an University of Science and Techn
College of Graduate Studies

Evaluation of Cost and Time Control using Earned Value in Building Projects in Khartoum State

تقويم التحكم في التكلفة والزمن بإستخدام القيمة المكتسبة في مشاريع البناء في ولاية الخرطوم

A thesis submitted in Partial Fulfillment for the Requirements of degree of M.S.C in civil engineering construction.

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بسم الله الرحمن الرحيم

قال تعالى:

{لاَ يُكَلِّفُ اللّهُ نَفْساً إِلاَّ وُسْعَهَا لَهَا مَا كَسَبَتْ وَعَلَيْهَا مَا اكْتَسَبَتْ رَبَّنَا لاَ تُؤَاخِذْنَا إِن نَّسِينَا أَوْ أَخْطَأْنَا رَبَّنَا وَلاَ تَحْمِلْ عَلَيْنَا إِصْراً كَمَا حَمَلْتَهُ عَلَى الَّذِينَ مِن قَبْلِنَا رَبَّنَا وَلاَ تُحَمِّلْنَا مَا لاَ طَاقَةَ لَنَا بِهِ وَاعْفُ عَنَّا وَاغْفِرْ لَنَا وَارْحَمْنَا أَنتَ مَوْلاَنَا فَانصُرْنَا عَلَى الْقَوْمِ الْكَافِرِينَ }

صدق الله العظيم

سورة البقرة الآية **286**)

Dedication

My humble effort, love, encouragement and prays of day and night, make me able to get such success honor

To My dear Mother

A strong and gentle soul who taught to trust in Allah, believe in hard work and that so much could be done with little

To My father

For earning an honest living for us and for supporting and encouraging believe in my self

To My all Family and My Friends

They have been a tremendous source of supporting and "fighting" during this period

Acknowledgment

I would like to thank Allah for giving me the strength to finish this research.

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My supervisor for her continuous guidance and encouragement.

I respectfully thank he not only for he thoughtful insights about clarity , coherence , but also for her high standards and valuable comments during the ups and downs in research preparation , that gave me confidence in myself and my work.

Finally if the study appears to have merits, my sincere thanks are due to Allah, but if fault is found it is mine.

Abstract

In the period between 2016-2019 and the problem of searching for roads lies in the cost and time of projects in the construction experience in Sudan from exceeding the time specified in the contract between the owner and the executing party and exceeding the cost in contracts

The research aims to know the cost and time control, monitor the project status and forecast the final work cost, to address weaknesses and defects in the plan and early identification of risks at the beginning of the project.

The study hypothesized that there is a relationship between controlling construction projects, namely controlling cost and time, monitoring the project's status through updating project costs, managing changes to the cost baseline, forecasting the final work cost, dealing with weaknesses and defects in the plan, reducing losses that occur when achieving the desired results.

The research followed the descriptive and analytical method

A case study was done for the Al-Sajana Commercial Tower project by collecting its data. A questionnaire was designed for workers in construction projects in Khartoum State targeting the engineering engineers registered in the engineering group. The approved number of participants was 110 participants. The research reached several results that demonstrated inflation has a major impact on project resources.

The earned value is more used in construction projects in Sudan because it is considered one of the most successful ways to monitor the project and forecast what it will be in the future.

The research reached several recommendations, including qualifying the administrative staff for construction projects in Sudan to use cost estimation methods in institutions, developing the role of administrative departments such as planning, follow-up, studies, designs and technical specifications for contracts to facilitate the implementation of projects

المســتــخلـــص

تناول البحث تقييم التحكم في التكلفة والزمن بإستخدام إدارة القيمة المكتسبة ومنهج تحليل التكلفة لمشاريع البناء في ولاية الخرطوم الفترة من 2016-2019م وتكمن مشكلة البحث في إيجاد أفضل الطرق في التحكم في تكلفة وزمن المشاريع إذ تعاني مشاريع التشييد في السودان من تجاوز الزمن المحدد في العقد بين المالك والجهة المنفذة وتجاوز التكلفة المحددة في العقود نسبة لتذبذب أسعار السوق والتضخم والحالة الإقتصادية التي يمر بها السودان .

يهدف البحث إلى معرفة ضبط التكلفة والزمن ومراقبة حالة المشروع والتنبؤ بتكلفة العمل النهائية ، لمعالجة نقاط الضعف وأماكن الخلل في الخطة والتحديد المبكر للمخاطر في بداية المشروع.

افترضت الدراسة هنالك علاقة بين التحكم في مشاريع التشييد تتمثل في ضبط التكلفة والزمن ومراقبة حالة المشروع من خلال تحديث تكاليف المشروع وإدارة التغيرات على خط الأساس للتكلفة ، التنبؤ بتكلفة العمل النهائية والتعامل مع نقاط الضعف وأماكن الخلل في الخطة ، تقليل الخسائر التي تحدث عند تحقيق النتائج المرغوبة.

أتبع البحث المنهج الوصفي التحليلي والمنهج الاستقرائي

تم عمل دراسة حالة لمشروع برج السجانة التجاري عبر تجميع البيانات الخاصة به تم تصميم استبيان للعاملين بمشاريع البناء بولاية الخرطوم مستهدفين شريحة المهندسين المسجلين في الهندسي وكان العدد المعتمد للمشاركين 110 مشارك . وتوصل البحث إلى عدة نتائج أثبتت التضخم له تأثير كبير على موارد المشروع .

القيمة المكتسبة أكثر استخداماً في مشاريع التشييد في السودان لأنها تعتبر من أنجح طرق مراقبة المشروع والتنبؤ بما سيكون عليه مستقبلاً.

توصل البحث إلى عدة توصيات منها تأهيل الكادر الإداري لمشاريع التشييد في السودان علي استخدام طرق تقدير التكلفة في المؤسسات، تطوير دور الأقسام الإدارية كالتخطيط والمتابعة والدراسات والتصاميم والمواصفات الفنية للعقود لتسهيل عملية تنفيذ المشاريع.

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Chapter One

Introduction

Chapter One

Introduction

1.1 General Introduction:

In the development of any country, the construction industry plays vital roles in transforming the aspirations and the needs of its people into reality by implementing various physical structures construction project is commonly acknowledged as successful when it is completed on time, within budget, and in accordance with specifications and to stakeholder's satisfaction.

Most project managers and contractors in Sudan find difficulty in controlling costs on their construction sites due to a number of problems which include poor project preparation, lapse in management and control, over budgeting, shortages in materials, labor shortages, increased cost of materials, delays in deliveries, wastage of materials, unexpected weather changes, loss of materials, This results unexpected weather changes, loss of materials, This results into cost and time overruns, conflicts, and sometimes abandoning projects. This study was therefore carried out to identify the cost and time control techniques used in Sudan and propose effective.

Project management, as a scientific discipline, has been developed since the 1960' [(1)] .

At that time, projects were largely independent endeavors with a relatively long Implementation period, calculated in months or years.

Their level of complexity was usually high and, therefore, budgetary concerns were a significant factor. As a result, the main effort was put into the detailed planning of tasks and then controlling the implementation of the projects in relation to former assumptions[(1).]

The turbulent, global environment put additional pressure on companies to significantly reduce the time spent on the development of new products [2].
and to customize their services to clients' needs [3].

Moreover, companies started to more carefully calculate their level of investment in project management As a result, new methods of managing projects had to be developed, which are hereinafter referred to as the modern project management approach [4].

Although traditional project management methods are well established, having been developed over a long period of time, it seems that they are no longer sufficient to overcome the challenges that companies face nowadays The shorter time- to- market demand, cost- cutting tendencies and increasing pressure on innovations are of high interest in companies.

Project managers should monitor and control the outcomes against the plan in the following areas :[4]

- Project Integration Management
- Project Scope Management
- Project Time Management
- Project Cost Management
- Project Quality Management
- Project Human Resource Management
- Project Communications Management
- Project Risk Management
- Project Procurement Management
- Project Stakeholder Management

1.2 Research Scope and Limitations:

The research work deals with the construction industry in Sudan with special focus on building projects in Khartoum. The researcher will cover the construction stage considering the factors causing and their impact and the assessment will be based on two performance dimensions: time and cost.

1.3 Research Problem:

Most contracting companies in Khartoum are concerned with the time factor only to complete the project, ignoring the rest of the elements, which leads to weak control over the project resources, also the Problems are identified during the implementation of project so that lead to delays in time and high cost and low performance.

1.4 Research Objectives:

1. An evaluation of the importance of using the earned value and explanation of how to use this methods to controlling cost and time scientifically in the process of control engineering projects in Sudan
2. Choosing the best scientific method of The Earned Value management or Cost Analysis to address the problem of cost overruns, waste of time and delay in implementation
3. Monitor the project by controlling the budget and schedule.

1.5 Research hypotheses:

To address this problem, the following main hypothesis will be put forward:

1. Project management using earned value management techniques can optimize the total project duration and cost. Through control of various parts before, after and during implementation to correct and to be and to take more appropriate

Procedures and methods to clarify the difference between the success and failure of project performance within the estimated duration and cost

Based on the main hypothesis, a number of the following sub-assumptions can be formulated

1. Project success depends on the accuracy of scheduling and good planning of various processes and stages
2. Coordinating and prioritizing the implementation of project activities is one of the most important factors for its success planning and follow-up techniques enable the scheduling and follow
3. up of project implementation and control over the duration of its implementation
4. The success and failure of project performance within the estimated duration and cost. Internal and external factors affecting on controlling of the cost and time of the projects.

1.6 Research Methodology:

This research adopts a combination of quantitative and qualitative methods.

It was conducted in two stages. The first stage was conducted using a quantitative method through a questionnaire survey in a bid to generate information from a large sample the descriptive approach.

In order to test the validity of the hypotheses, the case study will be applied to the application side Study discuss the major characteristics and highlight the key differences between traditional and earned value project control methods.

1.7 Research layout

Chapter One: Introduction- Chapter one covers the overall introduction of the research, the problem statement, objectives and methodology to reach these objectives, research hypotheses and area of study.

Chapter Two: Literature Review and previous studies-

This chapter covers all literature review about construction project and explores previous studies related to .definition of earned value management, the cost analysis, performance management, and how to measures it.

Chapter Three: Data Collection– Discussing studied cases and the survey approach and the method of Collecting data, selecting the appropriate causes from the compiled list and confirming this selection through semi-structured interviews. It also discusses the questionnaire, the sample size and methods using in the results analysis and discussing.

Chapter Four: Results analysis and discussion -The overall studied cases and survey results are presented for each part. The opinion of each party is presented individually and a degree of agreement between parties was concluded

Chapter Five: Recommendations and Conclusion

Discussion the Conclusion, Recommendations, The References researcher use and Appendices

Chapter Two

Literature Review

Chapter Two

Literature Review and Previous Studies

2.1 Introduction

Accurate construction planning is a key determinant in ensuring the delivery of a project on schedule and within budget [5]. As construction is becoming more complex, a more sophisticated approach is necessary to deal with initiating, planning, financing, designing, approving, implementing, and completing a project.

Identified five key factors affecting schedule performance; frequency of meetings, amount of time that project manager devotes to the project, project manager's experience, monetary incentives to designers, and implementation of constructability program[6].

Budget control is an important criterion for construction project success, the same can be said for construction schedule control.

2.1.1 PROJECTS MANAGEMENT

Project management as "application of knowledge, skills, tools and techniques to project activities to meet project requirements. Project management is accomplished through the application and integration of the project management processes of initiating, planning, executing, monitoring and controlling, and closing" [7].

