated cost (text) result of adjustments made to the project.

And we can through analysis of Works completed (actually) at the site to explain the following:

Table (4-3) : provide Cost estimated and The value of rise cost of construction for first case study:

Item	specification	Total(SDG)	Percentage
1	Cost estimated	178,939,130	%77.1
2	The value of rise cost of construction	5,3101,209	22.9%
total actual cost		232,040,339	100%

Where:

Item	specification	Total(SDG)	Percentage
1	Additional works	32,623,240	14.1%
2	Difference basic quantities on-site	20,272,969	%8.8
total rise of cost construction		53,101,209	%22.9(+)

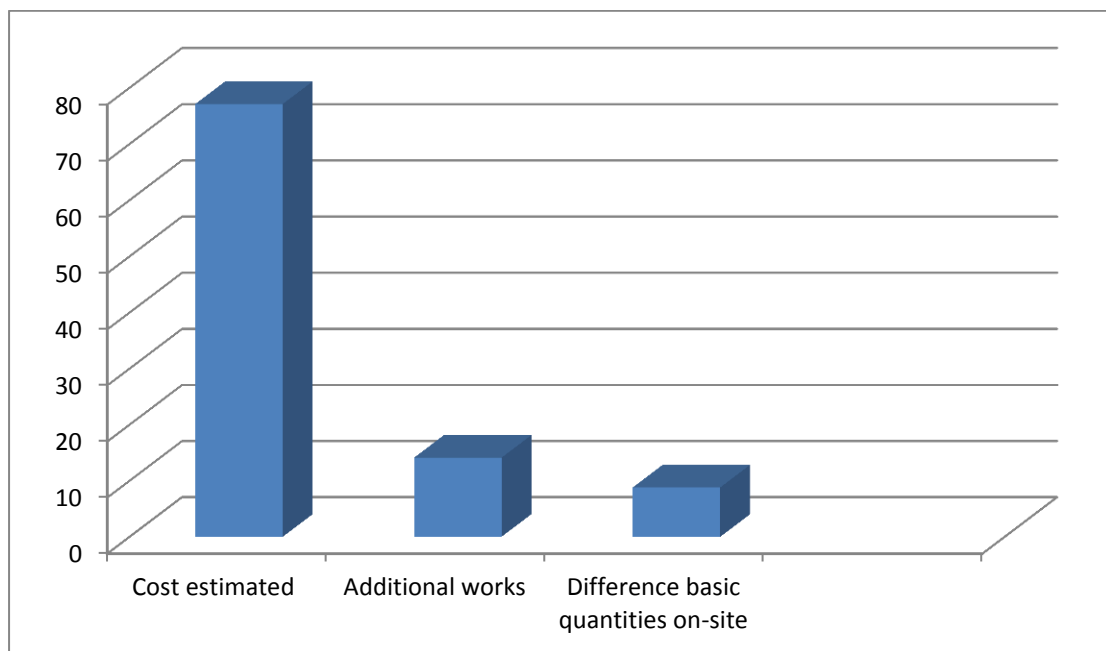


Figure 4-1: contribution of all items to the total cost of construction for project

➤ case study No (2) :

Quraysha Dam located in Quraysha Local, to Secure supply of clean water for the the population in Quraysha Local (25,000 people) and the neighboring villages and about a million head of cattle, which is estimated annually at about 860,000 m³ until 2033.

Table (4-4): provides the increasing basic quantities executed at the site:

item	Description	unit	Quantity		Unit rate SDG	Amount SDG	
			contract	actually executed		contract	actually executed
1	<u>Preparatory work:</u> Provide for temporary camp and mobilize equipment for excavation for execution of the work.	Job	1	1	80,000	80,000	80,000
1.2	EMPLOYER'S/ENGINEER'S SITE FACILTIES						
1.2.1	installation, supply, construction, furnishing and equipping of the Employer's and Engineer's camp (36 m2 for 3 rooms , including, building services as water Supply, sanitary and electrical installation, ventilation, air-conditioning	Job	1	1	110,000	110,000	110,000
2	Site clearance	Job	1	1	20,000	20,000	20,000
2.1	Demolishing and cart away of old spillway up to foundation level 578.00m including site clearance	m³	6000	7620	10	60,000	76,200
3	Earth work						
3.1	Excavation for new spillway and deep sluice, D/S aprons cutoff wall and plunge basin	m³	12260	12260	12	147,120	147,120

	energy dissipater in the existing embankment including remove and cart away of the expansive soil as per drawings and specification.						
3.2	Excavation for key trench foundation for the new embankment extension as per drawings and specification.	m ³	2310	8962	12	27,720	107,544
3.3	Cut 1m and cart away from existing embankment for the preparation of rising of the existing embankment up to contour 586.00m per drawings and specification.	m ³	400	532	12	4,800	6,384
3.4	Excavation of guide channel to main wadi channel, length of 100m, 40 width per drawings and specification	m ³	4000	10434	12	48,000	125,208
3.5	Provide material and construct of compact homogenous clay embankment (to 90% of dry density) after reshaping of the existing embankment to specified height as per drawing and specification including the repair of the damaged spillway location.	m ³	25228	32435	20	504,560	648,700
3.6	Provide material and construct of new embankment extension for both sides western	m ³	6866	9822	20	137,320	196,440

	and eastern including fill of foundation with compacted sandy clay (to 90% of dry density) per drawings and specification.						
3.7	Provide material and fill of compacted selected soil (to 90% of dry density) for the spillway body and under crest and chute slab, stilling basin, mortared apron and fill of trenches per drawings and specification.	m ³	10000	8632	30	300,000	258,960
3.8	Provide material and construct of dry stone pitching for U/S and D/S slope protection on sand filter ,as per drawing and specification	m ³	7451	5600	280	2,086,280	1,568,000

3.9	Provide material and place of geo-membrane (from high density polyethylene sheet, minimum thickness of 1.5mm) placed on well treated surface of the embankment covered all the embankment surface (U/S & D/S from top to bottom and top embankment crest), overlap joint should be welded , as per drawing and specification.	m ²	16500	12030	40	660,000	481,200	-178,800
3.10	Provide material and place of 0.15m sand filter under pitching stone for both D/S & U/S slope, as per drawing and specification.	m ³	3200	3200	100	320,000	320,000	0
3.11	Provide material and place of compacted not sieved gravel materials 300mm thickness of gravel for embankment crest protection as per drawings and specification.	m ³	2032	2247	150	304,800	337,050	32,250
3.12	Provide material and construct of geo-membrane (from high density polyethylene sheet, minimum thickness of 1.5mm) for anti-seepage impervious core depth of 5m for U/S side of spillway, as per drawings and specification	m ²	300	0	40	12,000	0	-12,000
4	Spillway							
4.1	Provide material and construct of reinforced concrete overflow chute spillway including U/S cutoff wall, U/S horizontal slab , vertical							

	U/S walls, retaining walls, crest slab, chute slab and stilling basin slab as per drawing and specification							
	a) plain concrete	m ³	220	285.8	600	132,000	171,480	39,480
	b) Reinforced concrete							
	1. 5 m U/S horizontal wall	m ³	75	99.6	2700	202,500	268,920	66,420
	2. U/S of spillway body vertical wall	m ³	72	74.7	2700	194,400	201,690	7,290
		m ³	99	99	2700	267,300	267,300	0
	3. Spillway body crest slab	m ³	258	365.5	2700	696,600	986,850	290,250
	4. Chute slab	m ³	198	198	2700	534,600	534,600	0
	5. Stilling basin slab	m ³	36	39.8	2700	972,00	107,460	10,260
	6. D/S cutoff wall	m ³	73	62.4	2700	197,100	168,480	-28,620
	7. Sill and baffle blocks							-
	8. Retaining walls	m ³	122	60.3	2700	329,400	162,810	166,590
4.2	Provide material and construct of mortar stone pitching for D/S Apron of spillway, as per drawing and specification.	m ³	240	240	400	96,000	96,000	0
4.3	Provide material and construct of 0.3m gabion mattresses filled with stone for D/S Apron of spillway on geotextile or 0.15 filter as per drawing and specification.	m ²	240	600	150	360,00	90,000	540,00
4.4	Provide material and construct of dry stone pitching for plunge basin, as per drawing and	m ³	108	108	280	30,240	30,240	0

	specification							
4.5	Provide material and construct of masonry guide wall, as per drawing and specification.	m ³	90	168	400	36,000	67,200	31,200
4.6	Provide material and construct of box culvert outlet system as per drawing and specification a) plain concrete	m ³	12	25.2	600	7,200	15,120	7,920
	b) Reinforced concrete							
	i) for box culvert as encasement for the outlet steel double pipe including entrance and valve support as per drawing and specification.	m ³	96	95.7	2700	259,200	258,390	-810
		m ³	15	36	2700	40,500	97,200	56,700
	ii) Stilling basin slab	m ³	4	8.3	2700	10,800	22,410	11,610
	iii) Sill and baffle blocks	m ³	5	3.6	2700	13,500	9,720	-3,780
	iv) D/S cutoff wall							
	v) Retaining walls	m ³	40	32.5	2700	108,000	87,750	-20,250
	vi) Provide and install of gate valve 1m diameter at D/S side and double steel pipes 1m diameter per drawing and specification.	job	1	1	240000	240,000	240,000	0
4.7	Provide material and construct of mortar stone pitching for D/S Apron of spillway, as per drawing and specification.	m ³	20	20	400	8,000	8,000	0
4.8	Provide material and construct of 0.3m gabion mattresses filled with stone for D/S Apron of spillway on geotextile or 0.15 filter as per drawing and specification.	m ²	50	50	150	7,500	7,500	0

Details Appendix Table 4.4

Accordingly, the:

Total basic contract (SDG)	in Total payment (SDG)	Cost difference (-/+)	The percentage of rise-cost
8,788,000	8,834,486	46,486	0.53(+)%

Table (4-5): provides a summary of the terms of additional works:

item	specification	unit	Quantity	unit rate SDG	Amount SDG
1	Mobilization	job		800,000	800,000
2	demolishing and cart away of old spillway up to foundation level 577.00 m including site clearance	m ³	6000	10	60,000
3	earth work				
	provide material and construct of compact homogenous clay embankment (to 90% of dry density)after reshaping of the existing embankment to specified height as per drawing and specification including the repair of the damaged spillway location	m ³	30110	20	602,200
4 A	provide material and construct of dry stone pitching for U/S slope protection as per drawing and specification	m ³	4320	270	1,166,400
B	provide material and place of 0.15m gravel filter under pitching stone as per drawing and specification	m ³	2160	200	432,000

5	spillway				
	provide material and construct of reinforced overflow chute spillway including retaining wall, stilling basin and deep R.C culvert as per drawing and specification a. plain concrete	m ³	240	600	144,000
6	b. reinforced concrete including water stop for the expansion joints as per drawing and specification	m ³	626	2600	1,627,600
7	provide material and construct of 0.3 mortar(1:4 mix) stone pitching for D/S apron of spillway and 80m ³ for masonry guide wall as per drawing and specification	m ³	280	400	112,000
8	provide material and construct of sluice gate regulator for desalting as per drawing and specification	job	2	120000	240,000
9	provide material and construct of 150mm thickness of gravel for embankment crest protection	m ³	810	200	162,000
10	provide material and construct of 0.3 gabion mattresses filled with stone for D/S apron of spillway as per drawing and specification	m ²	600	150	90,000
11	remove the existing fence on the embankment and provide barbed wires material for reconstruction of new fence	m	900	100	90,000
	Total				4,806,200

Details Appendix Table (4-5)

Accordingly, the:

total of additional Works	4,806,200
---------------------------	------------------

1. The cost of the project:

The total estimated cost of the project (878,8000 SDG) without (VAT) ,while the actual cost of completion (13,640,686 SDG), where the cost difference

(4,852,686 SDG), and can illustrate the factors that increase the cost as follows:

- error in calculations when preparing the final payments.
- re-pricing of some items variation quantities executed (Order) from estimated cost (text) result of adjustments made to the project.
- Lack of Schedule for implementation of project

And we can through analysis of Works completed (actually) at the site to explain the following:

Table (4-6) : provide Cost estimated and The value of rise cost of construction for first case study:

Item	specification	Total(SDG)	Percentage
1	Cost estimated	8,788,000	64.42%
2	The value of rise cost of construction	4,852,686	35.58%
total actual cost		13,640,686	100%

Where:

Item	specification	Total(SDG)	Percentage
1	Additional works	4,806,200	35.24%
2	Difference basic quantities on-site	46,486	0.34%
total rise of cost construction		4,852,686	35.58%

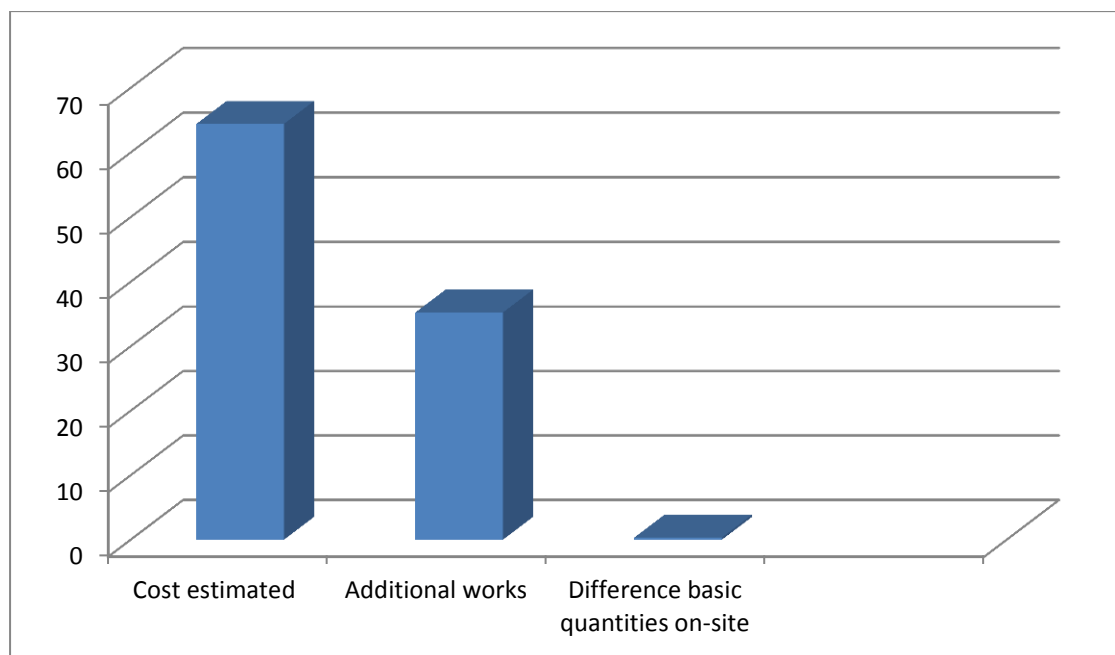


Figure 4-2: contribution of all items in total cost of construction for project

➤ From cases studies conclude:

Table (4-7) :Cost estimated and The amount of rise in the cost of construction for two cases studies:

Case study	Cost estimated	total rise of cost construction	Actual cost	Percentage
case study No(1)	178,939,130	53,101,209	232,040,339	%22.9
case study No(2)	8,788,000	4,852,686	13,640,686	%35.58

The following figure illustrates this:

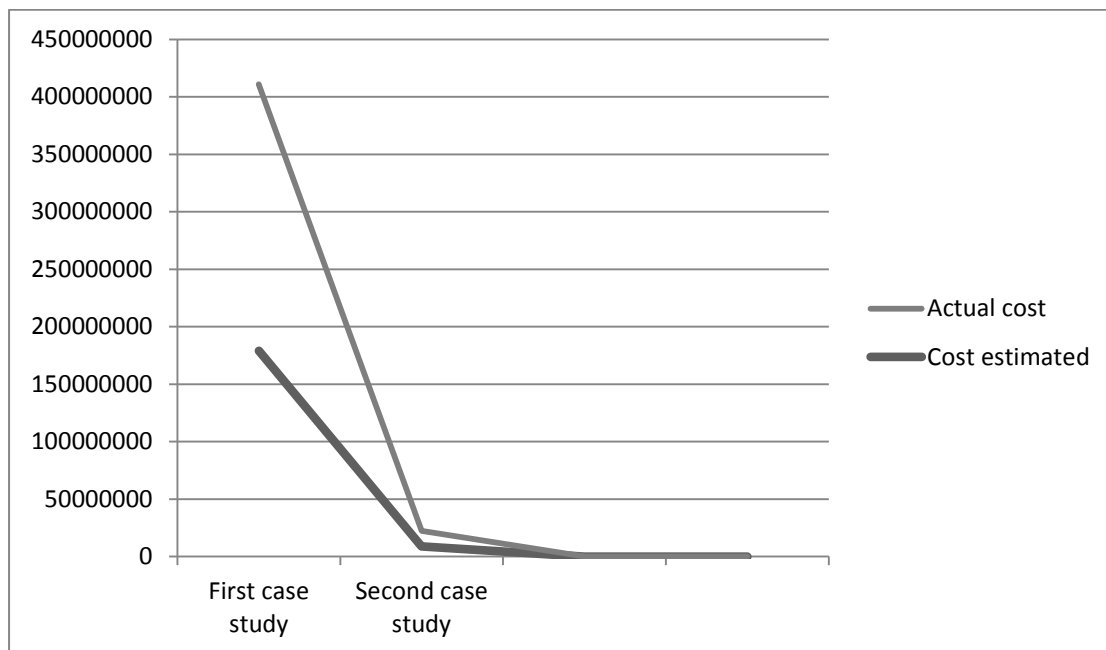


Figure 4-3: difference between Cost estimated and Actual cost for Each Case Study

Table (4-8): difference between Cost estimated and Actual cost for Each Case Study:

Case study	case study No(1)	case study No(2)
Cost estimated	178,939,130	8,788,000
Actual cost	232040339	13,640,686
Cost difference	53101209	4,852,686

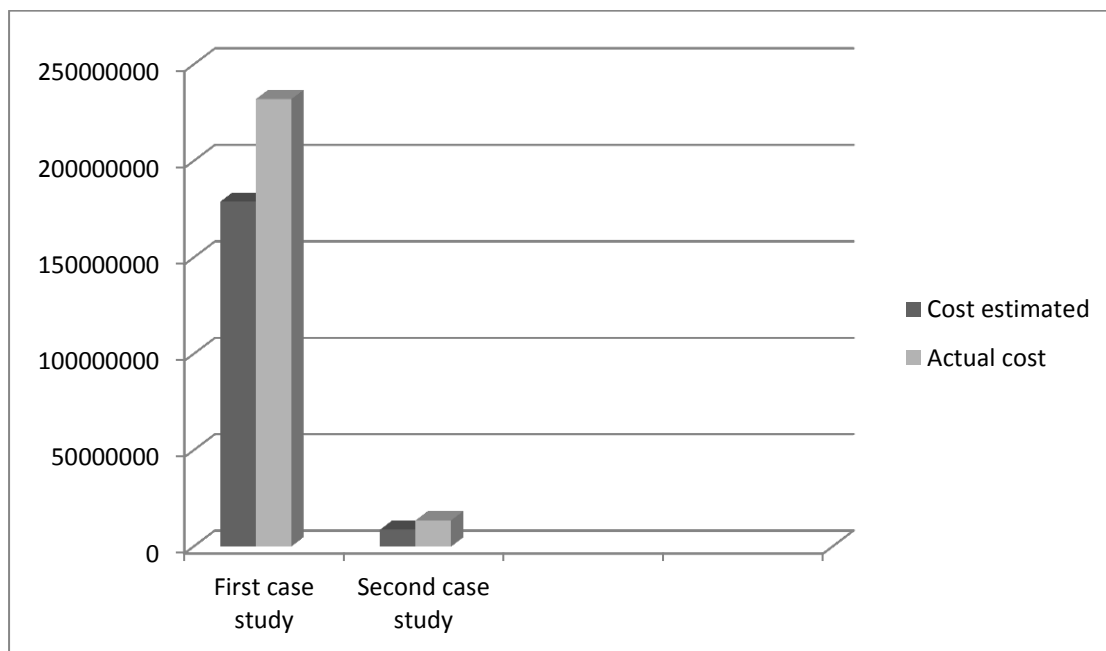


Figure 4-4: difference between Cost estimated and Actual cost for Each Case Study