2.1.2 Definition of the project

A project is a temporary endeavor undertaken to produce a unique product, service or result Temporary means that every project has definite beginning and end.

Unique means that this product, service, or result is different from others that may have preceded it

2.1.3 The theoretical basis for project management

The discipline of project management has undergone significant changes in the past 60 years, from both practitioners' and researchers' point of view. The fact that the changes took place in this fashion led to considerable progress in the professionalism of project management. Influences from organizational and management theory also provided valuable insights.

From a practical perspective, a growth in project work is recognizable through different-if not most-industries and industrial sectors. This leads to an increasing importance of project management and project management processes, which are slowly acknowledged as regular business processes creating value [8]. The rising significance is also obvious in the number of companies offering project management products and/or services, as well as a multitude of practically and academically oriented conferences on project management topics.

From an academic view, the call for a broader view of project management and an integration of further academic disciplines, such as the social sciences, is getting louder One aim is to better understand and explain why approved and successful measures in project management work in practice. The theoretical foundations underlying these practices also deserve a closer look, as does the question of which further practices can be successful under which circumstances. Even though the body of knowledge established in project management is "rich and helpful" it still takes on a rather practical view and often does not address the deeper-lying issues and interdependencies.

2.1.4 Project planning

The concept and importance of project planning

Planning, in general, can best be described as the function of selecting the enterprise objectives and establishing the policies, procedures, and programs necessary for achieving them. Planning in a project environment may be described as establishing a predetermined course of action within a forecasted environment. The project's requirements set the major milestones. If line managers cannot commit because the milestones are perceived as unrealistic, the project manager may have to develop alternatives, one of which may be to move the milestones. Upper-level management must become Planning, in general, can best be described as the function of selecting the enterprise objectives and establishing the policies, procedures, and programs necessary for achieving them. The project manager is the key to successful project planning. It is desirable that the project manager be involved from project conception through execution. Planning must be systematic, flexible enough to handle unique activities, disciplined through reviews and controls, and capable of accepting multifunctional inputs. Successful project managers realize that project planning is an iterative process and must be performed throughout the life of the project. One of the objectives of project planning is to completely define all work required (possibly through the development of a documented project plan) so that it will be readily identifiable to each project participant. [9].

This is a necessity in a project environment because:

IF the task is well understood prior to being performed, much of the work can be preplanned.

- IF the task is not understood, then during the actual task execution more knowledge is gained that, in turn, leads to changes in resource allocations, schedules, and priorities.

- The more uncertain the task, the greater the amount of information that must be processed in order to ensure effective performance.

2.1.5 Steps and stages and methods of project planning

Stages of project planning and control

- Defining the objectives of the project
- Identification of actions "activities"
- Identify business times "Activities"

Identification of available and required resources Costing .[9].

The cost table can be determined by:

- The amount of resources required to carry out each work
- Cost rates for each resource
- The time of each business
- Fixed costs "not dependent on business time"
- Evaluation of the basic plan
- Install the basic plan

This is done by saving the basic plan to be a reference in the future and is saved in the memory of the computer. Implementation and progress are reviewed on the plan. Adjustments are usually made to the plan according to working conditions.

Follow-up to the progress of work

- Follow-up costs
- Comparing the progress of work and costs to the basic plan.
- Project control involves several steps that lead to taking steps towards achieving the objectives of the project.

Two important indicators are used to assess project performance. The first is the completion date of the project and the second is the costs of the project.

It is not intended here to use these indicators for separate activities or only for a specific period of time, but to follow the general direction of these indicators at relatively long interval.

- Forecasting - Analysis - Making recommendations for correction:

Forecasting, analysis and recommendations for correction are the natural extension of performance evaluations.

Forecasting is a reflection or extension of the trend towards the future and standard cost indicators are used to determine the expected cost of project completion.

- **What and the Why of Successful Projects:**
- **Develop a Clear Project Statement.** To set boundaries, start with a project statement that lists the major outcome of the project and the completion date
- **Set the Boundaries by Developing Objectives.** Since a project statement does not include all of the desired project results and constraints, list objectives to fine-tune and sharpen the target image. All objectives should be written with clear measures and standards of performance, and activities should be monitored regularly against them. Sometimes project objectives seem obvious, such as “Work safely” or “Reduce costs.” Not-so-obvious--and often unwritten—objectives like “Develop a new engineer as a sub-project manager” or “Evaluate a new contractor” can quickly drain project funds. It is important to involve the right people when developing project objectives. The project manager, team members, and stakeholders need to help develop project objectives.

- **Define the Tasks with a Work Breakdown Structure.**

With the project statement and objectives in hand, outline the tasks necessary to achieve the objectives. This list—often called a work breakdown structure—provides an inventory of the major accomplishments.

- **Identify Required Resources.** Most project plans do a good job of identifying
- The resources that need to be built or installed. Often overlooked are seemingly minor requirements. For example, if the project objectives include developing a new sub-project manager, then resources to provide "mentoring" must be allocated.[12]

A detailed list of resources helps project budgets be more accurate.

Defining a project is the key to a successful outcome. The project statement that specifies the goal and completion date, the 006Fbjectives that characterize what should be accomplished, the work breakdown structure that details what steps are needed, and the list of required resources to complete the project. Developing these four elements ensures that you "plan the work and then work the right plan."

Planning methods: 1- Gantt Chart

A Gantt chart is a type of bar chart, developed by Henry Gantt that illustrates a project schedule. Gantt charts are easy to read and are commonly used to display schedule activities. These charts display the start and finish dates of the terminal elements and summary elements of a project.(The Gantt chart, a working tool of management)

- Specific activities and knowledge.
- Each activity has its duration, costs and resources
- Logical sequence of activities [9].

2 Critical path Method (CPM)

This method emerged in 1957 in the United States of America for planning, scheduling and development

The critical path method can be defined as a set of successive stages in which the string is formed. Critical of events and activities that constitute the total project to be completed and the time required for completion [9].

This method is embodied in:

- The division of the project into several activities: the first and most important step in the planning of the project where it works on.

The existence of independence among the various elements, but it is not without some of the difficulties encountered as a difficulty

Accurate identification and evaluation of activities, among the most important:

1. PBS: A division of the parts involved in final product delivery.
2. The technical plan "WBS": a division of the successive levels of the project.
3. OBS: It combines the parts of the project with the responsibility of each part.

The essential technique for using CPA is to construct a model of the project that includes the following:

- A list of all activities required to complete the project
- The time (duration) that each activity will take to completion
- The dependencies between the activities

Using this information, CPA calculates:

- The longest path of planned activities to the end of the project
- The earliest and latest that each activity can start and finish without making the project longer

This process determines which activities are "**critical"** (i.e., on the longest path) and which have "total float" [8]

Example of a computer-generated CPM schedule

example of a computer-generated CPM schedule.

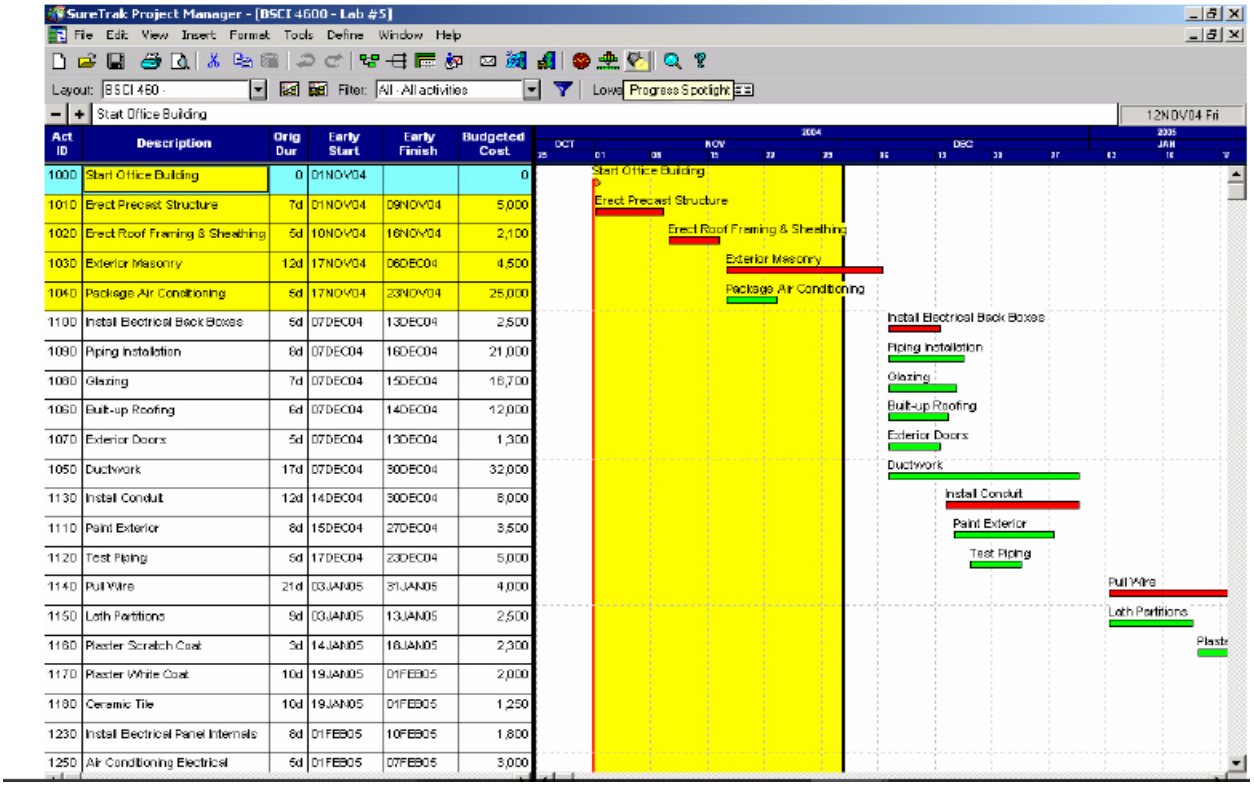

Fig ore (2.1) Gantt charts

3 Program Evaluation and review technique (PERT)

The technique is a management control tool that sizes up the outlook for meeting objectives on time; highlights danger signals requiring management decisions; reveals and defines both methodical ness and slack in the flow plan or the network of sequential activities that must be performed to meet objectives; compares current expectations with scheduled completion dates and computes the probability for meeting scheduled dates; and simulates the effects of options for decision [(11).]

PERT is an acronym for Program (Project) Evaluation and Review Technique, in which planning, scheduling, organizing, coordinating and controlling of uncertain activities take place. The technique studies and represents the tasks undertaken to complete a project, to identify the least time for completing a task and the

minimum time required to complete the whole project. It was developed in the late 1950s. It is aimed to reduce the time and cost of the project [12].

- **PLAN SCHEDULE MANAGEMENT:**

Project Schedule Management includes the processes required to manage the timely completion of the project.

The Project Schedule Management processes are:

1- Plan Schedule Management**:** The process of establishing the policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.

2- Define Activities**:** The process of identifying and documenting the specificactions to be performed to produce the project deliverables.

3- Sequence Activities**:** The process of identifying and documenting relationships among the project activities.

4- Estimate Activity Durations**:** The process of estimating the number of work periods needed to complete individual activities with the estimated resources.

5- Develop Schedule**:** The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule model for project execution and monitoring and controlling.

6- Control Schedule**:** The process of monitoring the status of the project to update the project schedule and manage changes to the schedule baseline[9].

PLAN SCHEDULE MANAGEMENT IN PUT

1- PROJECT CHARTER

The project charter defines the summary milestone schedule that will influence the management of the project schedule.

2- PROJECT MANAGEMENT PLAN

The scope management plan describes how the scope will be defined and Developed, which will provide information on how the schedule will be developed.

Development approach. The product development approach will help defined the scheduling approach, estimating techniques, scheduling tools, and techniques for controlling the schedule

3- ENTERPRISE ENVIRONMENTAL FACTORS

The enterprise environmental factors that can influence the Plan Schedule Management process include but are not limited to:

- Organizational culture and structure.
- Team resource availability and skills and physical resource availability.
- Scheduling software.
- Guidelines and criteria for tailoring the organization's set of standard processes and procedures to satisfy the specific needs of the project, and
- Commercial databases, such as standardized estimating data.

4- ORGANIZATIONAL PROCESS ASSETS

The organizational process assets that can influence the Plan Schedule Management process include but are not limited to:

- Historical information and lessons learned repositories;
- Existing formal and informal schedule development, management- and control-related policies, procedures, and guidelines;
- Templates and forms; and
- Monitoring and reporting tools.

PLAN SCHEDULE MANAGEMENT TOOLS AND TECHNIQUES

- EXPERT JUDGMENT
- DATA ANALYSIS
- MEETINGS

PLAN SCHEDULE MANAGEMENT: OUTPUTS

The schedule management plan can establish the following:

- **Project schedule model development**. The scheduling methodology and the scheduling tool to be used in the development of the project schedule model are specified.
- **Release and iteration length**. When using an adaptive life cycle, the time-boxed periods for releases, waves, and iterations are specified. Time-boxed periods are durations during which the team works steadily toward completion of a goal. Time-boxing helps to minimize scope creep as it forces the teams to process essential features first, then other features when time permits.
- **Level of accuracy**. The level of accuracy specifies the acceptable range used in determining realistic activity duration estimates and may include an amount for contingencies.
- **Units of measure**. Each unit of measurement (such as staff hours, staff days, or weeks for time measures, or meters, liters, tons, kilometers, or cubic yards for quantity measures) is defined for each of the resources.
- **Organizational procedures links**. The work breakdown structure (WBS) (provides the framework for the schedule management plan, allowing for consistency with the estimates and resulting schedules.
- **Project schedule model maintenance**. The process used to update the status and record progress of the project in the schedule model during the execution of the project is defined.
- **Control thresholds**. Variance thresholds for monitoring schedule performance may be specified to indicate an agreed-upon amount of variation to be allowed before some action needs to be taken. Thresholds are typically expressed as percentage deviations from the parameters established in the baseline plan [13].
- **Rules of performance measurement**.

Rules for establishing percent complete,

Schedule performance index **(SPI)** used to assess the magnitude of variation to the original schedule baseline.

- Reporting formats. The formats and frequency for the various schedule reports are defined.

2.1.5.5 COST MANAGEMENT Plan PROJECT

Definition

Cost management is the process, which is necessary to ensure that the planned development of a design and procurement of a project is such that the price for its construction provides **Value for Money (VFM)** and is within the limits anticipated by the client. Construction is a major capital expenditure, which clients do not commence until they are certain that there is a benefit. This benefit may be for society in the case of public projects, with justification based on a cost–benefit analysis, or purely based on financial considerations in the case of private projects. Most clients are working within tight pre-defined budgets, which are often part of a larger overall scheme. If the budget is exceeded or the quality not met the scheme could fail. Pre contract estimating sets the original budget – forecasting the likely expenditure to the client. This budget should be used positively to ensure that the design stays within the scope of the original scheme [(13).]

Process.

The process of managing project costs is an activity for estimating costs, developing project budget and controlling Spending.

The project cost management process includes the following key steps:

- **Plan Cost Management**: The process of defining how the project costs will be estimated, budgeted, managed, monitored, and controlled
- **Cost Estimation**. It is the project cost management process step when the project manager cooperates with the financial department to estimate costs required for purchasing all necessary good services and undertaking necessary

activities to deliver the project. Project Cost Estimation is conducted at the planning phase. The project manager uses project cost management software to develop spreadsheets and make calculations.

- **Budget Determination**. At this step of the cost management process, cost spreadsheets are used to develop the budget framework and determine the budget. The project manager can use project cost management software to work in collaboration with the financial department to determine items of the budget and sources of funding and then to allocate the budget. The step entails close cooperation with the project sponsor.
- **Cost control**. It is the step of the project cost management process when the allocated budget is reviewed and spending is tracked. The project manager takes responsibility for control spending and to ensure that the budget allocation is optimized and costs are fully covered with the planned and allocated budget (14).

2.1.5.6 CONTROL COSTS.

Control Costs 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 the cost baseline is maintained in the project. The PMBOK® Guide. Updating the budget requires knowledge of the actual costs spent to date. Any increase to the authorized budget can only be approved through the Perform Integrated Change Control process. Monitoring the expenditure of funds without regard to the value of work being accomplished for such expenditures has little value to the project, other than to track the outflow of funds. Much of the effort of cost control involves analyzing the relationship between the consumption of project funds and the work being accomplished for such expenditures. The key to effective cost control is the management of the approved cost baseline (14).

Project cost control includes:

- Influencing the factors that create changes to the authorized cost baseline;
- Ensuring that all change requests are acted on in a timely manner

- Managing the actual changes when and as they occur;
- Ensuring that cost expenditures do not exceed the authorized funding by period, by WBS component, by activity, and in total for the project;
- Monitoring cost performance to isolate and understand variances from the approved cost baseline;
- Monitoring work performance against funds expended;
- Preventing unapproved changes from being included in the reported cost or resource usage;
- Informing appropriate stakeholders of all approved changes and associated cost; and
- Bringing expected cost overruns within acceptable limits.

CONTROL COSTS: INPUTS

- PROJECT MANAGEMENT PLAN
- PROJECT DOCUMENTS
- PROJECT FUNDING REQUIREMENTS
- WORK PERFORMANCE DATA
- ORGANIZATIONAL PROCESS ASSETS

CONTROL COSTS: TOOLS AND TECHNIQUES

EXPERT JUDGMENT

Examples of expert judgment during the Control Costs process include but are not limited to:

- Variance analysis,
- Earned value analysis,
- Forecasting
- Financial analysis.

2.2 Earned Value Management (EVM):

2.2.1 Introduction

The earned value management (EVM) method has been used to manage project scope, schedule, and budget worldwide for a long time.

EVM is considered as powerful tool that supports the management of project a scope, schedule, and budget.

It is a powerful approach for quantitative measure of work performance in terms of cost deviation and schedule deviation and for quantitatively estimating actual completion time and actual cost at completion.

Traditional EVM monitoring of project performances is based on the budgeted cost of work performed (BCWP), budgeted cost of work scheduled (BCWS) and actual cost of work performed (ACWP).

And then, the cost variance (CV) and schedule variance (SV), or cost performance index (CPI) and schedule performance index (SPI) are calculated to measure the project performances.

CPI and SPI are usually expressed in the periodic or cumulative way. Although that the EVM approach is considered to be the most objective method available in the measurement of project performances, the Method is limited and does not directly account for variation in individual performance values about a normal or natural level of project performances.

A gap exists between the use of existing methods and the availability of an appropriate methodology that specifically addresses variation in

Performances [14].

2.2.2 Brief History

Earned Value really got its start in the 1960's by the Government and became a very important part of the United States Air Force in 1966. Back then Earned Value was called Cost/Schedule Planning Control Specifications or C/SPCS.

In 1967 the Department of Defense (DOD) put into place a 35-criteria approach that they called the Cost/Schedule Control Systems Criteria or C/SCSC but was

considered a financial control tool and was often ignored by Project Managers. It wasn't until the late 1980's and early 1990's that Earned Value Management (EVM) emerged as a Project Management Methodology.

Between 1995 and 1998 the EVM criteria was reduced to 32 from 35 and with the adoption of the ANSI EIA 748-A standards Earned Value became part of the industry.

2.2.3 Three Key Dimensions of Earned Value Management

EVM consists primarily of three dimensions including

Planned Value (PV): The authorized budget that has been assigned to scheduled work at a given point in time. This budget can be allocated by phase or over the life of the project and it describes in dollars the physical work that will be accomplished. The PV for the entire project or task is called the Budget at Complete (BAC).

Earned Value (EV): This is a measure of work performed expressed in terms of the budget that has been authorized for that work. The EV cannot exceed the PV that has been authorized and generally the EV is derived by multiplying a percentage of the work performed by the BAC. This value becomes the basis for our Earned Value metrics that will be described later.

Actual Costs (AC): AC is the realized costs that are incurred for the work performed and this costs corresponds to what was planned in the **PV** and measured in the **EV**. In a perfect world, the **AC** will equal the PV when the task or project is complete, but there is no real upper limit to what can be spent to achieve what **EV** has measured.

There alternative terminology to describe these values. **PV** is also referred to as Budgeted Costs of Work Scheduled **(BCWS), EV**is also referred to Budgeted

Costs of Work Performed (**BCWP),** and **AC** is also referred to as Actual Costs of Work Performed **(ACWP).**[14]

The controlling process is show

Application of the EVM in the construction site management practice do require systematic register of time and cost data (usually once a week) in order to get the two following values: ACWP which is Actual Cost of Work Performed and BCWP – Budgeted Cost of Work Performed. The third required value, namely/>>y BCWS – Budgeted Cost of Work Scheduled can be defined before start of works, based of the time schedule of all works and the respective cost plan (Fig.2.2).

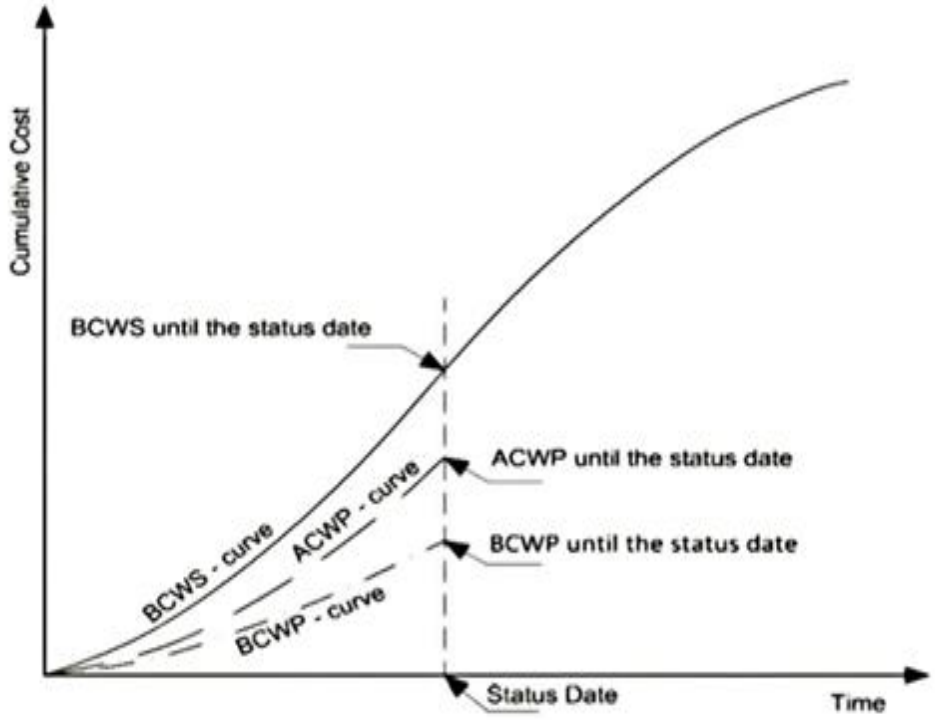

Fig 2.2 three basic curves used in the EVM [14].