Table(4-9) :sum total of difference between Cost estimated and Actual cost for Each Case Study:

Total Cost estimated for two case study	187,727,130
Total Actual cost for two case study	245,681,025
Total Cost difference for two case study	57,953,895

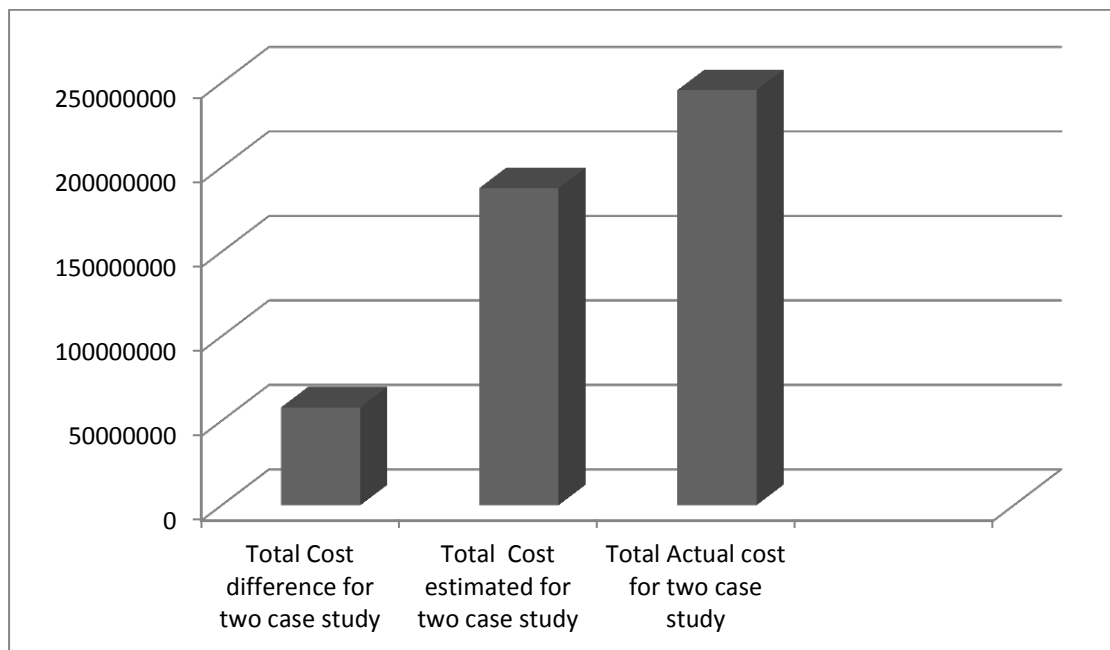


Figure 4-5: sum total of difference between Cost estimated and Actual cost for two Case Study

4.1.2 A questionnaire:

A questionnaire survey was carried out to gather information from technical professionals who are involved in the construction industry

4.1.2.1 SECTION (1) - Respondents classification:

Data obtained from this study was analyzed by stratifying the contractors into three grades, which were specified by a conducted review to the environment of construction industry in Sudan.

According to the questionnaire, Contractors' Companies have been classified based on two categories:

1- Contractor type:

- a) Building (General Building Construction ... etc.)
- b) (Highway, Bridge Etc)
- c) Plumbing, Sanitary, Irrigation, Water Supply.
- d) (Power Plants, Electro-mechanical plants, AC...etc.)
- e) Others (Fire Fighting, Aluminium... etc.).

And for the lack of time, this study has been limited to the construction companies which are working with type (a & b).

2- Contractor grade:

Contractors firms – limited to type a & b - have been classified into three grades, regarding the following factors:

- a) Number of permanent employees.
- b) Equipment value which is owned by the company.
- c) Average of job value.
- d) Average of job duration.

Index for each factor was calculated by the following formula:

Equation 1:

$$\text{Company size index} = \sum a_n \times P/10$$

Where:

a_n = Constant expressing the weight given for a certain factor

P = Number of points achieved by the company for the certain factor.

10 = maximum points that can be achieved for the certain factor.

Calculation for index of company size (grade) has been done in reference to the following table:

Table (4 -10) : Characteristic of Grading of Respondents

Wight of factor % a_n	Points (P)	Characters				
	factor	2	4	6	8	10
25%	No. of employees (including technical, Administration, Managerial staff ...etc)	UNDER10	10 - 50	50-100	100-200	over200
20%	Value of construction Equipment	UNDER1000	1000- Under 10,000	10,000- Under 50,000	50,000- Under 100,000	over or 100,000
40%	Average of job size	Under or equal 10,000	10,000 - 50,000	50,000- 100,000	100,000 - 500,000	Over 500,000
15%	Average of job duration	UNDER½	½ Under 1	1 Under 2	2 Under 3	3 or over

Where:

Index	Index 0.2 less than 0.4	0.4 less than 0.8	More than 0.8
Grade	Grade 3	Grade 2	Grade 1

Example:

If a certain company character is:

150 employees, 100,000 SDG equipment value, with average of job value about 100,000 SDG and the average of job duration is 4 years

Then the company size index is =

$$25\% \times (8/10) + 20\% \times (10/10) + 40\% \times (8/10) + 15\% \times (10/10)$$

$$= 0.87$$

Then ... the company is grade 1

The Respondent distribution across the previous classification method was as per the following schedule:

Table(4- 11): Sample Size & Classification

Grade	Description	Sample size
1	Big contractors company	7
2	Medium contractors company	10
3	Small contractors company	13
Total of Respondents		30

The rationale behind this stratification is that; since the grades depend on the number of employees, equipment value, job value & job duration, then a different procedures & level of cost control based on those grades could be expected. This hypothesis will be figured out during the analysis process.

4.1.2.2 SECTION (2) - Analysis of Cost control procedure (Tools & Effectiveness):

This section of interview examines the tools used by Sudanese contractors as well as the major factors which can affect the whole procedure of cost control.

The aim of each question in this section is to achieve the following goals:

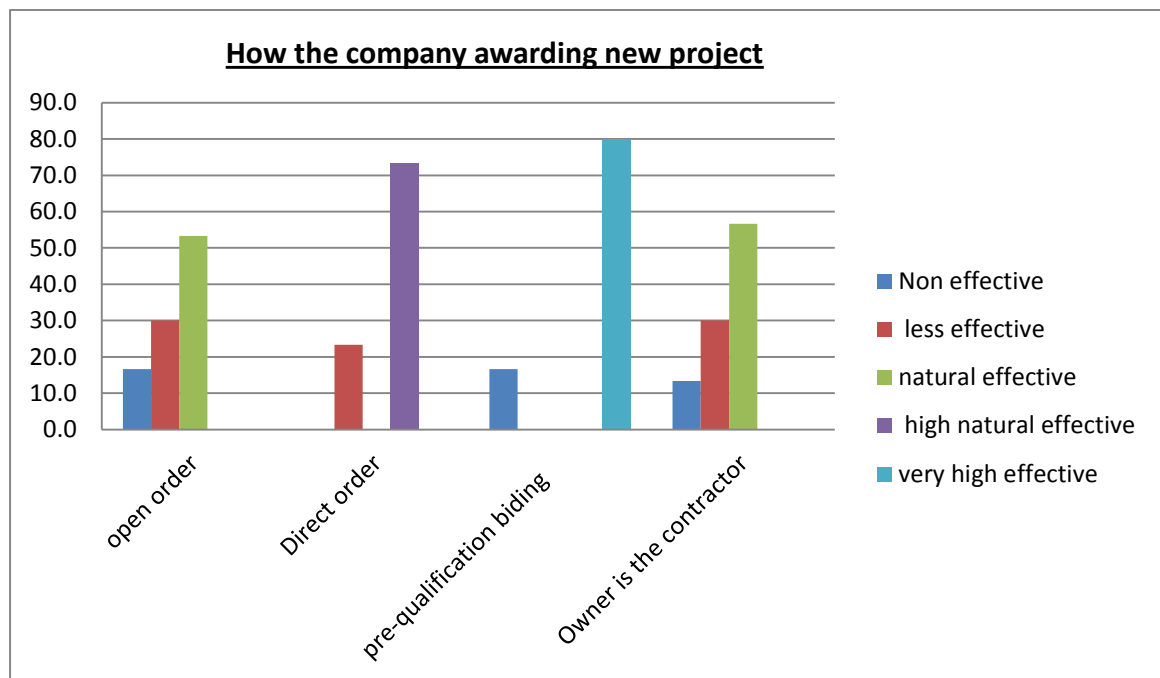
- 1- To identify which tools can be used by the firm so as to control the project cost.
- 2- To identify the importance/effectiveness of each tool in conducting cost control procedure & keeping the project on its cost track.

☒ Calculating of Effectiveness/importance:

The questionnaire handed out needs the level of agreement from the respondents about its importance of each procedure and its effectiveness on success of the cost control of the project, which was analyzed according to ordinal scale numbering from 1 to 5. The respondents need to choose from one of the ordinance scales based on Likert's, where each scale represents the following rating:

Ordinal scale Level of Effectiveness/Importance

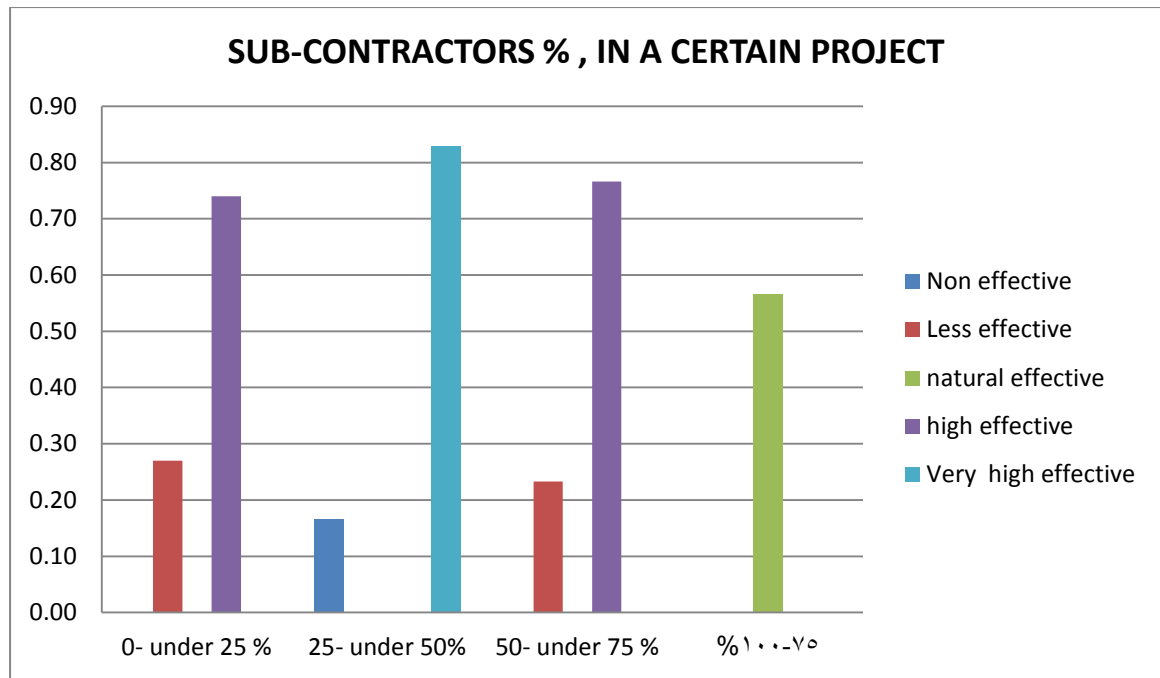
- 1.....very low degree of effectiveness
- 2.....low degree of effectiveness
- 3.....natural degree of effectiveness
- 4.....high degree of effectiveness
- 5.....very high degree of effectiveness



■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 6: How the company awarding new project:

a) Open tendering b) Direct order c) Pre-qualification bidding d)
Owner is the contractor



Non effective
 less effective
 natural effective
 high Effective
 Very high effective

Figure 4- 7:What is the percentage of subcontracted work in a given project:

a) 0- under 25 %
 c) 50- under 75 %

b) 25- under 50%
 d) 75- 100%

☒ General characters of the project

1. How the company awarding new project:

The way of awarding new projects can indirectly affect the cost control procedure by affecting the level of uncertainty, the time and effort needed to conduct better cost control plan, the realistic of the budget, the profitability of the project and the operation of risk analysis and consequently the sum of contingency which can be needed for the certain project.

Diagram no. (4-6) shows the respondents situation, and it has been clarified in the following points:

We find that companies get the new projects in the case of:

Open tender depend on them by 66%, which is the ratio of effective, Direct depends upon the tender of 60% in this case the tender is obtained by virtue of their experience and the extent of customer satisfaction the implementation of previous projects in a satisfactory manner, In the initial qualification stage of the tender or Submission rely on him by a large margin of 80%, provided that correspond bills of quantities, prices and specifications of the project so as to be competitive so as to enable the company to obtain the tender in either case the effect will be if there is less risk, However, if the owner is the same contractor is obtained on the effect of a very strong 90% but if I got on the impact of weak, it does not have a competitor.

2. What is the percentage of subcontractors working in a given project?

The percentage of subcontractors working in a given project can be ranging from (under 25%) up to (over 75%) of the project activities.

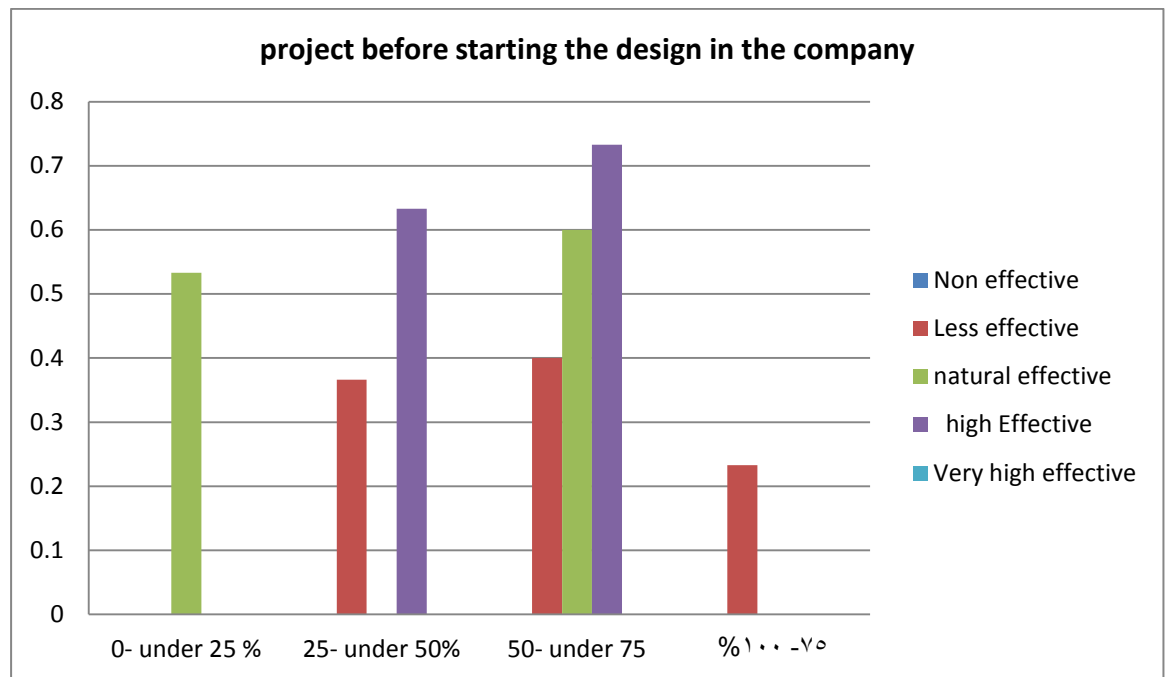
This could affect the cost control in many ways, such as identifying the base-line and to reduce the level of uncertainty and the other steps of

cost control. This will be in combination with the contract type which can use so as to hire a sub-contractor.

From the general observation, it seems that the larger project size and complexity; the more percentage of project activities can be undertaken by the subcontractors. That can be proved by the diagram no. (4-7), where the number of respondents of contractor the number of respondents of contractor of grade 1 are extremely over in (50% to 100% of work can be done by sub contractor) and it is the reverse condition for contractor of grade 3 where about 74% of the respondent of these grades is approved for (less than 50% of project activity to be done by sub-contractor)

According to overall respondent evaluation, 83% of them agree to give (25%- 50 % of projects activity so as to be executed by sub-contractors)

The degree of effectiveness for all grades is (effective) but it is noticed that the project cost control can be more affected by the number of sub-contractors working on it, while it is a big project with lot of component. In fact using sub-control is very necessary in big-sized projects aiming by that for good controlling.



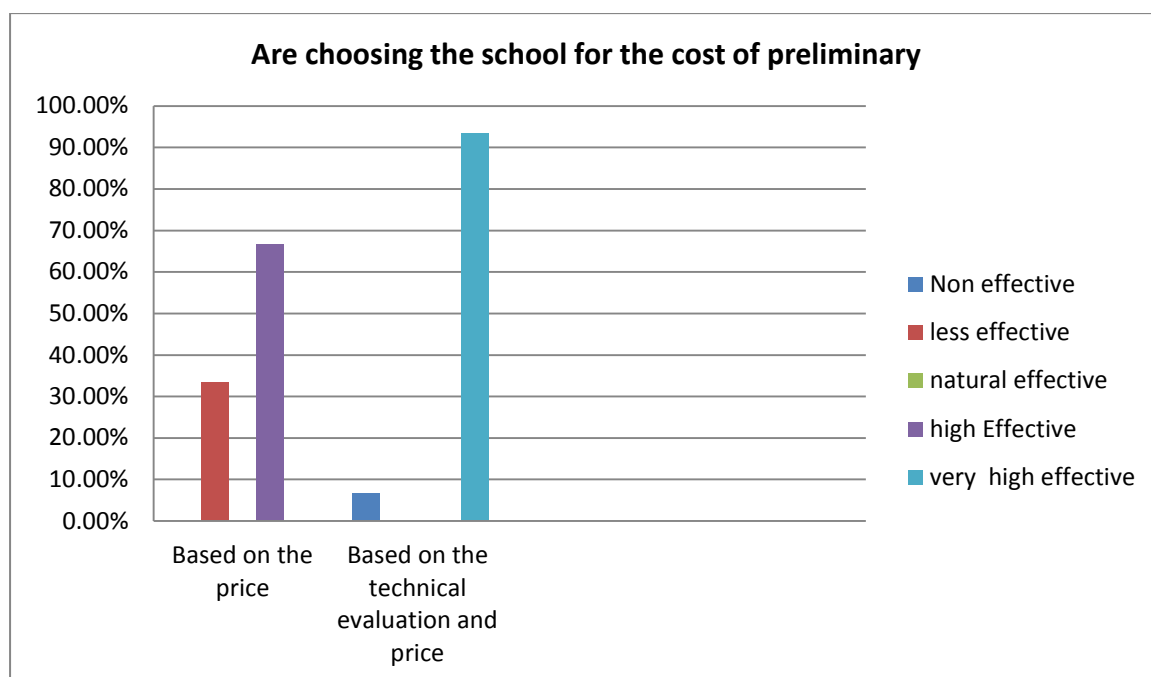
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 8:What is the percentage of subcontracted work in a given project:

- | | |
|-------------------|------------------|
| a) 0- under 25 % | b) 25- under 50% |
| c) 50- under 75 % | d) 75- 100% |

3. Do are put plan for initial costs of the project before starting the design in the company

When you the design has to be in the company to plan the initial costs of the project and was the point of 0 are under 25% of respondents have a few little effect and accounted for 53.3%, But from the point 50 under 25 and 75 under 50 and 75 under 100 were most respondents them effect by 70%.