Effective managing the construction site with supporting decisions by the EVM needs use of some additional

Past performance, examined till the status date. But, remaining works of the construction project could be subjected

To new risks, not recorded before the status control date. So, the EVM should be modified, taking into account also. The future risks, in order to be successfully used for project time management. [15]

Fig.2.3. Forecast values provided by EVM[14].

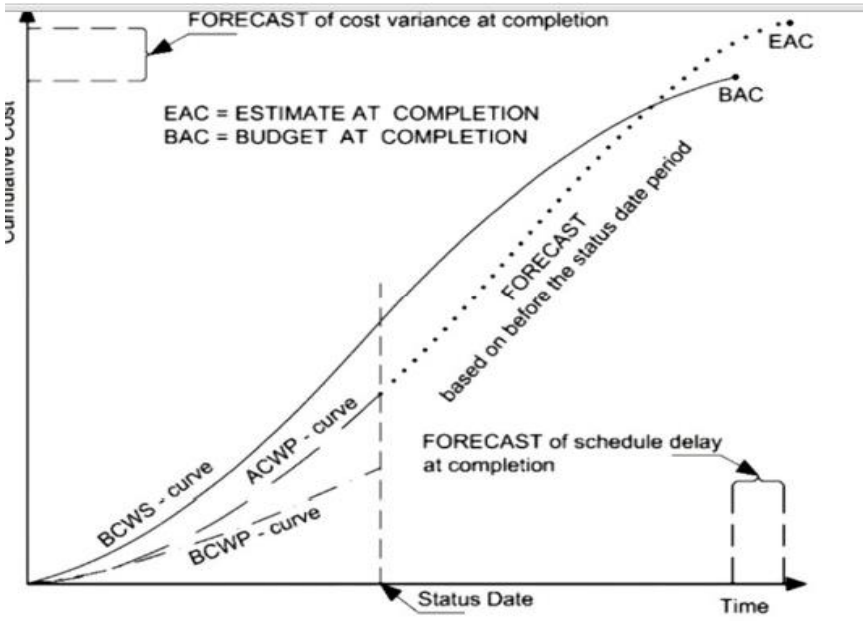

Fig.2.4 Forecast values provided by EVM

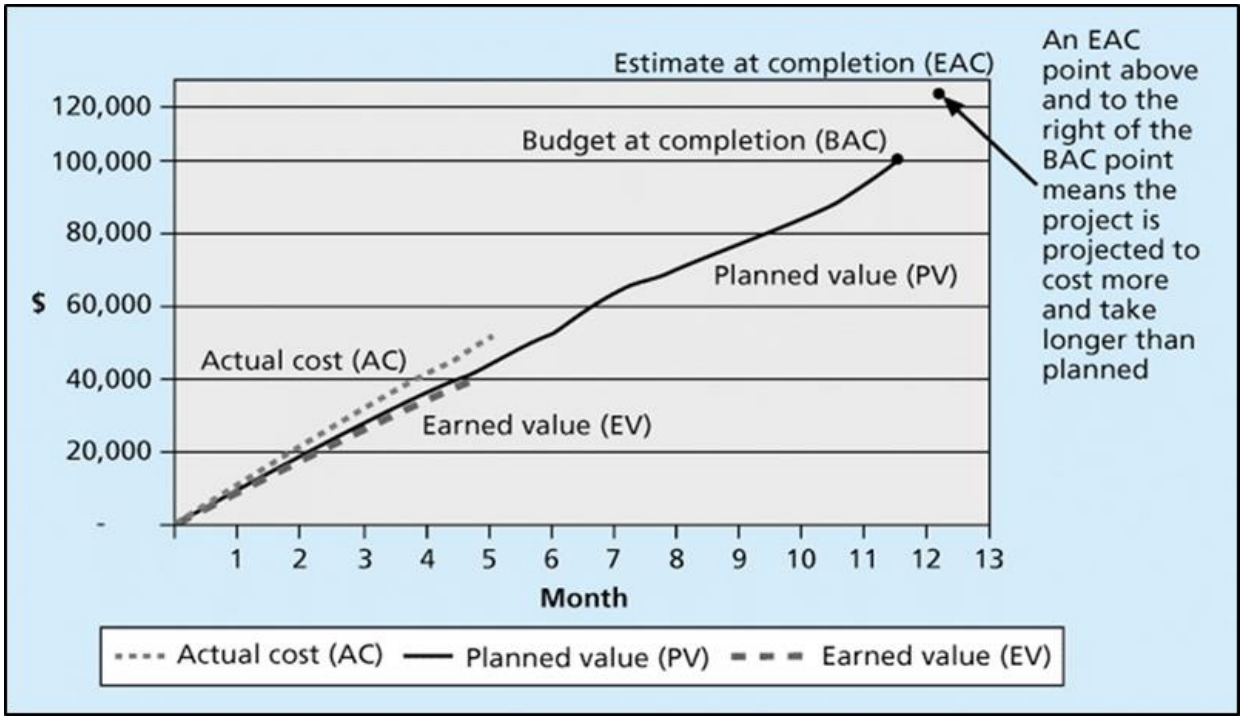

Table 2.1: EVM Project Performance Measures

Performance Measure	Formula	Description
Schedule Variance (SV)	EV-AC	Indicates the difference between the budgeted cost and the actual value of work completed at a given point in the project. A positive number indicates that project expenditures are less than expected.
Cost Variance (CV)	PV-AC	Indicates the difference between the budgeted cost and the actual cost at a point in the project. A positive number indicates that project expenditures are less than expected. Note: This performance measure does not necessarily indicate a project that is under budget or over budget, just the financial status relative to the project's schedule. A CPI or SV greater than "1" would indicate an under-budget project.
Cost Performance Index (CPI)	EV/AC	Compares expenditures to actual value at a point in the project. Values greater than 1 indicate a positive situation in a project with expenditures below budgeted amounts (under budget).
Schedule Performance Index (SPI)	EV/PV	Compares the expected value (planned work and project results at a point in the project to the actual value of work achieved. Actual value at a point in the project. Values greater than 1 indicate a positive situation in a project with the volume of work (productivity) exceeding the plan.

2.2.4 10 Steps to Successful EVA Implementation

1. Obtain top level organization commitment with EVA
2. Education and training of the people in the project in EVA
3. Scope well defined, detailed and identified, with proper WBS and packages
4. Schedule and budget organized according to the WBS
5. Clear Project Responsibility Tables, with clear responsibility descriptions
6. Clear flowchart of activities and relationship with the main participants
7. Cost/Schedule Control System with database and data collection procedures
8. Suitable reports related to EVA, well planned, analyses and distributed
9. Procedures to consistency analysis and validation of information
10. Lessons Learned - continuous improvement process

2.2.5Earned Value Management: Forecasting project outcome

- earned schedule
- Earned value management

Forecasting [15]

Cost forecasting EAC

Forecasting the final cost of the project is key to the success or failure of a project since it allows to take corrective actions when the predicted EAC exceeds a certain threshold. This forecast is based on the actual costs already spent and a prediction of the future spending for the remaining portion of work to be done. The general forecasting formula is equal to:

EAC = AC + PCWR AC: The actual cost at the current time moment (i.e. AT = actual time). [15]

PCWR: Planned Cost of Work Remaining as an estimate for the future More information on the cost forecasting formulas and techniques are discussed in "Earned Value Management: Forecasting cost".

Time forecasting EAC (t)

Forecasting the final duration of the project is key to the success or failure of a project since it allows to take corrective actions when the predicted EAC (t) exceeds a certain threshold. This forecast is based on the actual time already spent on the work done and a prediction of the duration of the remaining portion of work to be done. The general forecasting formula is equal to: EAC (t) = AT + PDWR - With AT: The actual time moment (i.e. today) [15]

PDWR: Planned Duration of Work Remaining

More information on the time forecasting formulas and techniques can be found in "Earned Value Management: Forecasting time" [15]

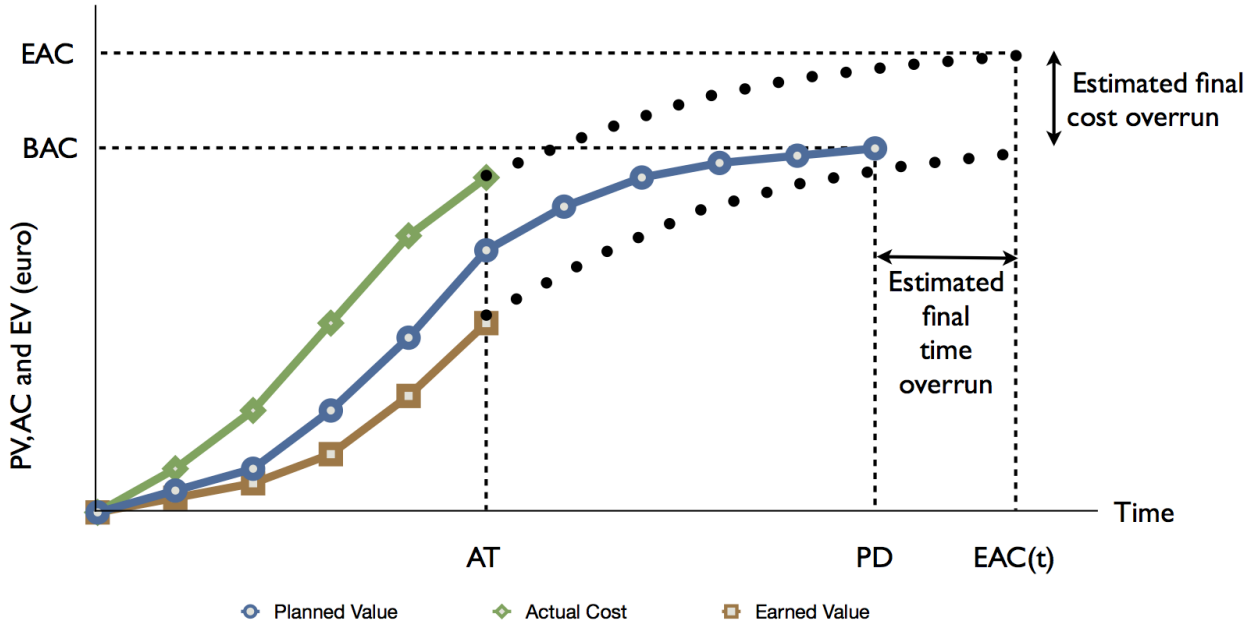

Figure 2.5: Forecasting cost (EAC) and time (EAC (t)) [15]

Figure 5 displays the three key metrics, Planned Value, Actual Cost and Earned Value of a project at a certain current moment in time AT. The EV is equal to the PV at the end of the project and hence, the current EV (which shows that the

project is late) is used to predict at what moment in time the EV equals PV. The total project duration prediction is shown in the figure by the EAC (t) which shows the project is expected to be late. Likewise, the current actual costs are higher than the EV, which shows a budget overrun at the current moment AT. The AC is expected to grow at the same rate until the project is expected to be finished, which results in an EAC which shows an expected final cost overrun.

2.3 Cost analysis.

The accountants use these Cost concepts to study the firm.

They are concerned with arranging the finances of the firm and there for keep a track of the firm .the accounting costs are used for taxation purposes and calculation the firm these are

- Opportunity cost
- Business cost
- Full cost
- Implicit cost
- Out - of-pocket cost
- Book cost

2.3.1 Type of cost analysis

- Cost –benefit analysis
- Cost – effectiveness analysis

2.3.1.1Cost–benefit analysis (CBA)

Sometimes called benefit costs analysis (BCA), is a systematic approach to estimating the strengths and weaknesses of alternatives it is used to determine options that provide the best approach to achieve benefits while preserving savings. It may be used to compare potential (or completed) courses of actions; or estimate (or evaluate) the value against costs of a single decision, project, or

policy. Common areas of application include commercial transactions, functional business decisions, policy decisions or project investments.

Broadly, CBA has two main applications [16]

1. To determine if an investment or decision is sound – verifying whether its benefits outweigh the costs, and by how much;
2. To provide a basis for comparing investments or decisions – comparing the total expected cost of each option against their total expected benefits.

CBA is related to cost-effectiveness analysis. In CBA, benefits and costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time are expressed on a common basis in terms of their net present value, regardless of whether they are incurred at different points in time.

Other closely related formal techniques include: cost-effectiveness analysis, cost–utility analysis, risk–benefit analysis, economic impact analysis, fiscal impact analysis, and social return on investment (SROI) analysis.

2.3.2 Theory of cost-benefit analysis.

Cost–benefit analysis is often used by organizations to appraise the desirability of a given policy. It is an analysis of the expected balance of benefits and costs, including an account of any alternatives and of the *status quo*. CBA helps predict whether the benefits of a policy outweigh its costs, and by how much, relative to other alternatives. This allows for ranking of alternate policies in terms of cost–benefit ratio. [17] .generally, accurate cost–benefit analysis identifies choices that increase welfare from a utilitarian perspective. Assuming an accurate CBA, changing the status quo by implementing the alternative with the lowest cost–benefit ratio can improve Pareto efficiency.[17] While CBA can offer an informed estimate of the best alternative, perfect appraisal of all present and future costs and

benefits is difficult, and perfection in terms of economic efficiency and social welfare is not guaranteed.[18]

2.3.3 Process:

The following is a list of steps that compose a generic cost–benefit analysis.

1. Define the goals and objectives of the action.
2. List alternative actions.
3. List stakeholders.
4. Select measurement(s) and measure all cost and benefit elements.
5. Predict outcome of costs and benefits over the relevant time period.
6. Convert all costs and benefits into a common currency.
7. Apply discount rate.
8. Calculate the net present value of actions under consideration.
9. Perform sensitivity analysis.
10. Adopt the recommended course of action.

Evaluation

CBA attempts to measure the positive or negative consequences of a project, which may include

1. Effects on users or participants.
2. Effects on non-users or non-participants.
3. Externality effects.
4. Option value or other social benefits.

A similar breakdown is employed in the environmental analysis of total economic value. Both costs and benefits can be diverse. Financial costs tend to be most thoroughly represented in cost-benefit analyses due to relatively abundant market data. The net benefits of a project may incorporate cost savings or public willingness to pay compensation or willingness to accept compensation for the welfare change resulting from the policy. The guiding principle of evaluating

benefits is to list all (categories of) parties affected by an intervention and add the (positive or negative) value, usually monetary, that they ascribe to its effect on their welfare.

Time and discounting

CBA generally attempts to put all relevant costs and benefits on a common temporal footing using time value of money calculations. This is often done by converting the future expected streams of costs and benefits into a present value amount using a discount rate.

Risk and uncertainty

Risk associated with project outcomes is usually handled using probability theory. This can be factored into the discount rate (to have uncertainty increasing over time), but is usually considered separately. Particular consideration is often given to agents' risk aversion — preferring a situation with less uncertainty to one with higher uncertainty, even if the latter has a higher expected return. In such a context, expected return calculations provide biased estimates of cost-benefits for a project, as they fail to account for differences in the degree of uncertainty.

Uncertainty in CBA parameters can be evaluated using a sensitivity analysis, which shows how results respond to parameter changes. Alternatively a more formal risk analysis can be undertaken using Monte Carlo simulations.[18] However, even a low parameter uncertainty does not guarantee the success of a project.

2.4 Performance

Performance management is the Strategic use of performance standards, measures, progress reports, and ongoing Quality improvement efforts to ensure that an agency achieves its desired results.

It consists of three phases: setting expectations for employee performance, maintaining.

A dialogue between supervisor and employee to keep performance on track, and measuring al performance relative to performance expectations.

According to Atkinson et al., (1997) successful construction project performance is achieved, when stakeholders meet their requirements, individually and collectively

The level of success in carrying out construction project development activities will depend heavily on the quality of the managerial, financial, technical and organizational

Performance of the respective parties, while taking into consideration the associated risk management, the business environment, and economic and political stability.[18].

THE MOST IMPORTANT FACTORS THAT INFLUENCE PROJECT PERFORMANCE IN SUDAN

The most important factors were determined through the use of Relative Importance .Index (RII) which produced five important factors that have much influence on the performance of construction projects. These five factors are explained below Factors affecting the performance of construction projects

Cost factor

- Liquidity of organization.
- Cash flow of project.
- Profit rate of project.
- Overhead percentage of project.
- Project design cost.
- Material and equipment cost.
- Project labor cost.
- Project overtime cost.
- Motivation cost.
- Cost of rework.

- Cost of variation orders.
- Waste rate of materials.
- Regular project budget update.
- Cost control system.
- Escalation of material prices.

Differentiation of currency prices. [18]

Time factors

- Site preparation time.
- Planned time for construction.
- Percentage of orders delivered late.
- Time needed to implement variation orders.
- Time needed to rectify defects.
- Average delay in claim approval.
- Average delay in regular payments.
- Unavailability of resources.
- Average delay because of closures leading to materials shortage.

Quality factors

- Conformance to specification
- Unavailability of competent staff
- Quality of equipment and raw materials
- Quality assessment system in organization
- Quality training/meeting

Productivity factors

- Project complexity
- Number of new projects / year
- Management-labour relationship
- Absenteeism rate through project

- Sequencing of work according to schedule

Client satisfaction factors

- Information coordination between owner and project parties
- Leadership skills for project manager
- Speed and reliability of service to owner
- Number of disputes between owner and project parties
- Number of rework incidents
- **Regular and community satisfaction factors**
- Cost of compliance to regulators requirements
- Number of non-compliance events
- Quality and availability of regulator documentation
- Site condition problems

People factors

- Employee attitudes
- Recruitment and competence development
- Employees motivation

Belonging to work [18]

Health and safety factors

- Application of health and safety factors in organization
- Project location is safe to reach
- Reportable accidents rate in project
- Assurance rate of project

Innovation and learning factors

- Learning from own experience and past history
- Learning from best practice and experience of others
- Work group
- Review of failures and solving them

Environmental factors

- Air quality
- Noise level
- Wastes around the site
- Climate condition

The top significant factors affecting the performance of construction project

- Escalation of material prices
- Unavailability of resources as planned through the project duration
- Average delay because of closures leading to materials shortage
- Unavailability of personals with high experience and qualification
- Quality of equipments and raw materials in project
- Leadership skills for project manager [19]

The performance factor (PF) is a way to express that the rate in which the increase in AC or EV (the dotted lines in figure 1) occurs might depend on the assumption of the performance of the remaining work to be done. Consequently, it refers to the assumption about the expected performance of the future work PDWR or PCWR, as follows:

- PF = 1: Future performance is expected to follow the baseline schedule.
- PF = SPI or SPI (t): Future performance is expected to follow the current time performance.
- PF = SCI or SCI (t): Future performance is expected to follow the current time and cost performance.

With the Schedule Cost Index defined as SCI = SPI * CPI or SCI (t) = SPI (t) * CPI. All these methods provide an estimate for the total project duration and cost, and offer a range of possibilities and hence a lower and upper bound on your predicted total time and cost. The choice of a specific forecasting method depends

on the project, the expertise of the project manager and many other unknown factors [20]

Chapter Three

Methodology of data collection

Chapter three

Methodology of data collection

3.1 Introduction

Chapter three outlines the plan of action that shows how the research problem was investigated, what information was collected, the methods used and how this information was analyzed in order to accomplish the objectives of the study. The chapter was organized around five major sections, namely: preliminary investigation, questionnaire design, population and sample, pilot study, data collection and instruments and data analysis.

3. 2 Preliminary Investigation

Project was studied in depth with detailed information was collected This was followed by face-to-face interviews with project participants with the aim of determining the way used for controlling their project on the overall performance of the studied project .

3.2.1 General Information of case study

Project Name	**Al-Sajana** Commercial Tower
Project Type	Commercial
Owner and Consultant	Housing and Development Fund
Contractor of Concrete Phase	Alkadabi Group of Companies
Contractor of buildings Phase	Bagia Engineering Works.
Project Location	Khartoum, Al-Sajana area, Al-Hurriya Street, Block **47**
Area	about 3000 square meters
Designer	Architectural Studies Company
Duration of concrete Phase	23 months

Duration of buildings Phase	12 months
Cost of concrete Phase	39,557,380 SDG
Cost of buildings Phase	4,479,676.70 SDG

Purpose of the project:

1. Contribute to the prosperity and development of Khartoum City while providing unique designs for commercial towers.
2. Upgrade the prison area to raise the level and quality of buildings.
3. Providing high-quality shopping places with international standards comparable to those outside Sudan.
4. Finding solutions for the merchants of Al-Sajana market by expanding and upgrading their traditional shops
5. Participate in the training of Sudanese cadres to acquaint them with such large projects and how to implement them (sub-goal)
6. Implementation of the new structural plan for the state of Khartoum

Scope of work in the project:

The team was assigned to build a commercial tower consisting of a building with 2Basmeant (parking spaces) and 10 floors, which are shops ranging from 26 to 268 square meters in the Khartoum district of Al-Sajana area of 3000 square meters

3.3 industry Survey

The questionnaire design took into consideration the objectives of the study as stated .with the aim to answer the research questions. Great effort and brainstorming went into designing the questionnaire. Case study analysis and meetings with members of the industry were conducted to identify the right questions required and to present them in a clear and an unambiguous format.

Special care also went into phrasing the questions in a language that is easily understood by respondents. In anticipation that many respondents may not be fluent English readers or speakers, an Arabic version of the questionnaire was developed. The same effort was put into the Arabic version to present a clear and easy to understand format.

3.3.1 Community Search and sample selection:

The sample requires the availability of certain characteristics and main characteristics that are directly and strongly related to the original society as a necessary step to reach accurate results on the subject of the study. The researcher was keen to be the sample of the research in the engineers group in various fields and represented the study society in the registered membership of the Engineering Council a sample was randomly selected in a systematic manner scientifically, so that this sample represents the research community as a correct representation. The total number of sample members was (83) individuals equivalent to (75%) of the distributed forms (110) form.

Sample size was determined as follows

$$n0 = (p*q)/ V2 \quad (1)$$

$$n = n0 / [1+ (n0 / N)] \quad (2)$$

Where:

n0: First estimate of sample size, P: The proportion of the characteristic being measured in the target population, q: Complement of „p‟ or 1-p, V: The maximum standard error allowed, N: The population size, n: The sample size. Equations 1&2 [21], [22].