■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

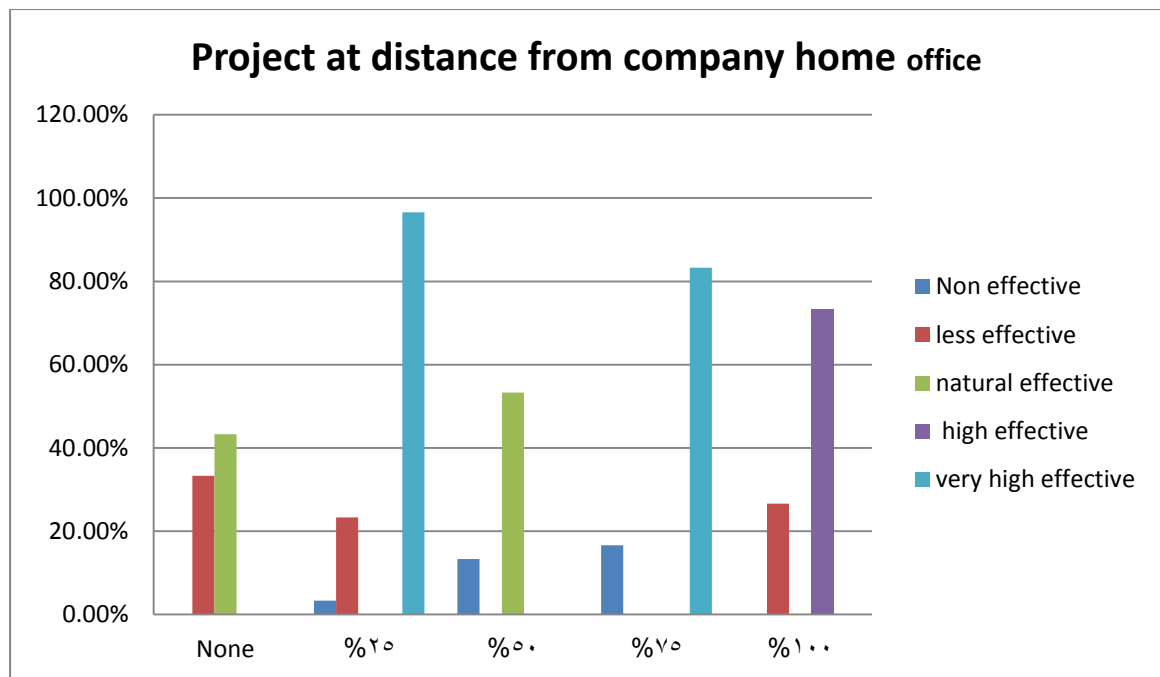
Figure 4- 9: How are choice side study for initial costs

a) Based on the price

b) Based on the technical evaluation and price

4. choice side study for initial costs:

When choosing initial Based on the price, the respondents who agreed 66% of any percentage of an impact, As for the technical evaluation in price was respondents who agreed 93% of any percentage of its effect is very strong.



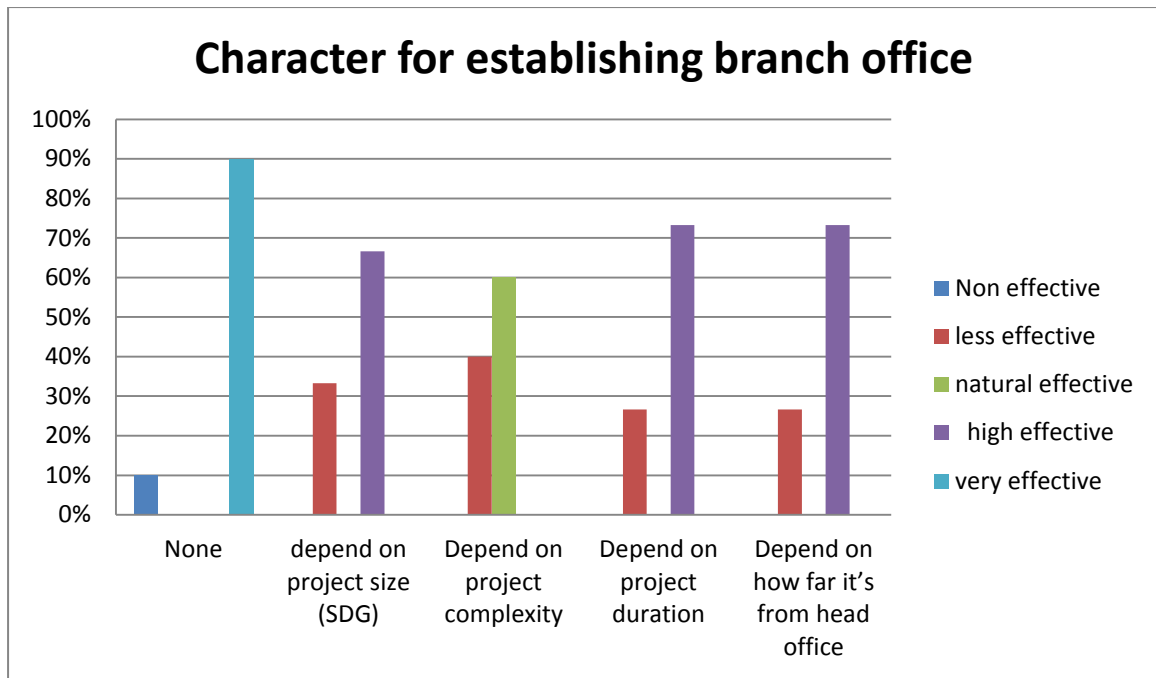
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 10 : Project at distance from company home office

a) Non b) 25% c) 50% D) 75% E) 100%

5. Percentage of projects which are built at a distance from the company's home office:

Percentage of projects that are being built at a distance from the company's home office: Most of the respondents who were for between 80-93% and this percentage refers to projects that are built from the home office have an impact is very effective.



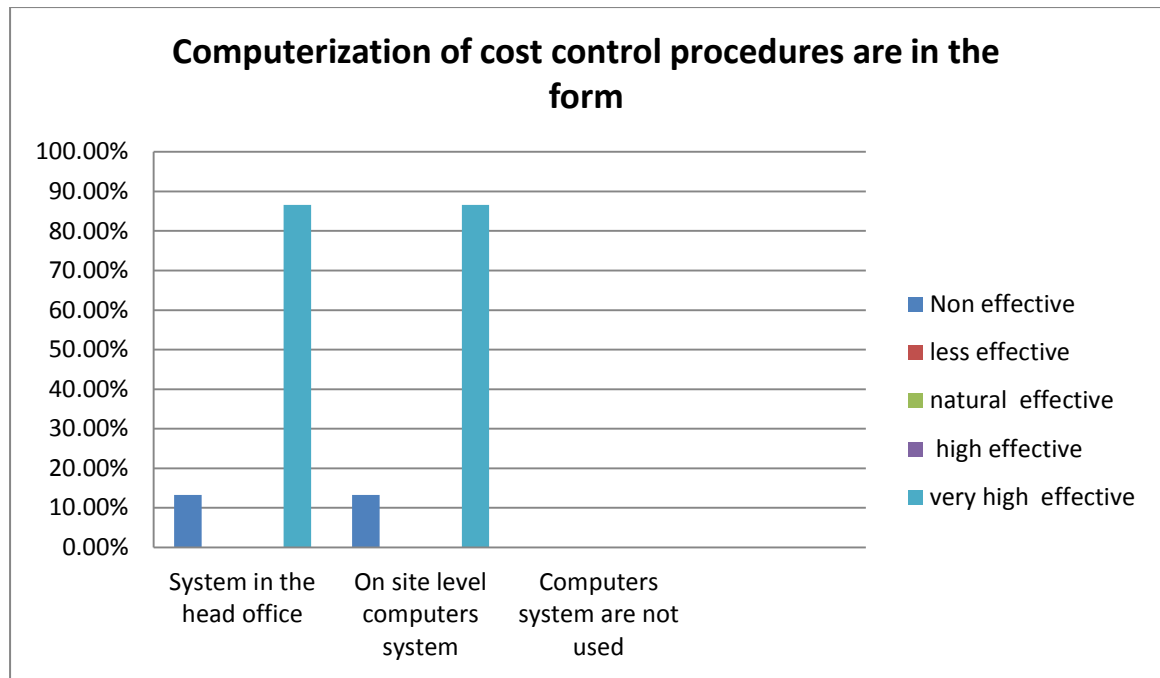
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 11 : According to above question how the company establish an area/branch offices (site offices):

- a) Non b) depend on project size (SDG) c) Depend on project complexity
 D) Depend on project duration E) Depend on how far it's from head office

6. According to above question how the company establish an area/branch offices (site offices):

Depends on the size of the project (SDG) was mostly respondents 66% have no effect size of the project, That depend on the complexity of the project, 60% of respondents any complexity of the project between the low and few, But that depends on the duration of the project, which relies on it from the bureau, 73% of respondents descent that any duration of the project and the impact of the office for them.



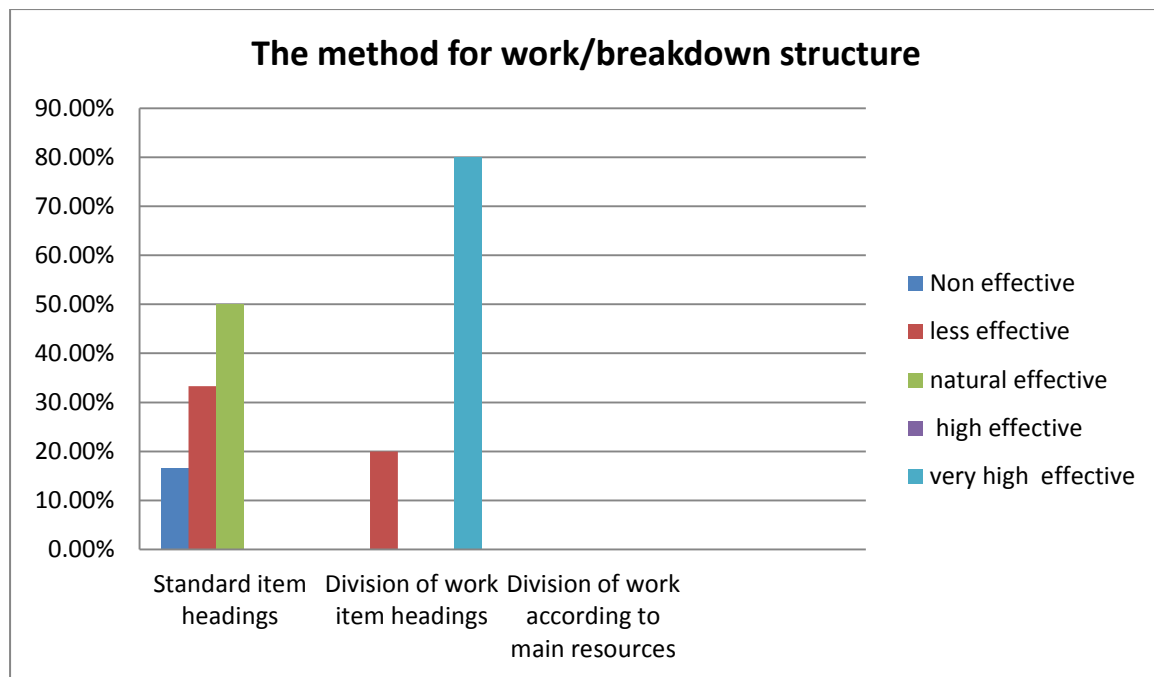
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 12 : Computerization of cost control procedures are in the form

- a) System in the head office b) On site level computers system
- c) Computers system are not used

7. Computerization of cost control procedures are in the form:

System in the head office and On site level computers system Accounted for 83% of respondents in any of these two points are very effective.



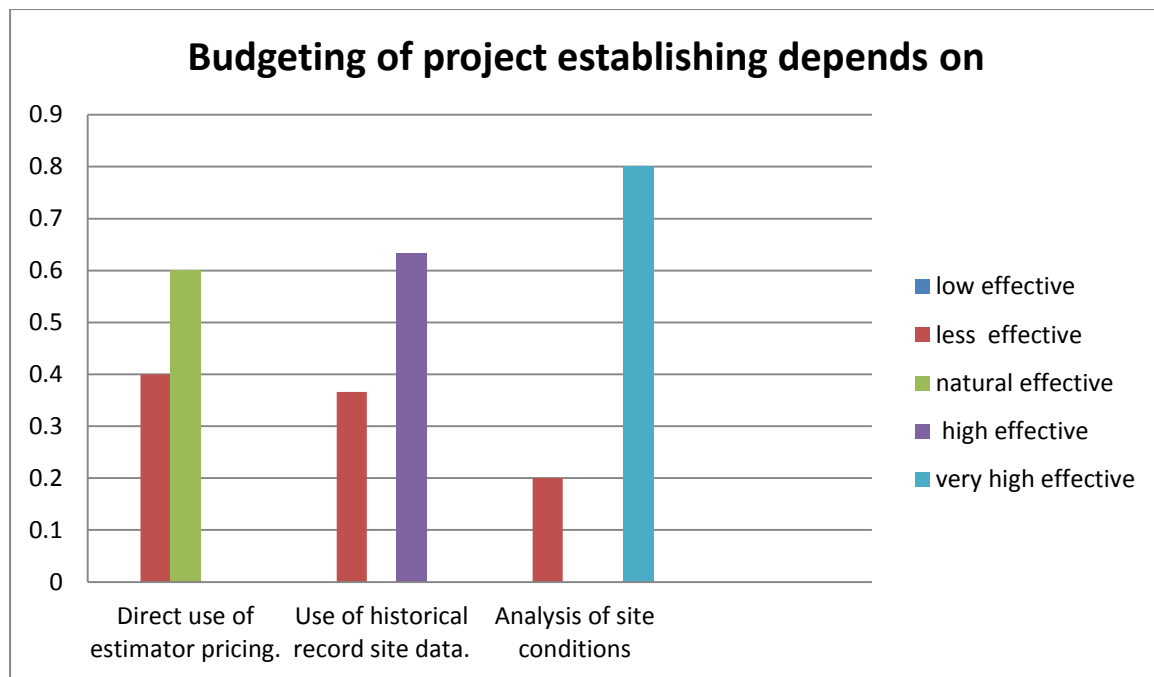
Non effective
 less effective
 natural effective
 high Effective
 Very high effective

Figure 4- 13 : The method for work/breakdown structure for site use depends on

- a) Standard item headings b) Division of work item headings
- c) Division of work according to main resources

8. The method for work/breakdown structure for site use depends on:

Division of work item headings especially for certain project & work divided into major construction components for 80% of respondents in any of the point are very effective, and Standard item headings And a small percentage of respondents 50% of any little effect.



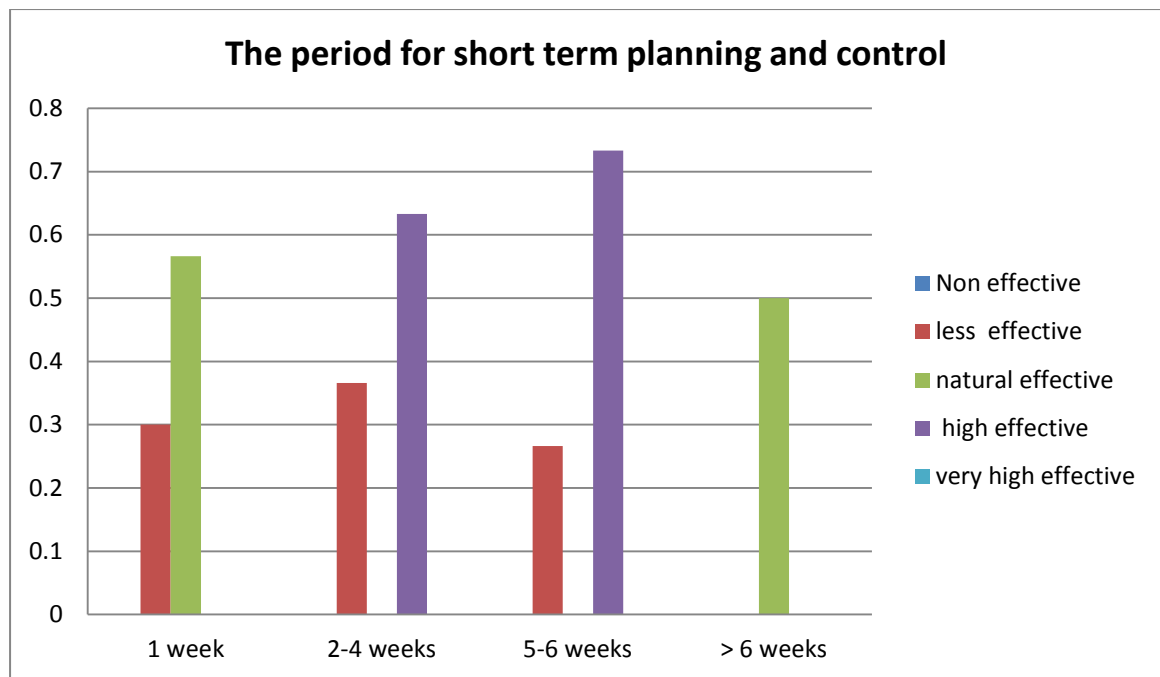
Non effective
 less effective
 natural effective
 high Effective
 Very high effective

Figure 4- 14: Budgeting of project establishing depends on

- a) Direct use of estimator pricing
- b) Use of historical record site data.
- c) Analysis of site conditions

9. Budgeting of project establishing depends on:

In the direct use of the estimated pricing and the use of location data record historical percentage of respondents was 60% and 63% of any data for the effect of the two Direct use of estimator pricing. Analysis of site conditions and subsequent budgetary adjustments have had a very strong impact.



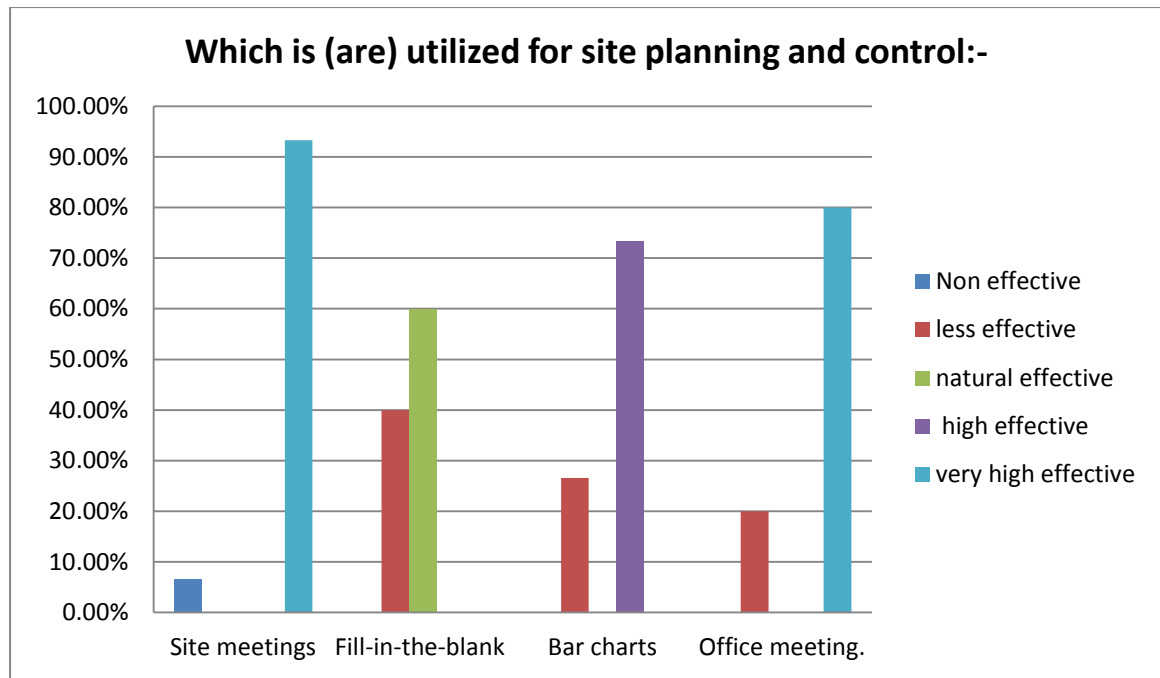
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 15 : The period for short term planning and control

a) 1 week b) 2-4 weeks c) 5-6 weeks D) > 6 weeks

10. The period for short term planning and control:

In >6 weeks , 5-6 weeks accounted for most of the respondents were weak, which led to the effect of weak, but 5-6 weeks The proportion of responders was 73.3% ie, that have an effect.



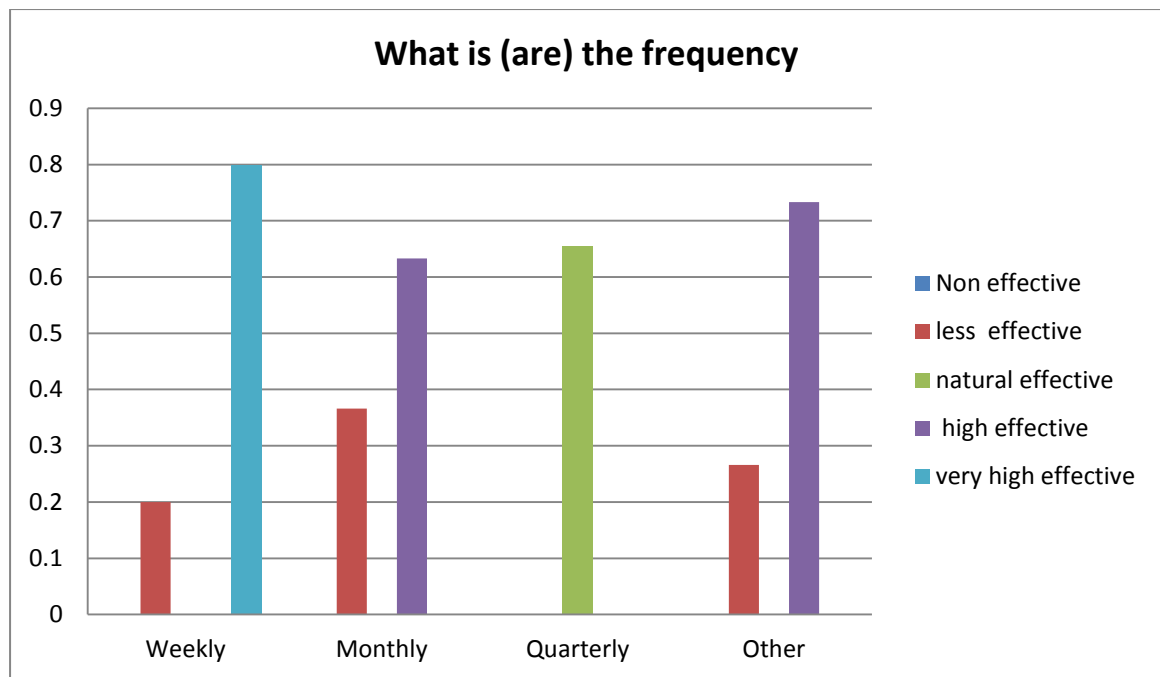
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 16 : Which is (are) utilized for site planning and control:-

a) 1 week b) 2-4 weeks c) 5-6 weeks D) > 6 weeks

11. The Which is (are) utilized for site planning and control:

Used for site planning and control was increased by 80-90% of respondents said any layout of the site has a very large impact.



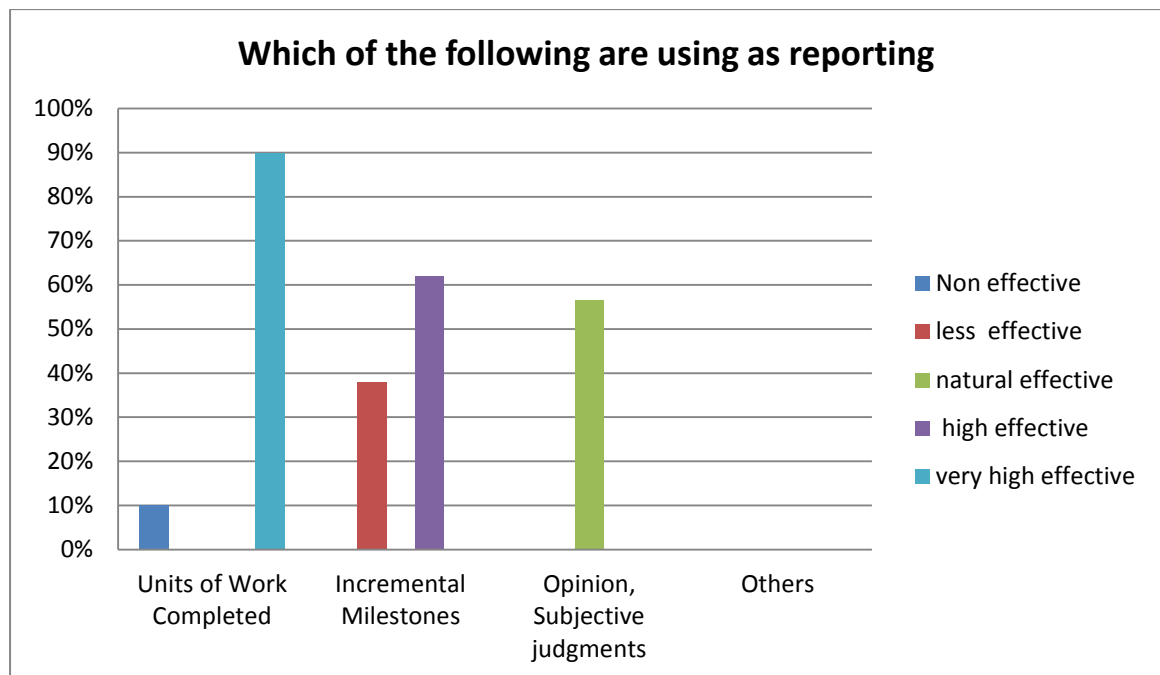
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 17: What is (are) the frequency of measuring actual performance during construction (frequency of cost statements) :

a) Weekly b) Monthly c) Quarterly D) Other

12. What is (are) the frequency of measuring actual performance during construction (frequency of cost statements) :

was increased by 60-73% of respondents said any layout of the site has effective.



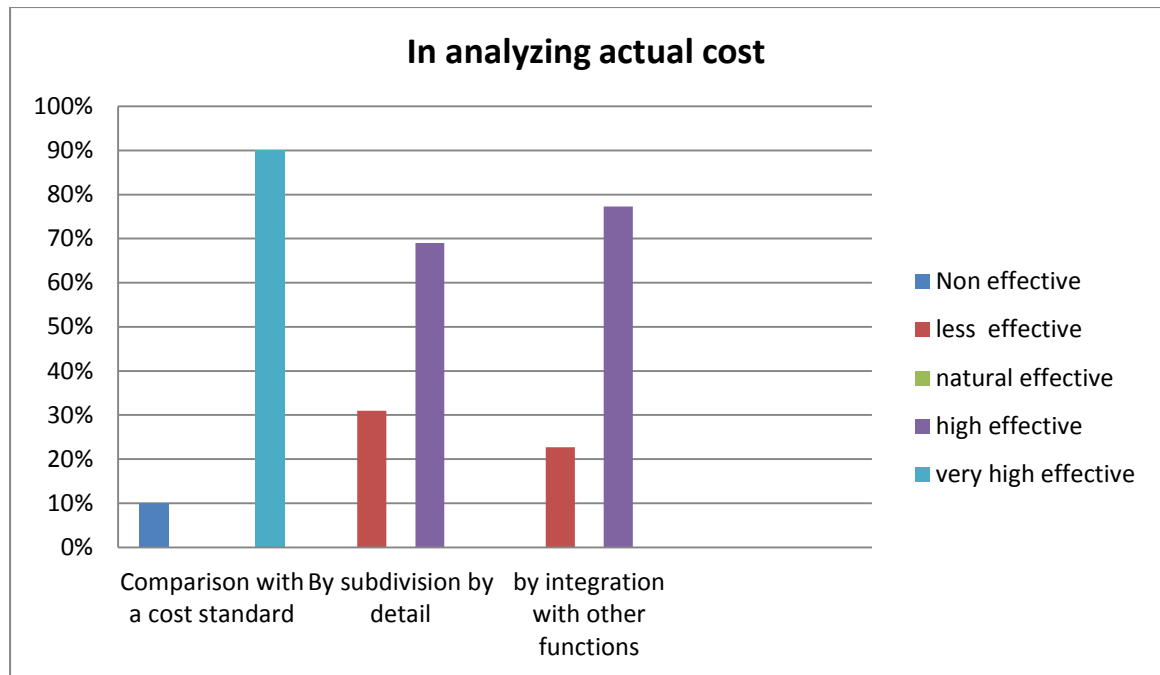
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 18: Which of the following are using as reporting method for actual work-done

- a) Units of Work Completed b) Incremental Milestones c)
 Opinion, Subjective judgments of the percentage complete. D) Other

13. Which of the following are using as reporting method for actual work:

Units of Work Completed 90% very effective , Incremental Milestones 62% effective , Opinion, Subjective its low effective but other is not respondents and not effective.



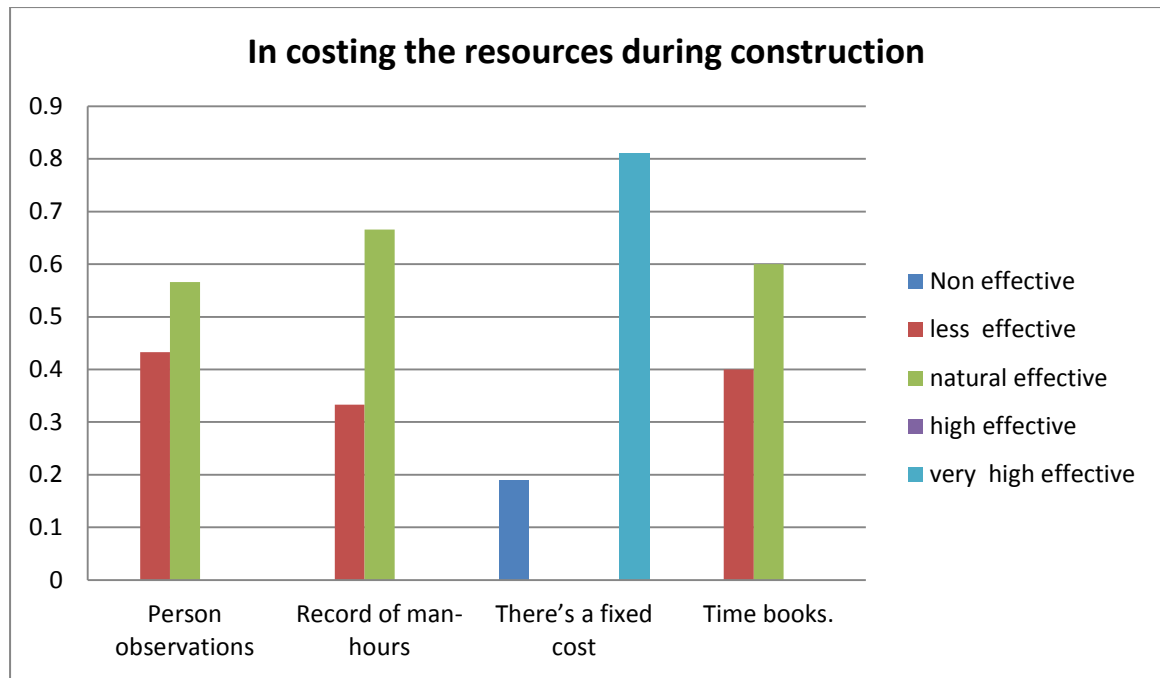
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 19: In analyzing actual cost vs. estimated cost , which of the following system are done use:

- a) Comparison with a cost standard
- b) By subdivision by detail
- c) by integration with other functions

14. In analyzing actual cost vs. estimated cost , which of the following system are done use:

Comparison with a cost standard 90% is very effective , By subdivision by detail and by integration with other functions 69% is effective.

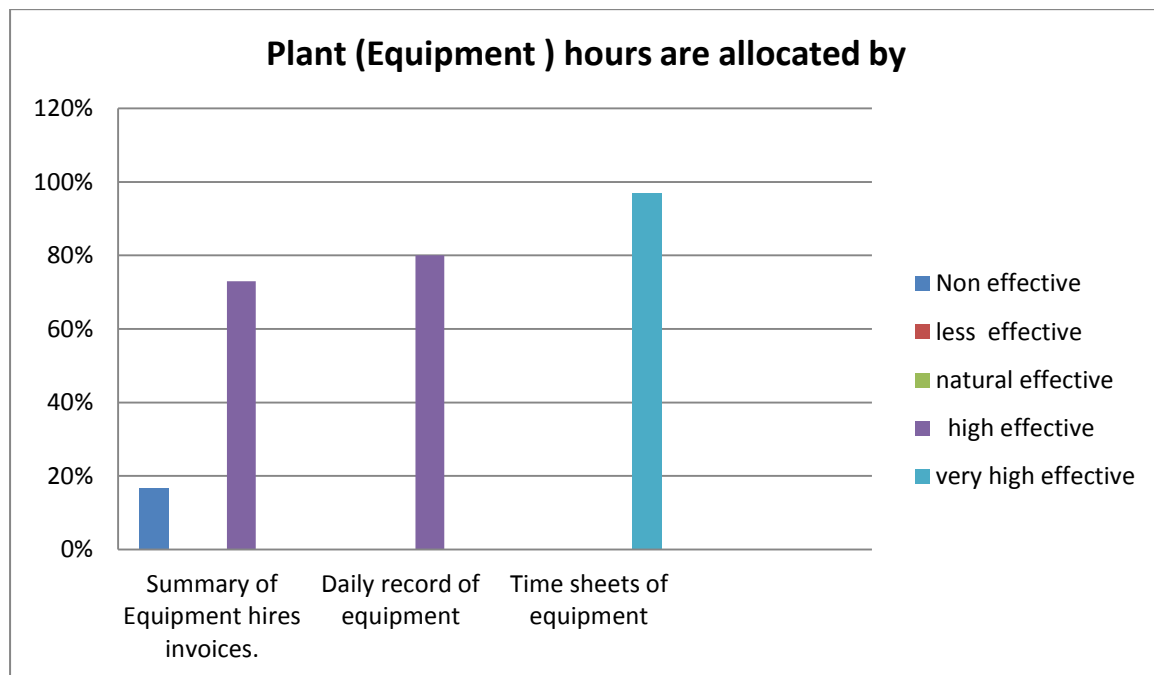


■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 20: In costing the resources during construction, labor hours are allocated by:

- a) Person observations
- b) Record of man-hours consumed
- c) Time books.
- D) There's a fixed cost for labor productivity

15. In costing the resources during construction, labor hours are allocated by: Person observations , Record of man-hours consumed , Time books. between are 55-66% effective , but There's a fixed cost for labor productivity 81% very effective.



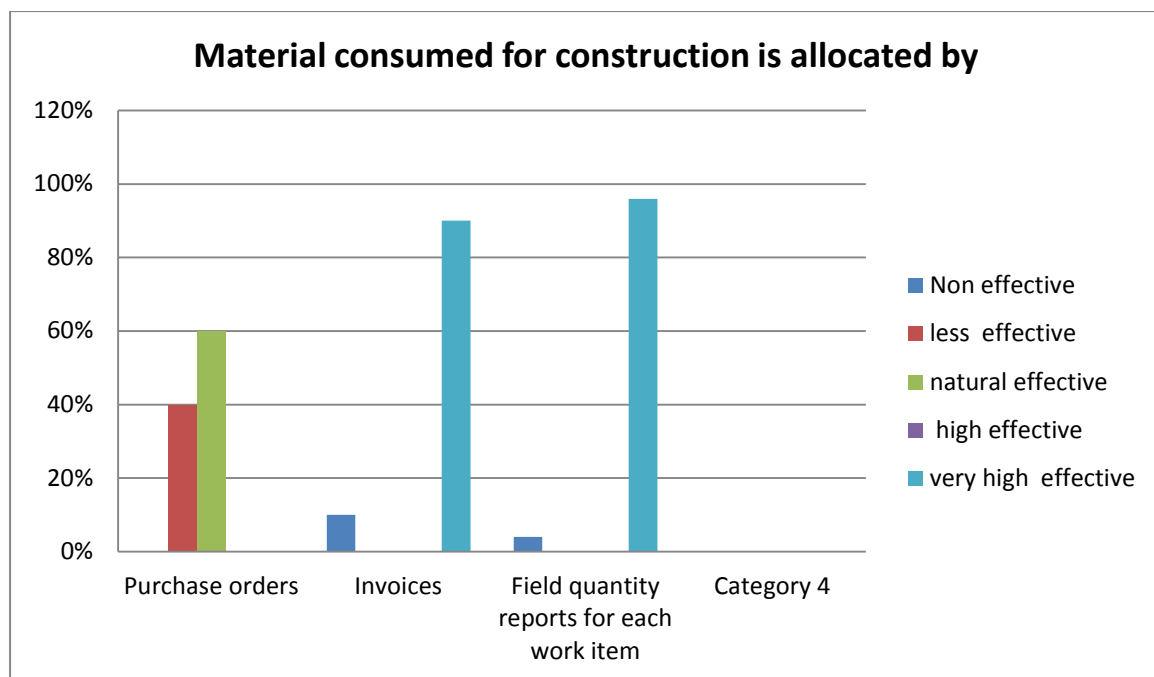
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 21: Plant (Equipment) hours are allocated by:

- a) Summary of Equipment hires invoices. b) Daily record of equipment
 c) Time sheets of equipment operators.