3.3.2 Data collection tool:

The data collection tool was used by the questionnaire as the most data collection tool used in the field of research and studies, and a questionnaire was designed to cover all research topics and trends based on research and studies in this field.

The questionnaire is designed to provide data that can be analyzed and discussed. It can be used to answer research questions, test hypotheses and then develop general guidelines that provide recommendations that address the gap between standard and local practice that will help solve the problems discussed in the research.

3.3.3Contents of the Questionnaire

The questionnaire as shown in Appendix is divided into five sections.

The first section includes "instructions" to respondents defining the key terms in the study and providing respondents with instructions on completing the questionnaire and contains general information about the respondents such as contact address, company size, type industry characteristics such as size, experience, amount of change, etc.

The second section addresses control and inspect of construction project cost A list of major causes as read from the literature is presented and the respondent is asked to state the frequency of occurrence of these causes in his projects. Most frequent causes corresponds to „Strongly agree; whereas the least frequent correspond to „Disagree; which denies existence of the condition as a cause

The third section: addresses is "Internal and External factors affecting on controlling of the cost and time of the projects."

The fourth section: addresses the possible" impact of earned value and analyses the cost and profit on the project performance".

Responses in this section are given on a 5-point scale starting with strongly agree and ending with „Disagree.

The last section in the questionnaire addresses the normally adopted "controls of project performance" in the building projects and the administrative procedures set to minimize their impact.

3.2.4 Statistical methods used in the study.

First: Test the degree of credibility of the data.

In order to measure the reliability and consistency of the responses of the members of the sample, the researcher used the coefficient of Alpha Kronbach, the degree of credibility of the answers to the hypotheses. The accepted degree of alpha Kronbach is 0.85, and therefore can be based on the answers of the sample of the study and then analyze the data.

Second: descriptive statistical methods. The researcher used the method of repetitive distribution of the responses of the members of the research sample to obtain the characteristics of the structure of the study society, which is a type of descriptive statistical methods that helps in obtaining general conclusions about the characteristics and composition of the study society and the distribution method.

3.3.4 Data Analysis

The analysis of the data was carried out with the help of statistical package for social sciences (SPSS) version 21.0. Data were carefully analyzed statistically using reliability test, frequencies and factor analysis, Importance index, Spearman's rank correlation coefficient, descriptive statistics.

- **Importance Index**:

Then Importance index for each factor was calculated according to the questions

Importance Index= $(Wi \times Xi)/N$ [23]

Where:

WI: the weight is assigned to the option of factor; Xi: the number of respondents who selected the option of factor; N: the total number of respondents.

Importance index for calculated by the following equation:

Importance Index = 5(x5) +4(x4) +3(x3) +2(x2) + 1 (x1) / (N) [24]

-Reliability

Reckon that reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials. Reliability in research is influenced by random errors. As random error increases, reliability decreases [25]. Provided a commonly accepted rule of thumb for describing internal consistency using Cranach's alpha is as follows:

Table (3.1) Cranach's Coefficient Alpha [26]

Cranach's Coefficient Alpha	Internal Consistency Remarks
$\alpha \geq 0.9$	Excellent
$0.7 \leq \alpha < 0.9$	Good
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

Reliability test was carried out to determine whether the questionnaire was capable of yielding similar scores if the respondents have used it twice. The test was conducted using SPSS version 21.0. The determined Cronbach"s alpha coefficient value for questionnaire was 0.857 as shown in table 3.13. This value indicates that the questionnaire items form a scale that has reasonable internal consistency reliability. Impliedly, the survey instrument used was good reliable and acceptable and that an agreement exists between construction industry participants.

Chapter Four

Results analysis and Discussion

Chapter Four

Results and Discussion

4.1 Preliminary Investigation

Case for building project was study as mentioned in chapter three. The results are shown in fallowing tables

Table (4.1) b Calculate the cost of concrete structure works

Item	Description	Total
1-	Basement (1)	9,924,699
2-	Basement (2)	3,709,147
3-	Ground floor	2,391,518
4-	Mezz. Floor	1,989,321
5-	1st floor	1,970,649
6-	2nd floor	1,970,649
7-	3rd floor	1,997,292
8-	4th floor	1,737,186
9-	5th floor	1,909,834
10-	6th floor	1,735,231
11-	7th floor	1,735,231
12-	Roof	151,097
Total		31,221,854
DES 2%		624,437
Total		30,597,417
VAT 17%		5,201,561
Sub Total		35,798,977
Additional work		3,758,403
Total		39,557,380

Table (4.2) Calculating the costs of building works

Item	Description	Total
1-	Basement (1)	65,923.50
2-	Basement (2)	0
3-	Ground floor	416,559.25
4-	Mezz. floor	452,116.75
5-	1st floor	306,324.00
6-	2nd floor	390,579.75
7-	3rd floor	390,579.75
8-	4th floor	390,579.75
9-	5th floor	390,579.75
10-	6th floor	390,579.75
11-	7th floor	390,579.75
12-	Roof	244,381.50
Total		3,828,783.50
VAT 17%		650,893.20
Total		4,479,676.70

Table (4.3) Calculation of the costs of finishing works

Item	Description	Total
1-	Plaster	3,818,278
2-	Painting	1,486,135
3-	Pavior	12,145,735
4-	Sanitary	959,545
5-	Joinery	21,347,000

6-	**Elevators**	**7,932,000**
7-	**Fire Fighting & Alarm**	**4,260,480**
8-	**Air Conditioning**	**17,272,053**
9-	**Electrical Works**	**24,191,085**
10-	**Treatments**	**3,099,328**
Total		**96,511,638.65**
VAT		**16,406,978.57**
Total + VAT		**112,918,617.22**

Table (4.4) Total cost of the project:

Item	TOTAL COST
Concrete structure works	**39,557,380**
Building works	**4,479,676.70**
Finishing works	**112,918,617.22**
Total	**156, 955,674.22**

4.1.1 Cost and Benefit Analysis:

1 Annual income:

Revenue is charged to the rental account of the project's shops because the building is large we took an average per square meter by market

Rent the ideals of the square meter on the street of Al-Hurriya in the current period ranges from:

Ground and Mezzanine: (300 - 500) SDG

Upper floors: (70 - 120) SDG

2 Annual yield calculation: Rate of return analysis

Number of square meters of the building= 14,112 square meters (shops of the entire building)

If we take an average rent per square meter = 400 pounds per month

(Foreground floor and mezzanine)

Annual yield of ground floor and mezzanine

= 2,015.16 * 400 * 12= 806,064.00 SDG

If we take an average rent per square meter = 100 pounds per month (for the rest of the floors)

Annual yield for the rest of the floors =

12,096.64 * 100 * 12 = 14,515,968.00 SDG

Total annual revenue per building = 15,322,032.00 SDG

Pay back Period.

Net Profit = Revenue - (Taxes + Depreciation + Annual Expenses

Depreciation = 3% of the cost per year

= 0.03 * 153,197,270.92 = 4,595,918.13 SDG

Annual disbursements:

Number of stores 211

(EGP 150 per month for each apartment), with an average of LE 600 per month for each shop (security services, central air conditioning, elevators, parking, cleaning, generator operation, etc.)

Annual expenses = 600 * 211 * 12 = 1,519,200.00 SDG

Taxes = 10% of rent per month per shop

= 0.1 * (2015.16 * 400 + 12096.64 * 100)

= 201.572.80 SDG

Net profit value = 15,322,032.00- (201,572.80 + 4,595,918.13 + 1,519,200.00)

= 9,005,341.07 SDG

Recovery = Total Cost / Net Profit

= 9,005,341.07 / 153,197,270.92 = 17.01 years

The capital will be redeemed in 17 years

- A positive NPV means that the project is expected to add value to the firm and will therefore increase the wealth of the owners.
- Since our goal is to increase the wealth of the shareholder, NPV is a direct measure of how well this project will meet our goal.

Table (4.5)2Scheduling work in the project:

date	Item
م2013/4/22	meeting
م2013/4/ 24	Starting work on the project (concrete phase)
م 2015/3/5	End of project work (concrete phase)
م2015/11/7	The start of work in the project (phase of buildings and buildings)
م2016/6/15	End of works in the project (phase of buildings and buildings)

The following table shows the payment methods contracted in the project (cash flow of the project):

Table (4.6): the payments of the concrete structure schedule

Date	Value in SDG	description	Payment	Item
م2013/4/11	5,369,846	It is the a provider to supply materials and start work	Submitted	1
م2013/7/5	4,192,847.94	The contractor shall be entitled to a first-class banking after the end of the work of the reinforced concrete	First payment	2
م2013/9/23	777,190.70	The contractor shall be entitled to a sanding after the completion of the reinforced concrete for the basement roof	Second payment	3
م2013/12/21	217,579.27	The contractor shall be entitled to a fine after the end of the work of the reinforced concrete	Third payment	4

		for the ceiling of the ground floor		
2014/2/17م	365,752.04	The contractor shall be entitled to a sandpaper after the end of the work of the reinforced concrete for the ceiling of the mezzanine floor	Fourth payment	5
2014/3/12م	1,428,343.01	The Contractor shall be entitled to a fine after the end of the work of the reinforced concrete for the roof of the first floor	Fifth payment	6
2014/4/21م	1,269,974.83	The contractor shall be entitled to a license after the end of the work of the reinforced concrete for the roof of the second floor	Sixth payment	7
2014/7/6م	1,231,949.83	The contractor shall be entitled to a sandpaper after the end of the work of the reinforced concrete for the ceiling of the third floor	Seventh payment	8
2014/9/2م	410,450.59	The contractor shall be entitled to a sandpaper after the end of the work of the reinforced concrete for the roof of the fourth floor	Eighth payment	9
2014/9/17م	772,425.60	The contractor is entitled to a sandpaper after the end of the work of reinforced concrete for the roof of the fifth floor	Ninth payment	10

م2014/1/5	491,980.59	The contractor deserves a license after the end of the work of reinforced concrete for the roof of the sixth floor	Tenth payment	11
م2014/3/5	552,067.39	The contractor shall be entitled to a sandpaper after the end of the work of reinforced concrete for the roof of the seventh floor and the surface	Eleventh payment	12

Table (4.7) the payments of the phase of the buildings and the blocks: -

Date	Value in pounded	description	Payment	Item
م 2015/11/26	508,898.89	The contractor is entitled to the first banking after the end of the building works for the ground floor	First payment	1
م2015/12/8	569,882.55	The contractor is entitled to the first banking after the end of the building works for the mezzanine floor and the first	Second payment	2
م2016/1/18	364,747.83	The contractor is entitled to a first banking after the end of the building works for the second and third floors.	Third payment	3
م2016/3/8	343,142.69	The contractor is entitled to the first banking after the end of the building works for the fourth and fifth floors	Fourth payment	4
م2016/10/12	288,142.69	The contractor is entitled to the first banking after the end	Fifth payment	5

		of the building works for the sixth and seventh floors		
2016/10/15م	258,142.69	The contractor is entitled to the first banking after the end of the works of the buildings for the floor surfaces and the rest of the notes floors	Sixth payment	6
2016/10/30م	273,403.87	The final contractor is entitled to the building works	Seventh payment	7

4.1.2 Cost control: Earned Value Management

Variance of the cost of the works of the contract: -

Concrete structure:

1- Contract Value:

- The plane value of the contracts PV =35,798,977 SDG
- The actual value of the contract is AC = 39,557,380 (including the basic contract + water insulation contract)
- **Variance =** 3,758,403 SDG
- **Variance** ratio 10.5%

2- Closing buildings:

The plane value of the basic contract is PV= 4,479,676

The value of the contract is 768,870

The total value of the contract is AC = 5,248,546 (including the basic contract + the attached contract)

Variance: CV = 14.6%

Variance: of time from the works of the contract: -

PlannedSchedule (PS): Concrete

Start: 22/4/2013

End: 5/3/2015EV-AC

Schedule Variance (SV) = EV-AC

Actual end of concrete 5/3/2015

Schedule Variance (SV) = EV-AC

Start: 7/11/2015

End: 15/6/2016

The actual end of buildings 30/10/2016

Table (4.8) Time deviation in buildings 4 months and 15 days

Performance Measure	Formula	Description
Schedule Variance (SV)	EV-AC	Indicates the difference between the budgeted cost and the actual value of work completed at a given point in the project. A positive number indicates that project expenditures are less than expected.
Cost Variance (CV)	PV-AC	Indicates the difference between the budgeted cost and the actual cost at a point in the project. A positive number indicates that project expenditures are less than expected. Note: This performance measure does not necessarily indicate a project that is under budget or over budget, just the financial status relative to the project's schedule. A CPI or SV greater than "1" would indicate an under-budget project.