16. Plant (Equipment) hours are allocated by:

Summary of Equipment hires invoices , Daily record of equipment 73-80% effective , Time sheets of equipment operators. 97% very effective.



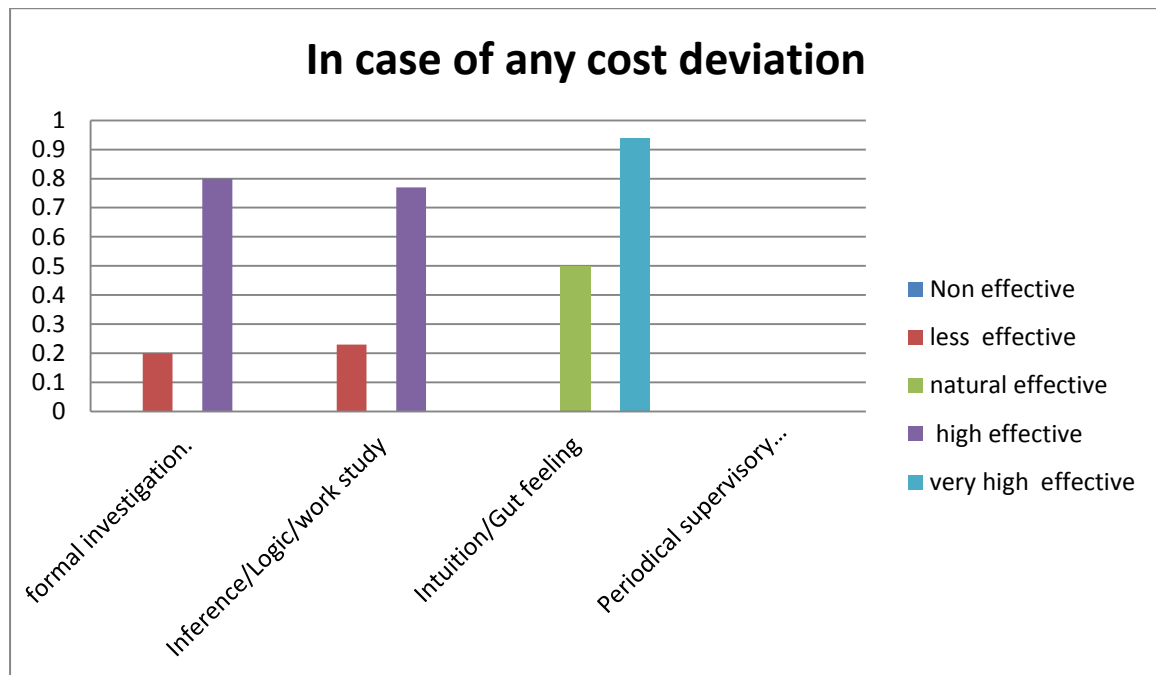
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 22: Material consumed for construction is allocated by:

- a) Purchase orders.
- b) Invoices
- c) Field quantity reports for each work item.

17. Material consumed for construction is allocated by:

Purchase orders 60% effective , Invoices and Field quantity reports for each work item 90-96% is very effective.



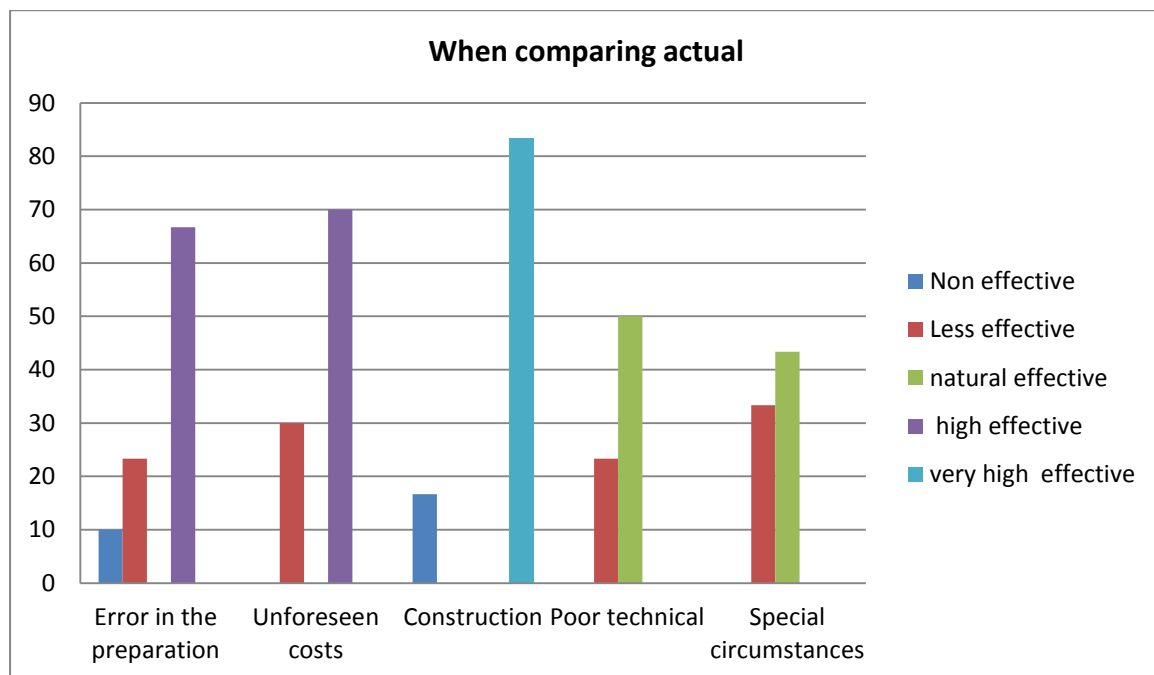
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 23: In case of any cost deviation, which of the following is (are) utilized for investigating cost discrepancy:

- a) formal investigation.
- b) Inference/Logic/work study
- c) Intuition/Gut feeling
- d) Periodical supervisory meetings.

18. In case of any cost deviation, which of the following is (are) utilized for investigating cost discrepancy:

formal investigation and Inference/Logic/work study 77-88% effective , Intuition/Gut feeling is very effective . but Periodical supervisory meetings. Is not effective.



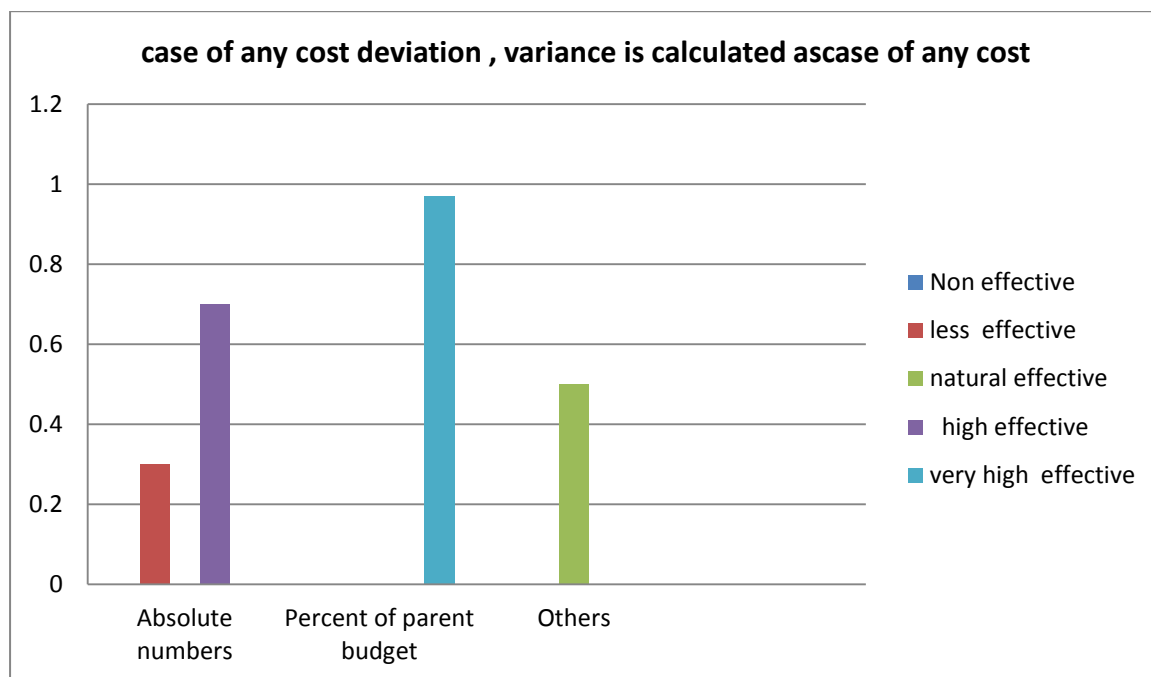
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 24 When comparing actual vs. - desired level of performance , in most project variance appear due to :

- | | | |
|--|-------------------------------------|--------------------------|
| a) Error in the preparation of estimates.. | b) Unforeseen costs | c) |
| Construction performance | d) Poor technical & administrative. | E) Special circumstances |

19. When comparing actual vs. - desired level of performance , in most project variance appear due to:

Error in the preparation of estimates and Construction performance 60% effective , Poor technical & administrative 80% very effective but Special circumstances is not effective.



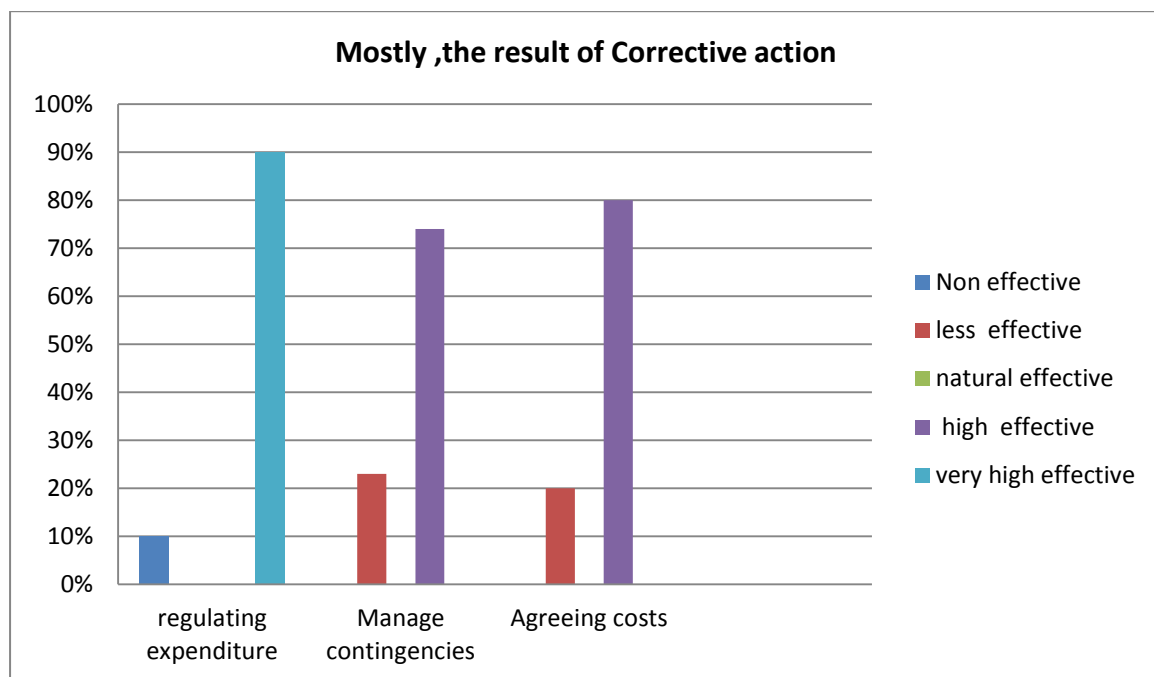
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 25 : In case of any cost deviation , variance is calculated as

- a) Absolute numbers.
- b) Percent of parent budget of work under consideration
- c) Others

20. In case of any cost deviation, which of the following is (are) utilized for investigating cost discrepancy:

Absolute numbers 70% effective , Percent of parent budget of work under consideration 97% very effective and other is less effective.



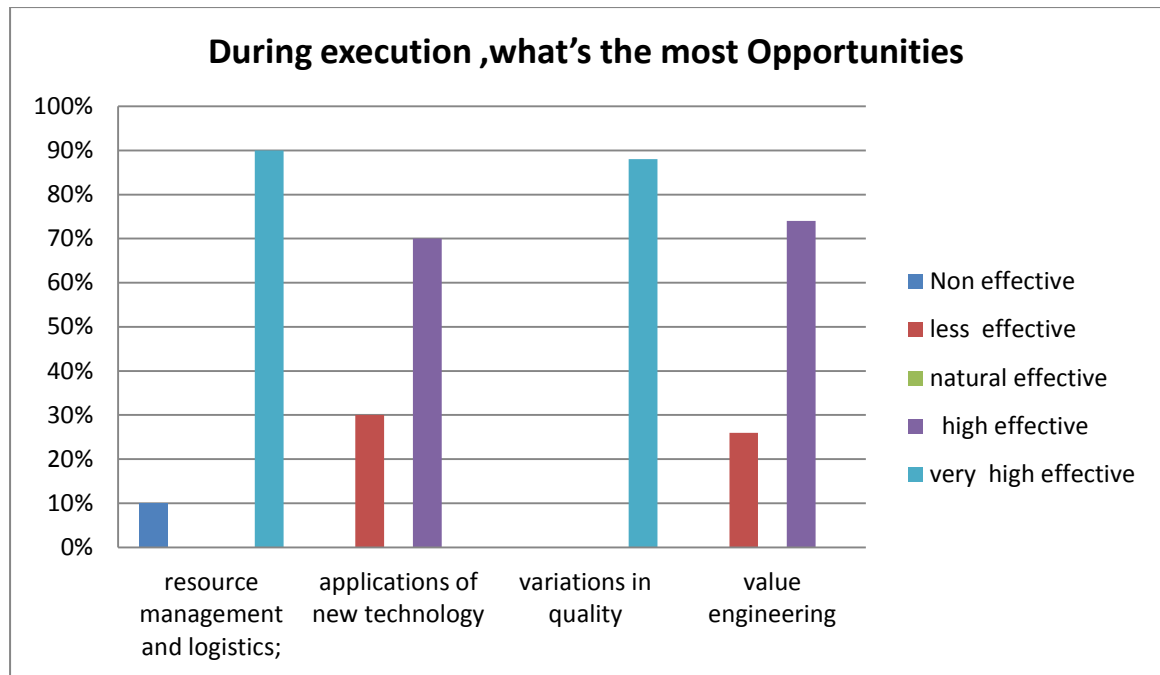
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 26: Mostly ,the result of Corrective action , is translated :

- a) regulating expenditure.
- b) Manage contingencies
- c) Agreeing costs

21. In Mostly ,the result of Corrective action , is translated :

regulating expenditure. Is very effective 90% , Manage contingencies and Agreeing costs 70-80% is effective.



■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

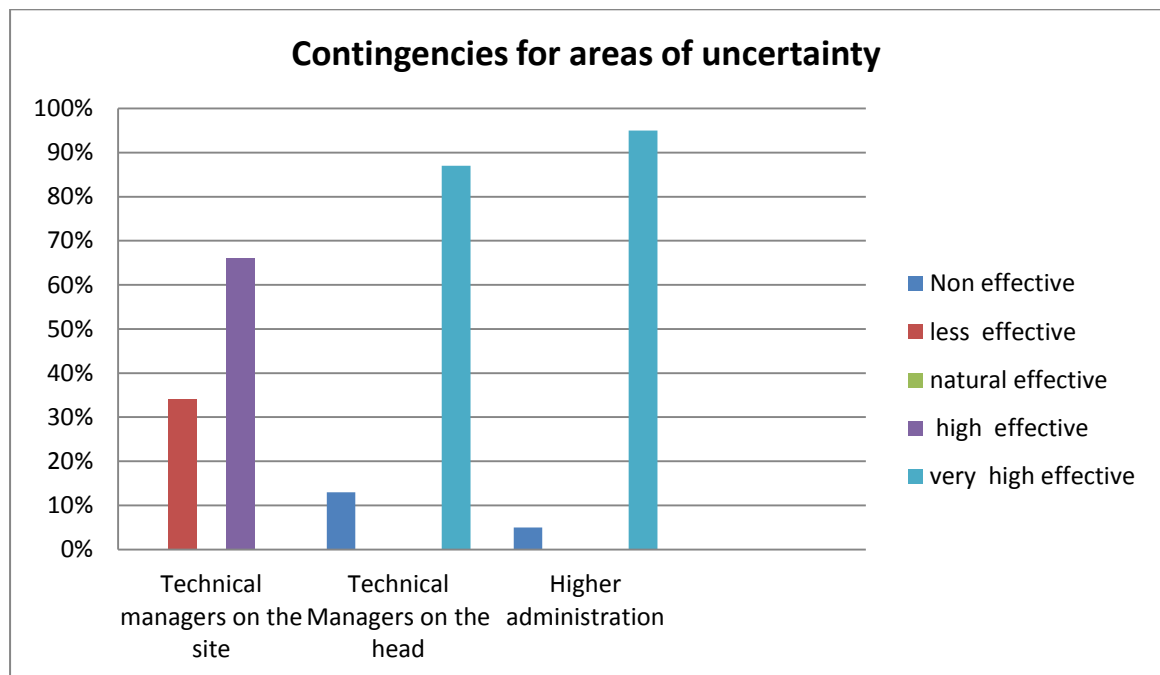
Figure 4- 27: During execution ,what's the most Opportunities for cost saving:

a) resource management and logistics. b) applications of new technology

c) variations in quality d) value engineering.

22. In During execution ,what's the most Opportunities for cost saving:

resource management and logistics and variations in quality is very effective, applications of new technology and value engineering effective .



■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 28: Contingencies for areas of uncertainty or potential difficulty ... On your organization , whom are allowed and authorized for the use of it:

- a) Technical managers on the site. b) Technical Managers on the head
 c) Higher administration level

23. Contingencies for areas of uncertainty or potential difficulty ...

On your organization , whom are allowed and authorized for the use of it:

Technical managers on the sit. effective 66% technical Managers on the head and Higher administration level very effective 83% >

4.1.2.3 SECTION (3) - FACTORS EFFECTING THE LEVEL OF COST CONTROL

When setting the cost plan, critical decision should be made about the level of cost control that should be exerted to control construction cost.

The level of cost control intends to achieve the following:

- 1-** The flexibility to do and to update.
- 2-** The easiness to understand with all techniques & administration level that involve on it.
- 3-** Avoid the expensive over-head which could happen when setting the control procedure.
- 4-** Cost control level must be setting in combination with the other managerial approach (integration management, scope management, time management, quality management, human resources management, communication management, risk management & procurement management).
- 5-** Cost control must assist in achieving the project objectives as well as company objectives.

On deciding on the level of control, all the factors that may affect the project cost should be gathered and evaluated. Such evaluation will aid project personnel and decide which factors contribute most to budget overrun and in turn place tighter control on them.

In this research, the level of control has been presented by studying the following three parameters:

- 1-** The frequency of reporting.
- 2-** The degree of work breakdown structure (W.B.S).
- 3-** The organization breakdown structure (O.B.S).