Performance Measure	Formula	Description
Cost Performance Index (CPI)	EV/AC	Compares expenditures to actual value at a point in the project. Values greater than 1 indicate a positive situation in a project with expenditures below budgeted amounts (under budget).
Schedule Performance Index (SPI)	EV/PV	Compares the expected value (planned work and project results at a point in the project to the actual value of work achieved. Actual value at a point in the project. Values greater than 1 indicate a positive situation in a project with the volume of work (productivity) exceeding the plan.

Calculate the direct costs

•Very important to unit cost analysis

•Largest cost: Staff Time

–Use staff time allocation tool or time study tool

•Other cost information

Calculate the indirect costs

Common bases for allocation include :

• Ratio of selected service to all services

Ratio of total revenue attributed to the service .Ratio of practice square-footage devoted to the service • Ratio of total direct costs attributed to the service

Calculate depreciation

Straight-line depreciation:-

Original value – Resale value = Depreciation Cost

Calculate the unit cost

Direct costs per unit + Indirect costs per unit + Depreciation costs per unit = Total Cost per Unit of Service

Calculation the Earned value:

Budget at completion = 153,197,674.22

Total cost

Planned value = 40,278,635.7

Percent complete = 0.263

Earned value (percent complete × BAC) = 40,290,988.32

AC = 44,037,056.7

- CV = EV – AC = 40,290,988.32 – 44,037,056.7 = - 3,746,068.38 SDG.
- SV = EV – PV = 40,290,988.32 – 40,278,635.7

  SC% = $^{SV}/_{P\square}$ = $\frac{12,35262}{-37}$ = 12,352.62 SDG.

Cost Performance Index (CPI) = $^{EV}/_{AC}$ = $\frac{40,290,988.32}{44,037,056.7}$ = 0.915

- Schedule Performance Index (SPI) = $^{EV}/_{PV}$ = $\frac{40,290,988.32}{40,278,635.7}$ = 1.00031
- EAC $\frac{153,197,674.22}{0.915}$
- TCPI = $^{(BAC - EV)}/_{(BAC - AV)}$

Schedule Analysis and Forecasting

How are we doing time wise?

Schedule variance (are we ahead or behind schedule)

SV = EV – PV: 40,290,988.32 – 40,278,635.7

= 12,352.62 SDG.

SC% = $^{SV}/_{PV}$ = $\frac{12,352.62}{40,278,635.7}$ = 0.0003

SPI = $^{EV}/_{PV}$ = $\frac{40,290,988.2}{40,278,635.7}$ = 1.00031

EAC_t = $(BAC / SPI) \div (BAC / month)$ = $\frac{153,197,674.22}{1.00031} \div \frac{153,197,674.22}{12}$ = 0.15 0.12 = 12 month

Cost Analysis And Forecasting

CV = EV – AC = **4029988.32 – 44037056.7** = -3,746,068.38 SDG.

CPI = $^{EV}/_{AC}$ = $\frac{40,290,988.32}{44,037,056.7}$ = 0.91

To complete performance Index (how efficiently must we our remaining resources?)

TCPI = (BAC – EV) / (BAC – AC) = $\frac{(153,197,674.22 - 40,290,988.32)}{(153,197,674.22 - 44,037,056.7)}$ = 1.034

= $\frac{112,906,685.9}{109,160,617.5}$

Estimate to completion (what is the project likely to cost)

EAC = $^{BAC}/_{CPI}$ = $\frac{153,197,674.22}{0.91}$ = 168,349,092.5

Variance at completion will be under overall budget

VAC = BAC – EAC = 153,197,674.22 – **168,349,092.5** = 15,151,418.28

$VAC\% = {}^{VAC}/_{BAC} = \frac{15,151,418.28}{153,197,674.22} = 0.1$

Estimate to complete (what will the remaining work cost?)

$ETC = (BAC - EV) / CPI = \frac{153,197,674.22 - 40290,988.32}{0.91} =$

124,073,281.2

EAC = AC + ETC

EAC ATC

44,037,056.7 + 124,073,281.2 *=168,110,117.9*

4.2 Questionnaire Analysis and Discussion

This section will include an in depth analysis for the questionnaire. This will be conducted in the same order of the questions as appearing in the questionnaire form. To evaluate the reliability statistics to the hypothesis we used Cranach's alpha, which gives 0.853 and that mean the questionnaire questions were answered with a very good knowledge by the engineers. A total of 83 engineer participated in this study; according to table 1 the educational level 14.5 % of them had diploma then 48.2% of them had a bachelor degree while 28.9% engineer had master degree and 8.4% PhD

Table 4.9 shows the educational level

Data	Freq.	Percent
Diploma	12	14.5%
Bachelor	40	48.2%
Master	24	28.9%
PhD	7	8.4%
Total	83	100%

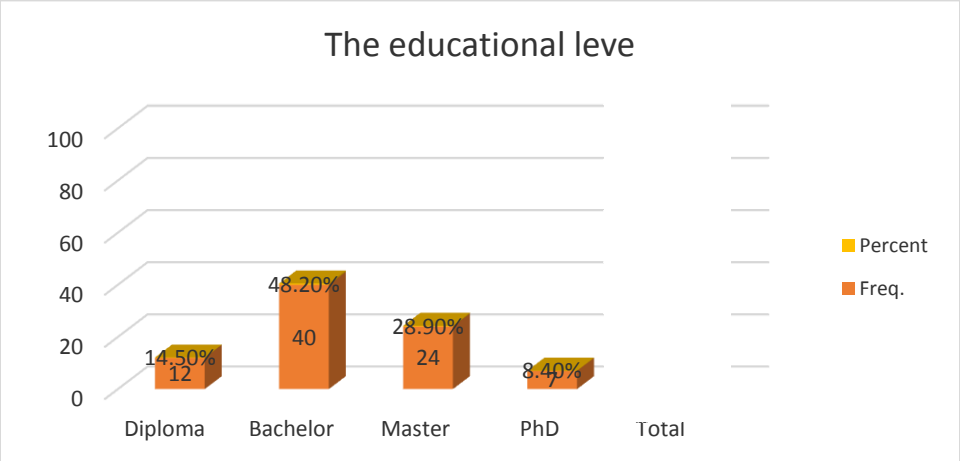

Figure (4.1) shows the educational level

Table 4.10 distribution of career level

Data	Freq.	Percent
Owner	4	4.8%
Contractor	43	51.8%
Consultants	34	41%
Other	2	2.4%
Total	83	100%

In term of career level 4.8% were owners then 51.8% of them were contractor then 41% consultant and 2.4% other career levels

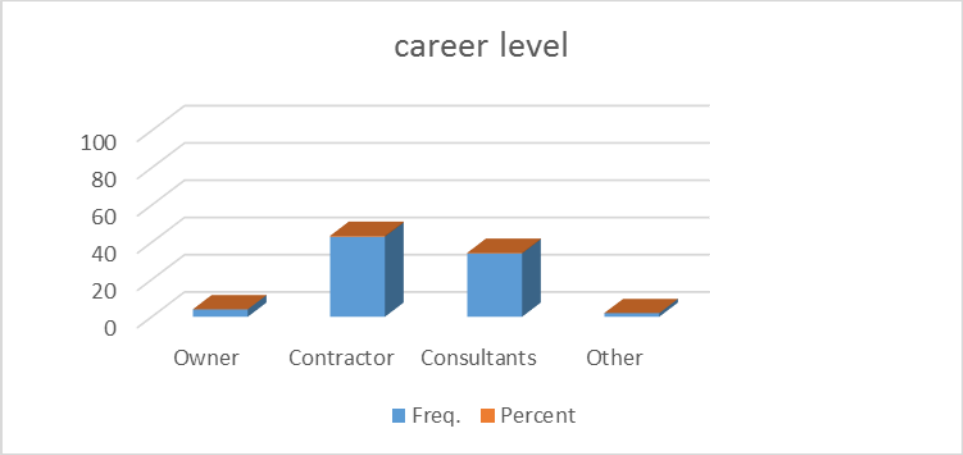

Figure (4. 2) distribution of career level

Table (4.11) shows the distribution of career location

Data	Freq.	Percent
Public sector	31	37.3%
Private sector	52	62.7%
Total	83	100%

37.3% engineers work at public sector while 62.7%. in private sector

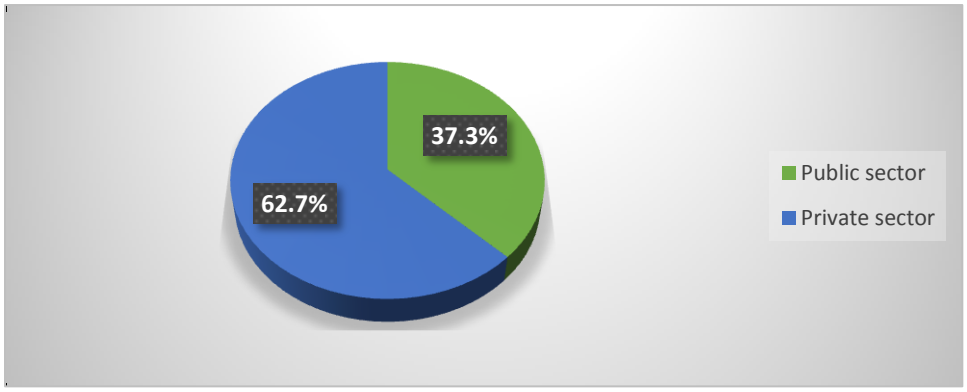

Figure (4. 3) distribution career location

Table 4.12 the distribution of work duration

Data	Freq.	Percent
5 to 10 years	38	45.8%
10 to 20 years	39	47%
More than 20	6	7.2%
Total	83	100%