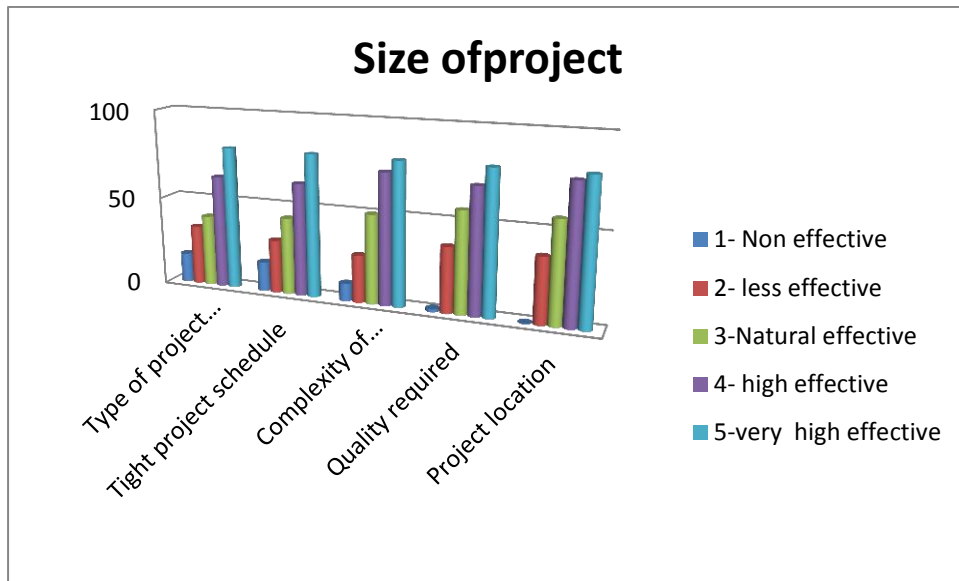
From an extensive review of the literature, twenty five potential factors were found to have an effect on the level of control exerted during construction. These factors were grouped into six categories:

- a) Project characteristics.
- b) Project documents.
- c) Labor characteristics.
- d) Equipment characteristics.
- e) Company characteristics.
- f) Outside influences.

Factors effecting frequency of reporting:

Reporting the project status during construction is considered as one of the most powerful tools for communication among project personnel. These reports may go from up to down, or vice versa differ in their frequencies.

Generally, more frequent reports aid in maintaining tighter control over project cost. At the other hand if it is over load, it will cause in blocking the project progress and will be considered as an expensive procedure comparing with its output.



Non effective
 less effective
 natural effective
 high Effective
 Very high effective

Figure 4- 29: Size of project:

1.1 Type of project (building , road,...etc)

1.2 Tight project schedule

1.3 Complexity of project

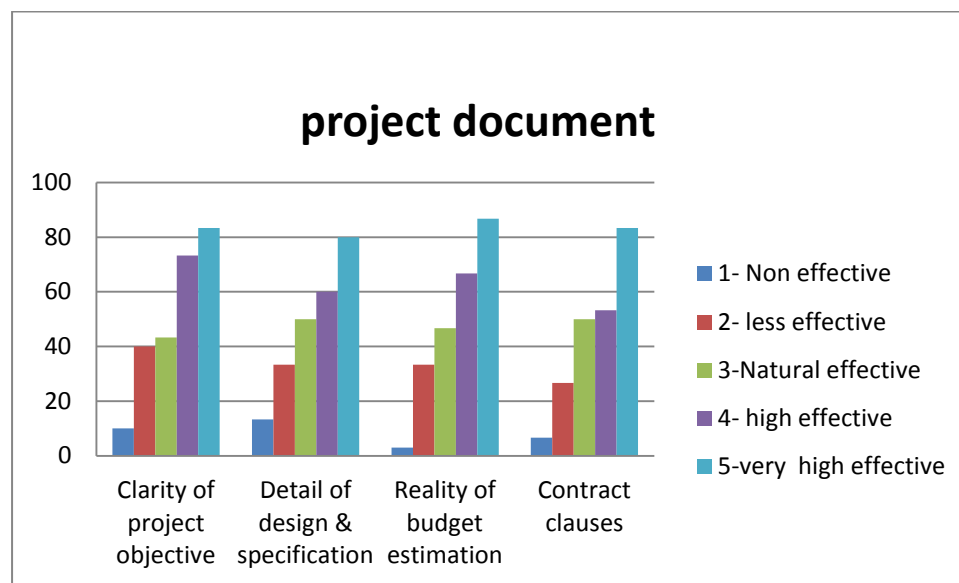
1.4 Quality required

1.5 Project location

1.6 Other

Table 4-12: The size of project

charactier	1- Non effective	2- less effective	3-Natural effective	4-high effective	5-very high effective
The size of project					
Type of project (building , road,...etc)	17	33	40	63	80
Tight project schedule	17	30	43	63	80
Complexity of project	10	27	50	73	80
Quality required	2	37	57	70	80
Project location	0	37	57	77	80
Other					



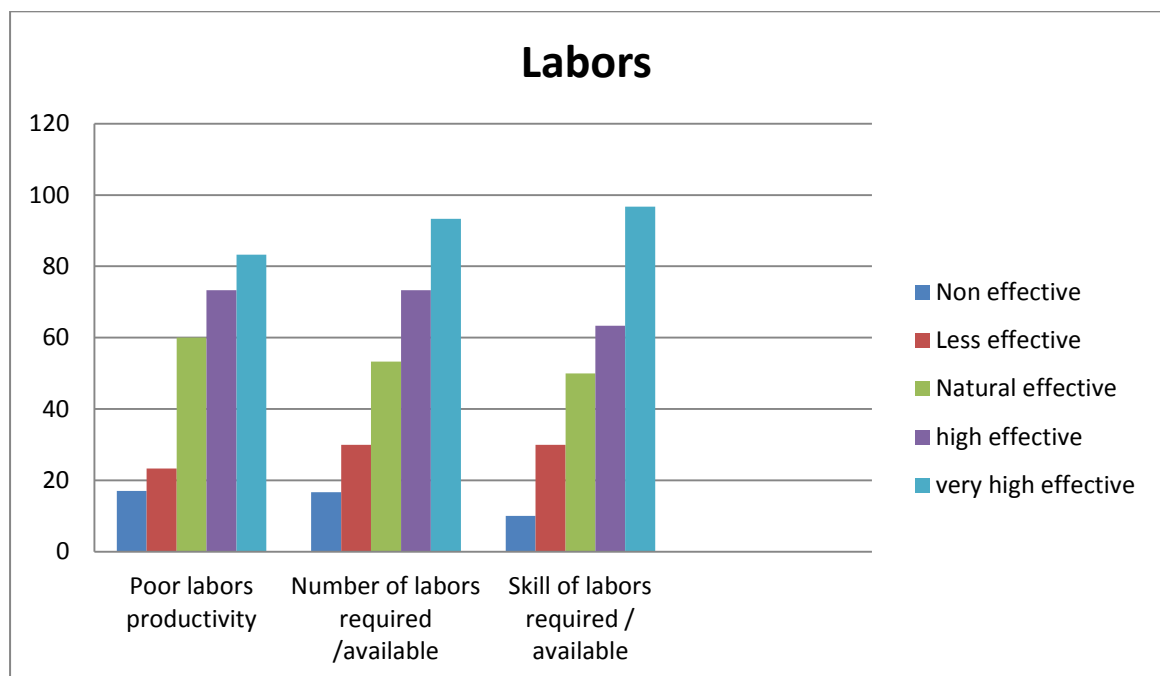
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 30: project document:

- 2.1Clarity of project objective
- 2.2 Detail of design & specification
- 2.3 Reality of budget estimation
- 2.4 Contract claus

Table 4-13: project document

Character	1- Non effective	2- less effective	3-medium effective	4-effective	5-very effective
project document					
Clarity of project objective	10	40.0	43.3	73.3	83.3
Detail of design & specification	13.3	33.3	50.0	60	80
Reality of budget estimation	3	33.3	46.7	66.7	86.7
Contract clauses	6.7	26.67	50.0	53.3	83.3



Non effective
 less effective
 natural effective
 high Effective
 Very high effective

Figure 4- 31: labors:

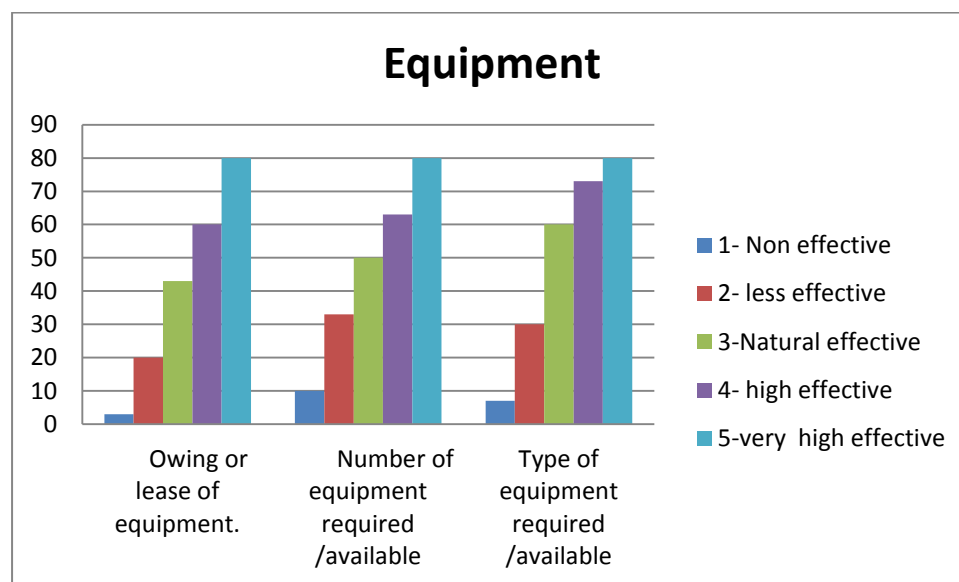
3.1 Poor labors productivity

3.2 Number of labors required /available.

3.3 Skill of labors required / available

Table 4-14: Labors

character	1- Non effective	2- less effective	3-medium effective	4- effective	5-very effective
Labors					
Poor labors productivity	17	23.3	60.0	73.3	83.3
Number of labors required /available.	16.7	30	53.3	73.3	93.3
Skill of labors required / available	10	30.0	50	63.3	96.7



■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 32: equipment.:

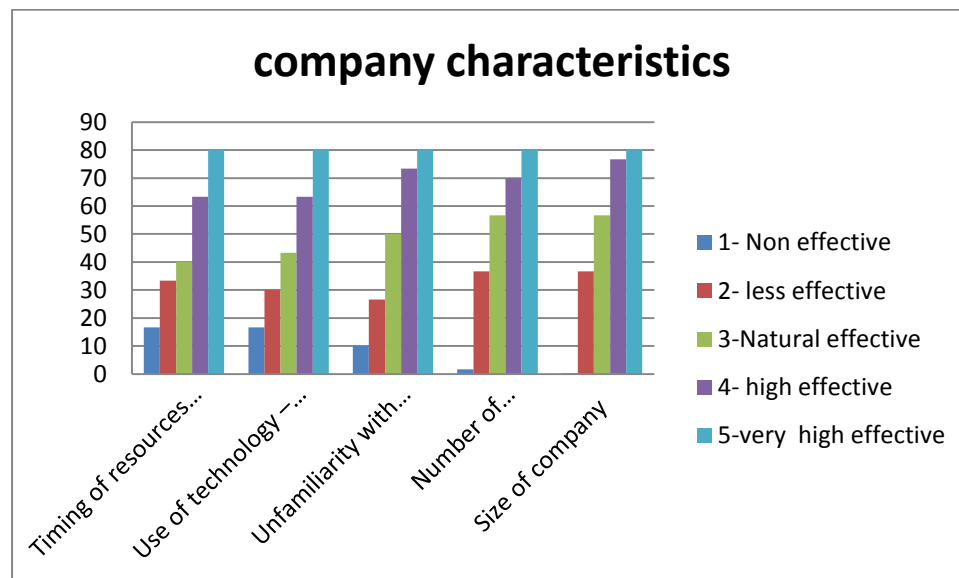
4.1 Owing or lease of equipment.

4.2 Number of equipment required /available

4.3 Type of equipment required /available.

Table(4-15): Equipment

character	1- Non effective	2- less effective	3-medium effective	4- effective	5-very effective
Equipment					
Owing or lease of equipment	3	20	43	60	80
Number of equipment requ ired	10	33	50	63	80
Type of equipment required	7	30	60	73	80



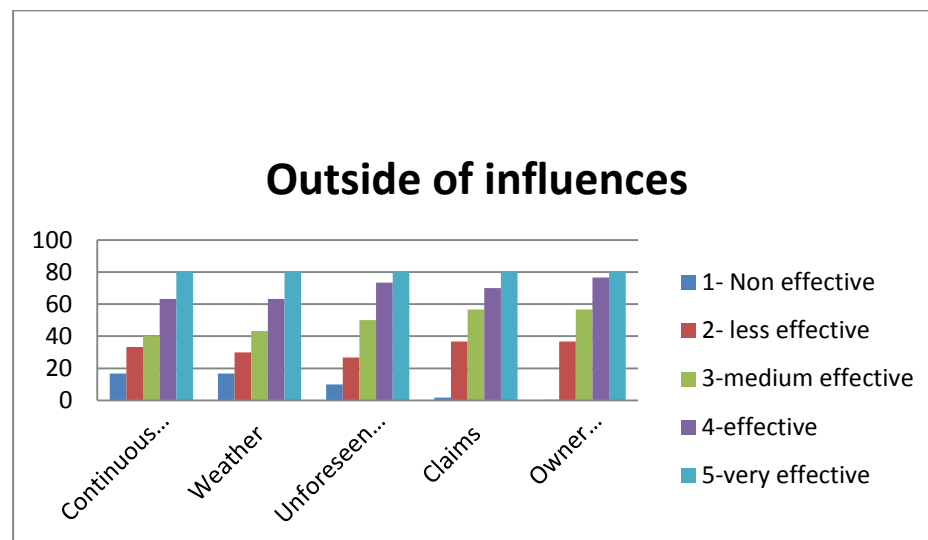
■ Non effective
 ■ less effective
 ■ natural effective
 ■ high Effective
 ■ Very high effective

Figure 4- 33: company characteristics:

- 5.1 Timing of resources procurement
- 5.2 Use of technology –COMPUTER
- 5.3Unfamiliarity with some construction processes
- 5.4Number of member in Board of director
- 5.5 Size of company

Table(4-16): company characteristics

character	1- Non effective	2- less effective	3-medium effective	4- effective	5-very effective
company characteristics					
Timing of resources procurement	7	23	60	63	80
Use of technology – COMPUTER	10	27	57	73	90
Unfamiliarity with some construction processes	7	27	50	67	87
Number of member in Board of director	3	30	43	70	97
Size of company	0	40	50	63	80



Non effective
 less effective
 natural effective
 high Effective
 Very high effective

Figure 4- 34: Outside of influences

- 6.1 Continuous change of government rules and regulations
- 6.2 Weather
- 6.3 Unforeseen condition
- 6.4 Claims
- 6.5 Owner interference during construction

Table 4-17: Outside of influences

Character	1- Non effective	2- less effective	3-medium effective	4-effective	5-very effective
Outside of influences					
Continuous change of government rules and regulations	17	33	40	63	80
Weather	17	30	43	63	80
Unforeseen condition	10	27	50	73	80
Claims	2	37	57	70	80
Owner interference during construction	0	37	57	77	80

From section (3): conclude:

1. Frequency of reporting (freq. of Rep.)

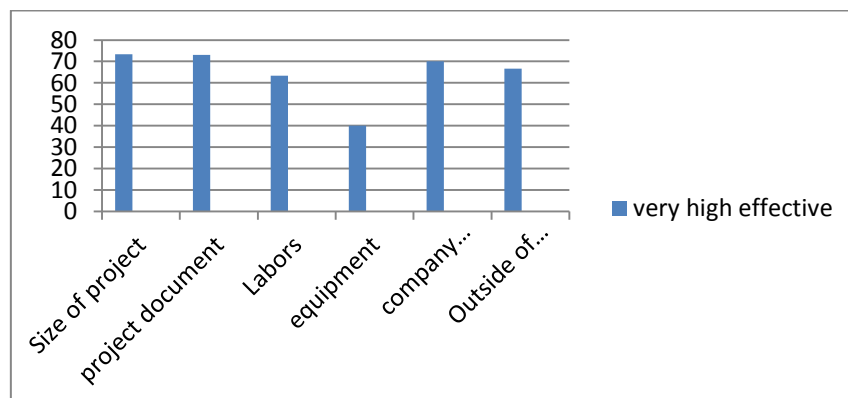


Figure 4- 35 : Frequency of reporting (freq. of Rep.)

- In deciding the frequency of reporting, were found project characteristics, project document and company characteristics were the most important categories. Within these broad categories the type of project (building, road ...etc)/ Tight project schedule/ Complexity of project/Quality required and project location ,reality of budget estimation ,and number of member in board of director were the most important factor

2. Degree of work breaks down structure (W.B.S.)

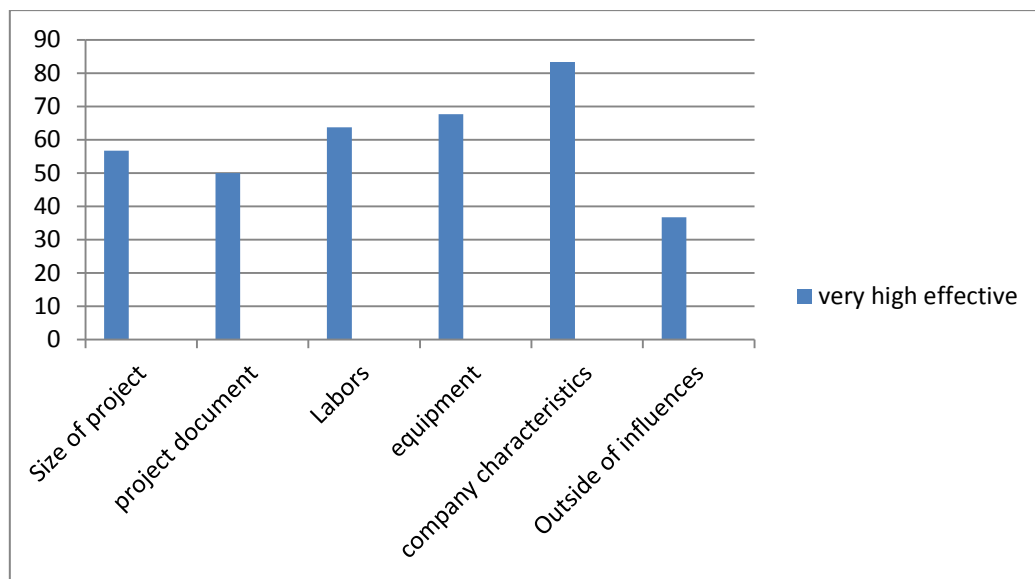


Figure 4- 36 : Degree of work breaks down structure (W.B.S.)

- In deciding the frequency of degree of work breakdown structure(W.B.S) , it has been found company characteristics ,equipment and labors were the most important categories. The most important factors on those categories were the Number of member in board of director, number of equipment required/available and owing or leasing of equipment and skill of labor required/available

3. Degree of organization break down structure (O.B. S)

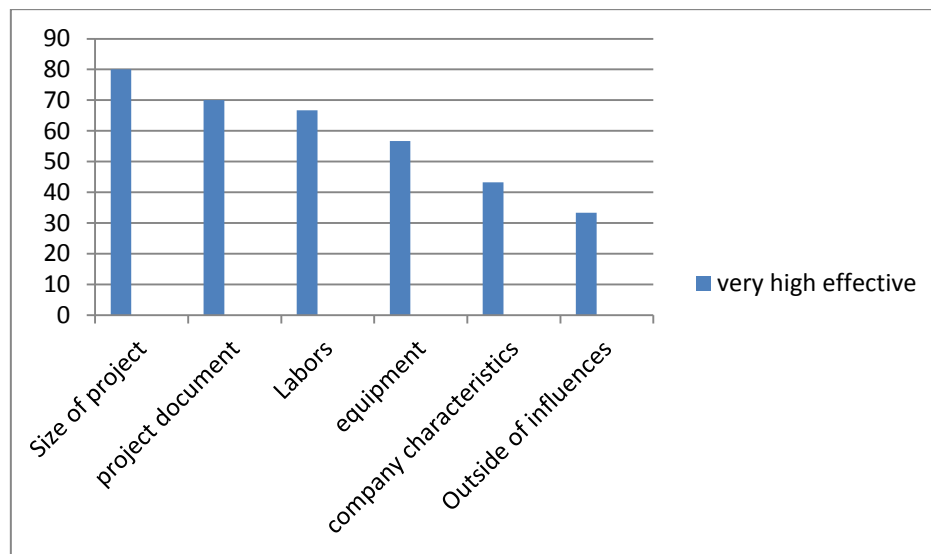


Figure 4- 37 : Degree of organization break down structure (O.B. S)

- organization breakdown structure(o.B.S) is mostly effected by project characteristics, project document and labors were the most important categories . The most important factors on those categories were the type of project (building, road ...etc), reality budget estimation and skill of labor required/available.

4.1.2.3 SECTION (4) – GENERAL INFORMATION

This section of the interview has been taken as a general task of information, regarding the following aspects:

☒ Comment about the Questioner:

The aim of this session is to generate a general evaluation regarding the questioner's structure (weakness/mistakes), as well as any other comments, which could help in adding more feedback to this study...

This information has been used to conduct and re-structure of the questioner as well as the literature review using the (pre-understanding/ understanding spiral) methodology, which has been mentioned in the previous chapter.

☒ Knowledge about Cost Control:

This question has been formed to find out where is the Sudanese construction

industry position is, comparing with the standard and international method of the cost control.... Scales of 1 to 5 have been used to describe the degree of knowledge about the cost control procedure where:

1..... There is totally Lack of knowledge

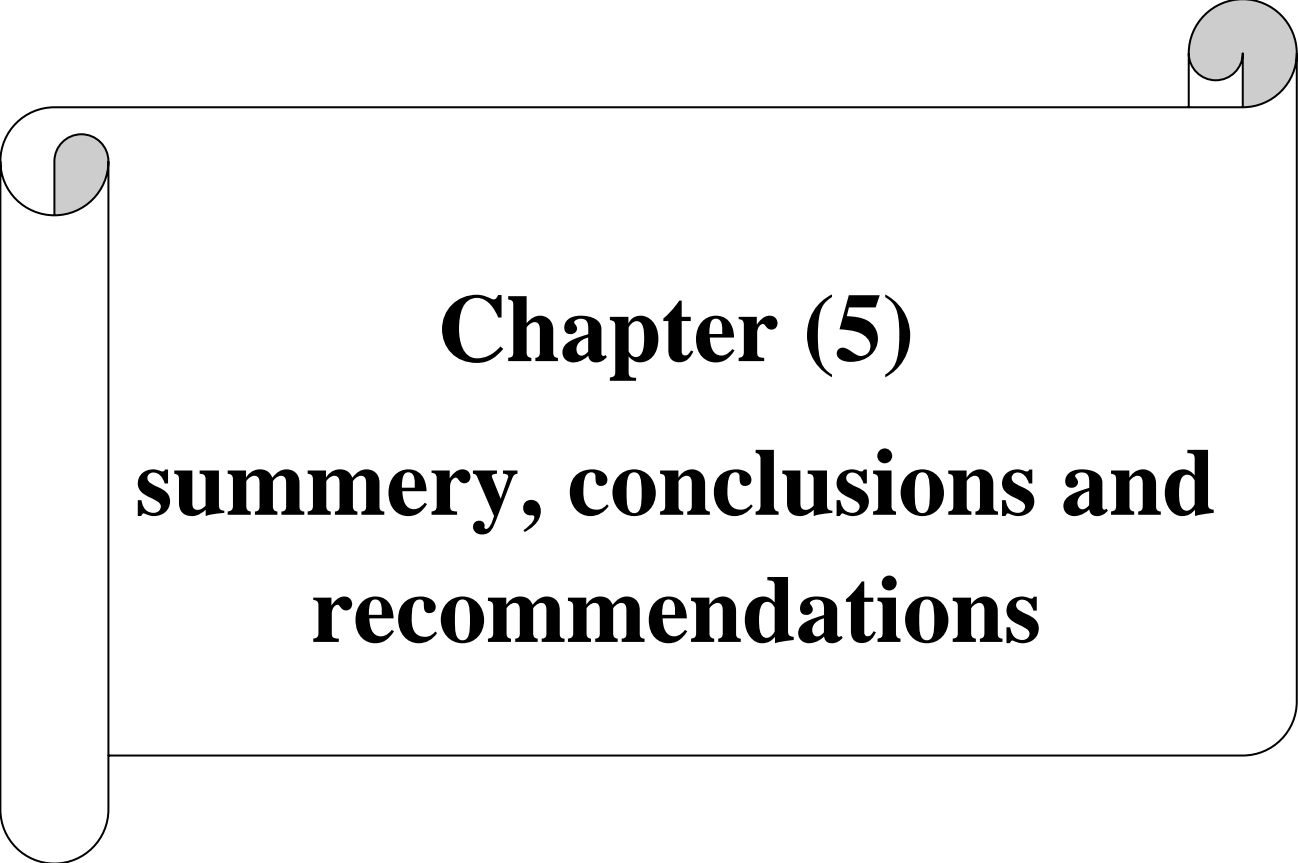
5..... There is a very good knowledge about cost control

The data collected from the interviewees was analyzed using frequency analysis and relative indexes (RI) technique which had been described before. Using the same The following observations have been figured out:

- The relative index was found = 0.56 \equiv there is some lack of knowledge about the cost control for construction industry in Sudan.

- Most of the respondents were relating this lack of knowledge about cost control to the following areas:

- 1- Risk analysis & allocation it on the tender stage and the effective of this process in the cost control during construction stage.
- 2- Preparing appropriate work breakdown structure, and constructed of strong base line for the cost of the project.
- 3- Utilization of coding system to be appropriate with the project components.
- 4- Integrated cost with the other function of the projects such as time control, quality control...etc.
- 5- The relation between cost control department and the other department such as procurement department, financial & accountant department.
- 6- Maintaining the contract clauses in a way that guarantees the controlling of variation order and the method of measurements and payments.
- 7- Applying of value engineering study for cost saving process.
- 8- Using of sophisticated and professionals cost control software.

A decorative graphic of a scroll with a light gray background and a black outline. The scroll is partially unrolled, with the top and bottom edges showing a gray inner layer. The text is centered on the white surface of the scroll.

Chapter (5)

summery, conclusions and recommendations

5.1 STUDY SUMMERY:

Controlling the cost of the project construction is considered as one of the major and most important concerns for any contractor. Due to such an importance, this study is directed towards investigating the current construction cost control practiced among the building construction contractors in Sudan.

Cases studies and questionnaire is the first source in order to achieve the objectives. Besides, literature review also helps to achieve the objectives. Data analysis using relative index and frequency analysis is explained in Chapter 4.

Overall, the objectives of the study were achieved. The following are the objectives that has been achieved:

- what main problem faced by Sudanese contractors in controlling cost of projects?
- What methods do Sudanese contractors follow to control the project's cost? Why these methods are followed in particular?
- what factors that can affect the level of cost control and How can it be ranking?

The study of the cost control method in a construction project was achieved by literature review. The control method used by Sudanese contractor during the construction stage and main problem faced by the Sudanese contractor in controlling the costs of projects was achieved using the cases studies and questionnaires.

5.2 CONCLUSION AND RECOMENDATIONS:

From the study that was done, the conclusion of each objective was achieved. The conclusions from the study that can be made are:

5.2.1 main problem faced by Sudanese contractors in controlling cost of projects :

1. Shortages of material, labor or mechanical plant
2. Difficulty in collection of cost data
3. Ever-changing environment of construction work (e.g. weather)
4. Qualified expertise
5. Duration of the project
6. Additional costs to carry out the cost control system (not beneficial)

The shortage of materials, labor or mechanical plant is the main problem faced by Sudanese contractor in controlling the costs of projects . The duration of the project and additional costs to carry out the system are the least problem faced by faced by Sudanese contractor in controlling the costs of projects.

5.2.2 Method of construction cost control:

The results of this research indicate that the contractors follow a basic logic sequence in cost control. This can be noticed in the following points:

A. Setting for baseline(Budgeting):

1. Division of work item headings especially for certain projects & work divided into major construction components and locations. But for the big company they usually use standard item headings predefined at head office. Regardless of the justification behind these choices, an effective work breakdown structure should reflect

the actual site conditions. These conditions, in effect, aid in determining the appropriate level of W.B.S. details. This level of details will in turn form the basis for determining the most economical and practical number of cost codes, cost Centre, responsibilities Centre...etc.

2. Budgeting of project establishing depends on Analysis of site conditions and subsequent budgetary adjustments. This can be considered as the idle situation for Sudanese construction industry due to the uncertainty about the site condition especially in the bidding stage. In addition, the lack of time and resources at this stage influences the estimating price to be not accurate enough to take it as baseline for the cost control procedure.

B. Procedure of planning, measuring and Reporting:

1. A period between 2-6 weeks was noticed to be the most commonly used for short term planning. Generally, this period can be defined according to the speed and tight of the schedule and the total duration of the project, as well as the nature and complexity of the needs issued at this report. Also the qualifying of the organization staff and the type of relations and communications between the different departments can play an important rule on the frequently of these reports.
2. The commonly way to transfer the situation of the site to the head office is the(Fill in blank-forms and templates); where it seems to be the most systematic and easiest way to do so. On the other hand, the far distance between the head office and the site makes it more reasonable comparing with the supervision site meeting. Furthermore, site meeting needs the higher manager to be involved directly on the site which does not make a scene especially for the big company.

3. Measuring of the actual completed work, and presenting it in way of proportion or absolute numbers, (Units of Work Completed) is the most safe and accurate method to measure the actual work done. Milestones can be used to indicate the percentage of work completed based on historical averages.. This method is better to be used when describing faces finished of the project specially when these faces are well-defined and have no variation from budget or it is relatively a short duration.

C. Analyzing of data obtained:

1. Contractors usually use the estimation price so as to compare the actual cost against it, while this estimating generally is not precise enough; they cover this shortage by breaking down it into small details and then assigning updating information to these packages, gaining by that to a better comparison procedure against the actual performance.
2. When the contractor intends to allocate the working-hours for equipment which is owned by the company, they use daily record of equipment operating hours for each work item. High percentage of lease or rent among the respondents where they are charging for equipment's working & non-working hours by the Summary of Equipment hired invoices.
3. Materials charging during construction were noticed to be highly dependent on invoices. However, since this tool does not show exactly how much is consumed, they always take into account the Field quantity reports for each work item.

D. Variance cause & Corrective action:

1. Informal –tried and true- methods for investigating is widely spread among contractors. But when the deviation from base line is major, they use work study technique for investigating the cause behind it.
2. The causes of cost discrepancy mostly appear from unforeseen cost, and in many cases it appears due to poor construction performance or poor administrative performance.

E. Effectiveness of cost control procedure:

The study sets a clear point about when the contractor intends to keep his project within the base line. He must conduct the aerialist procedure and set the degree of priority to focus on the setting of the baseline at the first place with an accurate and appropriate way, following that with a good tracking and analyzing and then study all the available alternative about the corrective action in case of any cost deviation.

5.2.3 Factors affecting level of cost control:

1. In deciding the frequency of reporting, were found project characteristics, project document and company characteristics were the most important categories. Within these broad categories the type of project (building, road ...etc)/ Tight project schedule/ Complexity of project/Quality required and project location ,reality of budget estimation ,and number of member in board of director were the most important factors.
2. In deciding the frequency of degree of work breakdown structure(W.B.S) , it has been found company characteristics ,equipment and labors were the most important categories. The most important factors on those categories were the Number of member in board of director, number of equipment

required/available and owning or leasing of equipment and skill of labor required/available

3. organization breakdown structure(o.B.S) is mostly effected by project characteristics, project document and labors were the most important categories . The most important factors on those categories were the type of project (building, road ...etc), reality budget estimation and skill of labor required/available.
4. Project characteristics, company characteristic and using of equipment (or not) are the common dominator categories among deciding the frequency of report, the level of work breakdown structure and the degree of the organization break down structure. Inside those categories, the greet impact on deciding on the level of control is directed when defining the type of project (building, road, bridge...etc), tight of project schedule, complexity of project and size of the company.

☒ There are several points that must be overcome when implementing an effective

level of project control, but most are normal characteristics of the construction , such as:

1. to decide the frequency of producing project cost reports (frequency of reporting), tight project schedule should be emphasized.
2. Determine company characteristic (company policy and objective and in-house management efficiency). This could be considered as one of the most influential broad categories on the level of control exerted during construction. The contractors are recommended to study this factor thoroughly when deciding on the appropriate level of control.

3. A major change in the cost control process & level occurs at the start of the Detailed Design Stage.
4. Determine job management and local site condition for the project in hand.

5.3 RECOMMENDATION FOR FUTURE STUDY:

1. The research has produced several outlines which can be a strong base for several extensive studies, this is including but not limited to:
2. The study has been clarifying the relation between the project stage and the cost control process, where it appears that controlling of the project can be more achievable in the earliest stage. Depending on that, farther study can be applied for bidding stage cost control, pre-tendering estimation...etc.
3. Survey study could be done for the software available in the market, which helps in cost budgeting, reporting, and analysis.

A decorative border resembling a scroll, with a vertical strip on the left and rounded corners at the top and bottom. The word "REFERENCES" is centered within the main rectangular area.

REFERENCES

1. Project Management Institute,(2013), A guide to the project management body of knowledge: PMBOK® guide”. 5rd edition , Newtown Square,
2. Joseph Andrew Brown (1978), Construction Cost Control After Bidding, Florida 32899, Nasa Construction Cost Engineer.
3. Barrie, Donald. (1984). Professional of construction Management, Washington USA, McGraw-Hall Inc.
4. Fried, H. O., Lovell, C. A. K. & Schmidt, S. S. (Ed.). (1993), The Measurement of Productive Efficiency: Techniques and Applications, New York, Oxford University Press.
5. Nunnally, S.W. (1998). “ *Construction Methods and Managements*”, Prentice-Hall, Inc., New Jersey, p 501
6. Parker, H.W. (1988). “*Method Improvement For Construction Project*”, Litton Educational Publishing Inc., United States.
7. Ritz, George J. (1994). “ *Total Construction Project Management*” Mc Graw-Hill, USA, pp 242-243
8. Lucey, T (1996), Costing, London and New York, Continuum
9. Edmond Joseph Condon, (2006), The project Game: Strategic Estimating on Major Projects-A Thesis submitted in Partial fulfilment of the fulfilment of the requirements for the degree of doctor of philosophy- university of Calgary, Canada, Library and Archives Canada.
10. Management By Walking Around (MBWA article is licensed under the GNU Free Documentation License, JE , found at
<http://www3.hi.is/~joner/eaps/n5-mbwa.htm>. 10/6/2014.
11. KOH WEE LIANG(2005),Cost control in construction project for the site, University of technology, Malaysia .
12. Samer Al Zamil (1991), Construction Cost Control In the Eastern Province of Saudi Arabia- A Thesis submit in Partial Fullfillment of the Requirment for the Degree of Master of Science in Construction Engineering & Management, from King fahad University-KSA, USA, UMI.
13. Lucey, T. (1996) “*Costing*”, Continuum, London and New York.
14. <http://www.propertyserve.com.cy.1/6/2014>.
15. <http://preciseinfosystems.com.2/6/2014>

A decorative border resembling a scroll, with a vertical strip on the left and a horizontal strip at the top, both featuring rounded ends and a light gray fill.

APPINDEX

INTERVIEW QUESTIONS

(ENGLISH & ARABIC)

INTERVIEW QUESTIONS

Dear Sir /

I am a post-graduate student in MSC in construction management;
currently I am doing a thesis with the title:

(Methods Of Cost Control In Construction Projects In Sudan)

The main objectives of this survey are:

- what main problem faced by Sudanese contractors in controlling cost of projects?
- What methods do Sudanese contractors follow to control the projects cost?
Why these methods are followed in particular?
- what factors that can affect the level of cost control and How can it be ranking?

Thank you.

Yours sincerely,

E.ROWA MOHAMMED ABDUL HALEEM

TEL: 0119492208-0912415922

Please provide the personal details for academic purpose. All the details are private and confidential:

Routine Information :	
Name :	
Company name :	
Position in the firm :	
TEL :	

- All the detail is private and confidential.

SECTION (1): Questions about contractor firm

Please circle the statement (s) that describe (s) your firm.

1. Type of contractor

- a) Building (general building construction ... etc.)
- b) (Highway, bridge Etc)
- c) Plumbing, sanitary, irrigation, water supply.
- d) (Power plants, electro mechanical plants, AC, etc.)

2. Number of permanent Employees in company including Trade and Foremen).

- a) Under 10 b) 10-50 c) 50 - 100
- d) 100-200 e) over 200

3. Value of construction equipment owned (thousands of SDG):

- a) Under 10000 b) 10000- Under 500000 c) 50000- Under 100000
- d) 100000- Under 500000 e) 500000 OR OVER

4. Average of Job size (thousands of SDG):

- a) Under or equal 100000 b) 100000 -500000
- c) 500000- 1000000 d) 1000000 - 2000000
- e) Over 2000000

5. Average of job duration (years):

- a) Under 1/2 b) 1/2 Under 1 c) 1- Under 2
- d) 2- Under 3 e) 3- Under 5 f) 5 or over

SECTION (2): Questions regarding cost control Procedures

- Circle the answer (s) that best describes your firm. You may circle more than one answer.
- In scale of 1-5, please notify how each of these factors can affect the procedure of cost control. Remark it in the circle attached to the question.

1. How the company awarding new project:

- a) Open tendering
- b) Direct order, where the job could assign directly to contractor based on him reputation and if the work it self is needs special experience
- c) Pre-qualification bidding:
- d) Owner is the contractor (developers).

2. Do you put plan for initial costs of the project before starting the design in the company

- a) 0- under 25 % b) 25- under 50%
- c) 50- under 75 % d) 75- 100%

3. How are choice side study for initial costs

- a) Based on the price
- b) Based on the technical evaluation and price

4. What is the percentage of subcontractors work in a given project:

- a) 0- under 25 % b) 25- under 50%
- c) 50- under 75 % d) 75- 100%

5. Percentage of projects which are built at a distance from the company's home office:

- a) None b) 25% c) 50%
- d) 75% e) 100%

6. According to above question how the company establish an area/branch offices (site offices):

- a) None b) depend on project size (SDG)
- c) Depend on project complexity d) Depend on project duration
- e) Depend on how far it's from head office

7. Computerization of cost control procedures are in the form of:

- a) System in the head office
- b) On site level computers system.
- c) Computers system are not used

8. The method for work/breakdown structure for site use depends on:-

- a) Standard item headings predefined at head office (main or total resources for each trade package, i.e. all brick work).
- b) Division of work item headings especially for certain project & work divided into major construction components and locations.
- c) Division of work according to main resources categories per period (i.e. plant, material etc).

9. Budgeting of project establishing depends on:-

- a) Direct use of estimator pricing.
- b) Use of historical record site data.
- c) Analysis of site conditions and subsequent budgetary adjustments.

10. The period for short term planning and control:-

- a) 1 week b) 2-4 weeks
- c) 5-6 weeks d) > 6 weeks

11. Which is (are) utilized for site planning and control:-

- a) Site meetings to discuss problems
- b) Fill-in-the-blank forms and templates.
- c) Bar charts (specify target actual progress).
- d) Office meeting.

12. What is (are) the frequency of measuring actual performance during construction (frequency of cost statements) :

- a) Weekly b) Monthly c) Quarterly
- e) Other _____

13. Which of the following are using as reporting method for actual work-done :

- a) Units of Work Completed measuring of the actual completed work,
- b) Incremental Milestones. Milestones can be used to indicate the percentage of work complete based on historical averages.(i.e. finishing Skeleton = 50% of work)
- c) Opinion, Subjective judgments of the percentage complete.

d) Others _____

14. In analyzing actual cost vs. estimated cost , which of the following system are use :

- a) Comparison with a cost standard (the standard set up by estimation , or from other historical data)
- b) By subdivision by detail (monetary analysis -comparing the money in with the money out for every single item)
- c) by integration with other functions (time, quality...etc)

15. In costing the resources during construction, labor hours are allocated by:

- a) Person observations
- b) Record of man-hours consumed for each work item.
- c) Time books.
- d) There's a fixed cost for labor productivity according to QTY of work done (5 SDG / M2 of plastering)

16. Plant (Equipment) hours are allocated by:

- a) Summary of Equipment hires invoices.
- b) Daily record of equipment operating hours for each work item.
- c) Time sheets of equipment operators.

17. Material consumed for construction is allocated by:

- a) Purchase orders
- b) Invoices
- c) Field quantity reports for each work item

18. In case of any cost deviation, which of the following is (are) utilized for investigating cost discrepancy:

- a) formal investigation.
- b) Inference/Logic/work study
- c) Intuition/Gut feeling
- d) Periodical supervisory meetings

19. When comparing actual vs. - desired level of performance , in most project variance appear due to :

- a) Error in the preparation of estimates.
- b) Unforeseen costs
- c) Construction performance.

d) Poor technical & administrative performance, such as in design of the facility or in the purchases of materials.

e) Special circumstances which have an effect on the site in particular, such as strikes & poor weather.

f) Other _____

20. In case of any cost deviation , variance is calculated as :

a) Absolute numbers

b) Percent of parent budget of work under consideration.

c) Others: _____

21. Mostly ,the result of Corrective action , is translated as :

a) regulating expenditure to conform with budgets;

b) Manage contingencies

c) Agreeing costs

Please set the percentage which it can represent the situation that describe the projects handled by your company at these session.

22. During execution ,what's the most Opportunities for cost saving:

a) resource management and logistics;

b) applications of new technology;

c) variations in quality;

d) value engineering

23. Contingencies for areas of uncertainty or potential difficulty ... On your organization , whom are allowed and authorized for the use of it:

a) Technical managers on the site level. (Site manager).

b) Technical Managers on the head office level (P.M).

c) Higher administration level (chairman, etc).

N.O	Characteristics	Freq of report	Deg. Of WBS	Deg. Of Organization w.B.S
-----	-----------------	----------------	-------------	----------------------------

SECTION (3): Question about the factors that affect the level of control and Financial problems

Depend on your construction Experience in your company, please indicate what impact of the following factors have on the level of cost control in respect of the following aspect:

- a) Frequency of reporting (freq. of Rep.)
- b) Degree of work breaks down structure (W.B.S.)
- c) Degree of organization break down structure (Org .B S...)

Use a scale from 1-5 where

N.O	Characteristics	Freq of report	Deg Of WBS	Deg. Of Organization W.B.S
1	Size of project			
1.1	Type of project (building , road,...etc)			
1.2	Tight project schedule			
1.3	Complexity of project			
1.4	Quality required			
1.5	Project location			
1.6	Other			

1= don't have an effect (Least Important)

5= have a great effect (Very important)

2	project document			
2.1	Reality of budget estimation			
2.2	Detail of design & specification			
2.3	Contract clauses			
2.4	Clarity of project objective			
3	Labors			
3.1	Poor labors productivity			
3.2	Number of labors required /available.			
3.3	Skill of labors required / available			
4	equipment			
4.1	Owing or lease of equipment.			
4.2	Number of equipment required /available			
4.3	Type of equipment required /available.			
5	company characteristics			
5.1	Size of company			
5.2	Number of member in Board of director			
5.3	Unfamiliarity with some construction processes			
5.4	Use of technology – COMPUTER			
5.5	Timing of resources procurement			
6	Outside of influences			

6.1	Continuous change of government rules and regulations			
6.2	Weather			
6.3	Unforeseen condition			
6.4	Claims			
6.5	Owner interference during construction			

SECTION (4): KEY –Questions

Dear Sir,

1. According to the above questionnaire, and depend on your experience through the construction industry in Sudan , what do you think about the cost control managerial approach , please notify your answer in scale of 1-5 where:

1- Theirs totally lack of knowledge.

5- Theirs good knowledge about this approach.

Please clarify you answer:

.....

.....

.....

.....

.....

2. If you have any comments that may help to add more feedback to this study please add below:

.....

.....

.....

.....

.....

استبيان

الاخ الكريم.....

السلام عليكم ورحمة الله

هذا الاستبيان هو جزء من بحث تكميلي لنيل درجة الماجستير في إدارة التشييد وهو

بعنوان (طرق التحكم في تكلفة بمشاريع التشييد بالسودان)

الاهداف الرئيسية لهذا البحث تتمثل في:

- ماهي المشاكل الرئيسية التي تواجه المقاولين السودانيين للتحكم في التكلفة.
 - تحديد الطرق التي يتبعها المقاولون في السودان للتحكم في تكلفة التشييد. ما هي الاسباب الراجعة لاستخدامها.
 - ما هي العوامل التي قد تؤثر على درجة التحكم وتعقيدها وكيف يمكن ترتيبها .
- لكم جزيل الشكر والتقدير لتفهمكم ومنحكم الزمن الازم لاتمام هذا العمل.

رؤى محمد عبد الحليم

0119492208-0912415922

معلومات اولية	
	الاسم
	المؤسسة
	الوظيفة
	رقم التلفون

- هذه المعلومات تبقى سرية وتستخدم فقط للتحليل والاستنتاج لاغراض هذا البحث

القسم الأول

أسئلة عن مؤسسة المقاولات

رجاء ضع دائرة حول (الحالة – الحالات) التي تصف مؤسستك.

1. نوع المشاريع التي تقوم المؤسسة بتنفيذها:

- (أ) مباني عامة (مباني خرسانية – جملونات – مباني متعددة الطوابق الخ)
(ب) طرق وجسور.
(ج) ري وحفريات
(د) الكترولمينيكال – تكييف مصاعد – مكافحة وإنذار حريق.. الخ.

2. عدد العمالة الدائمة في المؤسسة:

- (أ) أقل من 10 (ب) من 10-50
(ج) من 50-100 (د) من 100-200
(هـ) أكثر من 200

3. عدد العمالة المؤقتة في الشركة:

- (أ) أقل من 10 (ب) من 10-50
(ج) من 50-100 (د) من 100-200
(هـ) أكثر من 200

4. قيمة المعدات البناء المملوكة للشركة (بالجنيه السوداني):

- (أ) أقل من 10000 (ب) من 10000-50000
(ج) من 50000-100000 (د) 100000-500000
(هـ) 500000 أو أكثر

5. متوسط المشاريع التي تقوم بتنفيذها الشركة سنوياً (بالجنيه السوداني):

- (أ) أقل من أو يساوي 100000 (ب) 100000 - 500000
(ج) من 500000-1000000 (د) 1000000 - 2000000
(هـ) 2000000

6. متوسط فترة تنفيذ المشاريع (بالأعوام):

- (أ) أقل من 1/2 (ب) 1/2 - أقل من 1
(ج) 1 - أقل من 2 (د) 2 - أقل من 3
(هـ) 3 - أقل من 5 (و) 5 أو أكثر

القسم الثاني

أسئلة عن طريقة التحكم في التكلفة

-ضع دائرة حول أفضل ما يصف مؤسستك يمكنك اختيار أكثر من إجابة واحدة.
في الدرجات من(1-5) رجاء وضع كيفية تأثير كل من هذه الأدوات علي طريقة التحكم في التكلفة ، ضع العلامة في الدائرة بجانب السؤال.

1=لا يوجد تأثير 5=يوجد تأثير كبير

1.كيف تتحصل الشركة علي المشاريع جديدة:

(أ) عطاء مفتوح لجميع الشركات

(ب) ترسية مباشرة للمشروع دون اللجوء لعطاء

(ت) عطاء لشركات تم تأهيلها سابقا

(ث) المالك هو الشركة المنفذة

2.هل يتم وضع خطة للتكاليف الاولية للمشروع قبل البدء في التصميم في مؤسستكم:

(أ) -اقل من 25% (ب) 25%-اقل من 50%

(ج) 50%-اقل من 75% (د) 75%-100%

3.تتم اختيار الجهة الدراسية للتكاليف الاولية:

(أ) على اساس السعر

(ب) على اساس التقييم الفني والمالي

4.نسبة المقاولين من الباطن في المشاريع المنفذة بواسطة الشركة:

(ب) 0-اقل من 25% (ب) 25%-اقل من 50%

(ج) 50%-اقل من 75% (د) 75%-100%

5.نسبة المشاريع التي تبني بعيدا عن مقر الشركة:

(أ) لا شيء (ب) 25%

(ج) 50% (د) 75%

(هـ) 100%

6.تبعاً للسؤال السابق كيف تؤسس الشركة فرعاً لها او مكتب للموقع:

(أ) لا يوجد (ب) اعتماداً علي قيمة المشروع.

(ج) اعتماداً علي درجة تعقيد المشروع (د) اعتماداً علي مدة تنفيذ المشروع.

8. (ه) اعتمادا علي بعد المشروع من المقر الرئيسي للشركة.

7. استخدام الكمبيوتر في عملية التحكم في التكلفة يكون في شكل:

(أ) استخدام النظام في المكتب الرئيسي فقط.

(ب) استخدام الكمبيوتر علي مستوي الموقع والمكتب.

(ج) عدم استخدام الكمبيوتر.

8. طريقة تقسيم نشاطات المشروع (W.B.S) تعتمد علي:

(أ) عناصر تم تعريفها مسبقا في المكتب الرئيسي المواد الرئيسية أو الكلية لتنفيذ نشاط معين في المشروع (مثال :أعمال البناء بالطوب الأحمر).

خصيصا لمشروع معين وتقسيمه اعتمادا علي النشاطات الرئيسية للمشروع

(ب) تقسيم (W.B.S) أعمال الهيكل الخرساني –أعمال التشطيباتي ---- - الخ (أو تقسيمه حسب مواقع

المباني (المبني الشمالي – المبني أ – المبني ب – المبني ج الخ)

(ج) تقسيم المشروع حسب الموارد الرئيسية (نوع المعدات – نوع المواد – نوع العمالة الخ).

9. عمل موازنة للمشروع يعتمد علي:

(أ) الاعتماد المباشر علي تسعر العطاء

(ب) استخدام بيانات مسبقة لمشاريع مشابهة

(ج) الاعتماد علي حالة الموقع

10. تقرير احتياجات المشروع يتم إعداده كل:

(أ) أسبوع واحد

(ب) 2-4 اسبوع

(ج) 5-6 اسابيع

(د) أكثر من 6 أسابيع

11. ماهي الطريقة المعتمدة لعمل تقرير وتخطيط لأعمال الموقع:

(أ) اجتماعات بموقع المشروع

(ب) استخدام فورمات ثابتة يتم ملئها بواسطة المسؤولين بالموقع

(ج) مخطط زمني (يوصف التطور المستهدف والفعلي)

(د) اجتماعات بالمكتب الرئيسي.

12. ماهي المدة المعتادة لقياس الأداء الفعلي أثناء المشروع:

(أ) أسبوعيا (ب) شهريا

(ج) ربع سنويا

13. ماهي الطريقة المتبعة لرفع تقرير بكمية العمل المنجز:

(أ) كمية العمل المنجز (بالوحدات – أو بالنسبة المئوية).

(ب) المراحل المنجزة آليا أو جزئيا (مثال 50 % من أعمال الهيكل الخرساني)

(ج) بالتقريب (وصف العمل المنجز بنسب تقريبية دون اللجوء للقياس الدقيق

14. في عملية تحليل التكلفة الحقيقية للمشروع في مقابل موازنة المشروع ، أي من الطرق التالية يتم استخدامها:

(أ) (المقارنة مع التكلفة التقديرية في مرحلة العطاء أو مع التكلفة السابقة لعنصر متشابه في مشروع آخر.

(ب) مقارنة العامة بين العائد والمنصرف.

(ج) دمج عملية التحكم بالتكلفة وعمليات إدارية أخرى (زمن ، جودة ، إلخ)

15. في عملية التقييم للموارد المستهلكة في المشروع ، كيف يتم تقييم ساعات العمالة:

(أ) (الآخذ بمراقبة المسئول عن العمالة شخصيا.

(ب) سجلات خاصة لحساب ساعات العمل لكل منصرف المشروع

(ج) سجلات الدخول والخروج من الموقع

(د) هناك سعر ثابت للعمالة نسبة لكمية ووحدة العمل المنجز (مثلا 5 ج/م 2 لأعمال الدهان).

16. عملية تقييم ساعات العمل للآليات:

(أ) فواتير الإيجار للآليات.

(ب) كشف يومي لساعات عمل الأجهزة لكل عنصر عمل.

(ج) دفتر مواعيد العمل للآليات.

17 . عملية تقييم مواد البناء المستهلكة بالمشروع يتم عن طريق:

(أ) (أمر الشراء (ب) فواتير الشراء

(ج) سجلات خاصة بالمواد المستهلكة لكل عنصر.

18. في حالة الانحراف عن التكلفة ، ما هي الآلية المتبعة للكشف عن سبب الانحراف:

(أ) (التقصي والبحث الغير الرسمي.

(ب) استخدام طرق منطقية / دراسة منظمة وعملية

(ج) استخدام الحدس والبديهة

(د) استخدام الزيارات الميدانية للبحث والتقصي

19. ماهي الأسباب الشائعة لانحراف التكلفة للمشاريع التي تعمل بها الشركة:

(أ) (خطأ في إعداد التكلفة التقديرية وموازنة المشروع.

(ب) تكاليف غير منظورة.

(ج) الأداء عند التنفيذ.

(د) الأداء الإداري أو التقني (عملية التصميم ، سياسة المشتريات... إلخ).

20. في حالة الانحراف ، يتم التعبير والإظهار له عن طريق:

(أ) أرقام مطلقة . (ب) بنسبة مئوية

21. عملية تصحيح انحراف التكلفة تكون عن طريق:

(أ) تصحيح المنصرفات لتوافق الميزانية مرة أخرى.....

(ب) استخدام المبلغ أو الكمية الاحتياطية الموضوعية في الموازنة.....

(ج) القبول بالانحراف الموجود.....

-الرجاء وضع نسبة مئوية منسوبة إلي استخدام هذه الحالات في المشاريع التي تقوم بتنفيذها الشركة.

22. كيف تتم عملية تصحيح الانحراف في التكلفة:

(أ) إدارة موارد المشروع

(ب) استخدام تقنيات مختلفة جديدة لتنفيذ المشروع

(ج) التقليل من جودة العمل

(د) استخدام دراسات الهندسة القيمة

23. من هو المصرح له باستخدام المبلغ أو الكمية الاحتياطية الموضوعة في الموازنة:

(أ) مدير الموقع

(ب) مدير المشروعات بالمكتب الرئيسي

(ج) مستوي إداري اعلي (مدير تنفيذي ، مجلس إدارة ، ...)

القسم الثالث

أسئلة عن درجة التحكم في التكلفة والمشاكل المالية

- اعتمادا علي خبرتك في أعمال الإنشاءات ، الرجاء تحديد تأثير العوامل أدناه في تحديد درجة التحكم في التكلفة ، حيث يتم تعريفها من خلال ثلاث محددات:
- (أ) فترات إعداد التقارير.
- (ب) درجة تقسيم مكونات المشروع.
- (ج) درجة تقسيم الهيكل الوصفي
- الرجاء استخدام درجات قياس من 1-5 حيث:
- 1=لا يوجد تأثير 5= يوجد تأثيرا كبير جدا

الرقم	الوصف	فترات إعداد التقارير	تقسيم درجة مكونات المشروع	تقسيم درجة الهيكل الوظيفي
1	حجم المشروع			
1.1	نوع المشروع (مباني ، طرق... ، الخ)			
1.2	مدة تنفيذ المشروع			
1.3	تعقيد المشروع			
1.4	درجة الجودة المطلوبة			
1.5	موقع المشروع			
1.6	اخرى			

الرقم	الوصف	فترات إعداد التقارير	تقسيم درجة مكونات المشروع	تقسيم درجة الهيكل الوظيفي
2	المشروع مستندات			
2.1	دقة عملية تقدير الموازنة			
2.2	التفاصيل بالتصميم والمواصفات			
2.3	بنود العقد			
2.4	وضوح الهدف من المشروع			
3	طبيعة العمالة			
3.1	إنتاجية العمالة			
3.2	عدد العمالة المطلوبة \ المتوفرة			
3.3	مهاراة العمالة المطلوبة \ المتوفرة			
4	طبيعة معدات الإنشاء			
4.1	امتلاك أو إيجار المعدات			
4.2	عدد الآليات المطلوبة \ المتوفرة			
4.3	نوع الآليات المطلوبة \ المتوفرة			
5	طبيعة الشركة			
5.1	حجم الشركة			
5.2	أعضاء مجلس الإدارة			
5.3	عدم الخبرة ببعض أنواع المشاريع			
5.4	استخدام التكنولوجيا – الكمبيوتر			
5.5	سياسة المشتريات			
6	عوامل خارجية			
6.1	التغيير الدائم للقوانين والتشريعات الحكومية			
6.2	حالة الطقس			
6.3	أشياء غير منظورة			
6.4	المطالبات (زمنها ، تفاصيلها)			
6.5	تدخل المالك أثناء التنفيذ			

القسم الرابع

سؤال مفتاحي

1. على ضوء هذا الاستبيان و بالاستناد الى خبرتك العملية كيف تقيم درجة استيعاب شركات المقاولات السودانية لعملية التحكم في التكلفة ...الرجاء نسب اجابتك الى مقياس من 1 الى 5 حيث:

1=هناك عدم فهم كامل.

5=هناك فهم متكامل لهذه العملية.

الرجاء توضيح بعض الجوانب التي تنسب اليها اجابتك السابقة:

.....

.....

.....

.....

2. هل لديك اي تعليق او اضافة الى هذا الاستبيان :

.....

.....

.....

.....