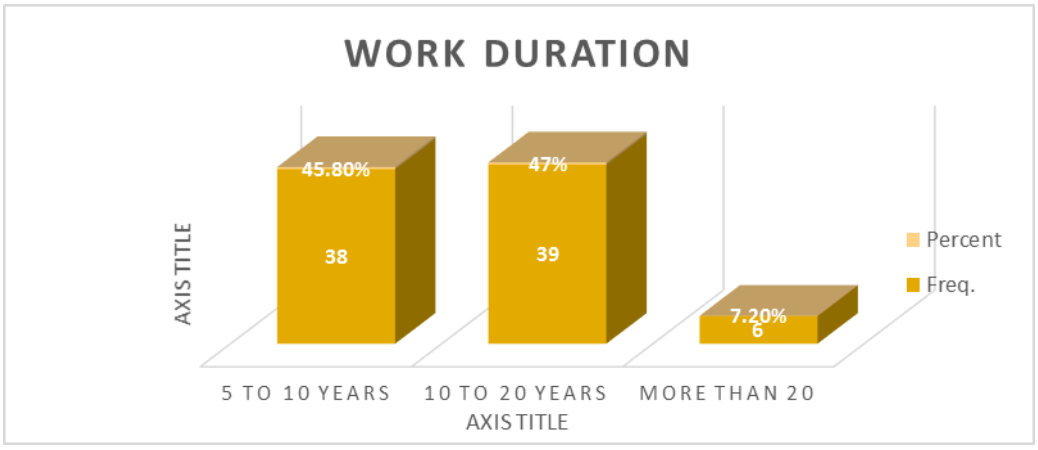

Figure (4. 4) distribution of work duration

In work duration 35.8% of the engineers in the range of 5 to 10 years then 47% engineers in the range of 10 to 20 while 7.2% engineers were more than 20

Table 4.13 Average of applying the projects

Data	Freq.	Percent
Less than 6 months	3	3.6%
6 month to 1 year	13	15.7%
1 to 2 years	34	41%
2 to 3 years	7	8.4%
3 to 5 years	8	9.6%
More than 5 years	16	19.3%
Total	83	100%

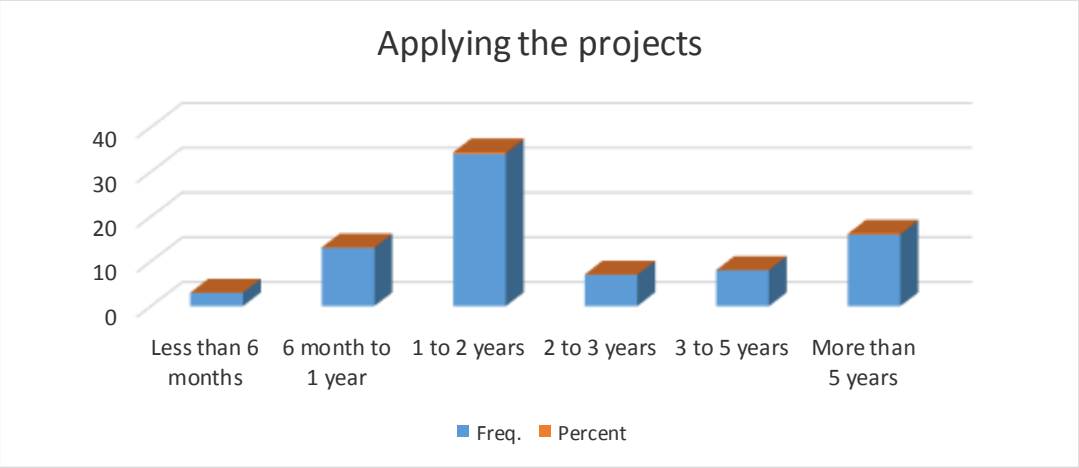

Figure (4. 5) Average of applying the projects

The average of the applying the projects for less than 6 months were 3.6% projects with while from 6 month to year were 15.7% with then from 1 to 2 years 41% with and 2 to 3 years were 8.4% with then 3 to 5 years 9.6% projects with then more than 5years were 19.3% project

Table 4.14 Number of projects that applied by the organization

Data	Freq.	Percent
Less than 5	16	19.3%
5 to 10	41	49.4%
11 to 15	23	27.7%
16 to 20	2	2.4%
More than 20	1	1.2%
Total	83	100%

Less than 5 applied the project by the organization which represent 19.3% then from 5 to 10 projects times represent 49.4% while from 11 to 15 projects times represent 27.7% then 16 to 20 projects times represent 2.4 and more than 20 projects time represent 1.2%.

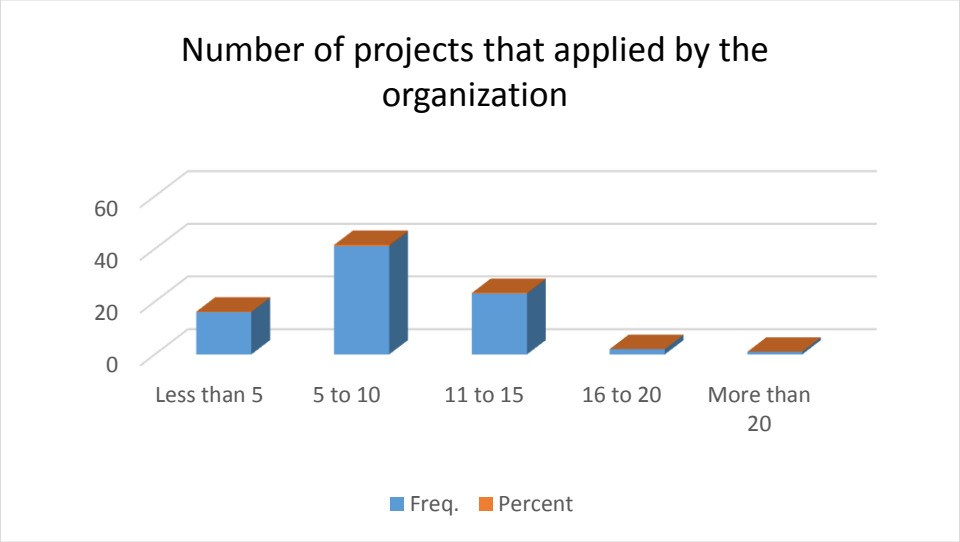

Figure (4. 6) number of projects that applied by the organization

Table 4.15 Number of projects according to the duration plan

Data	Freq.	Percent
Less the 5%	11	13.3%
5% to 10%	22	26.5%
10% to 30%	16	19.3%
30% to 50%	22	26.5%
50% to 80%	12	14.5%
Total	83	100%

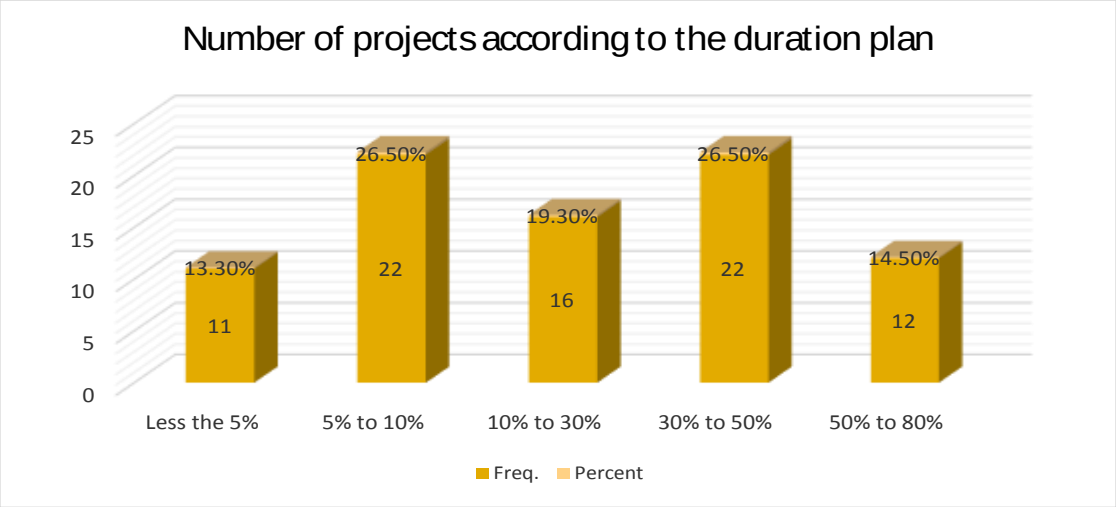

Figure (4. 7) number of projects according to the duration plan

Number of the projects according to the duration plan for less of 5% in represent 13.3% while from 5% to 10% in 26.5% times represent then 10% to 30% in 19.3% times represent then 30% to 50% were 26.5% times represent and 50% to 80% in14.5% times represent.

Table (4.16) Completed project according to the cost plan

Data	Freq.	Percent
Less the 5%	15	18.1%
5% to 10%	23	27.7%
10% to 30%	20	24.1%
30% to 50%	25	30.1%
Total	83	100%

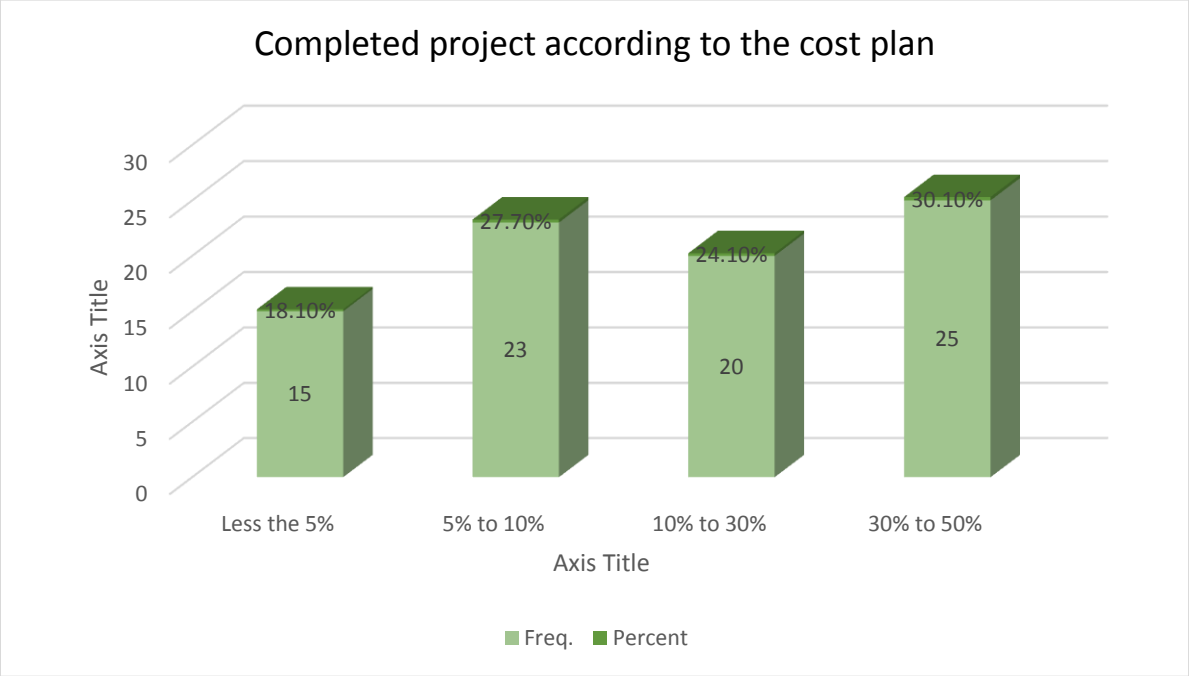

Figure (4. 8) Completed project according to the cost plan

Completed project according to the cost plan, 18.1% of the engineers sees complete the project in less than 5% then 27.7% represent sees from 5% to 10% then from 10% to 30% in 24.1% engineers represent and form 30% to 50% in 30.1% engineers represent .

Hypothesis (1): control and inspect of construction projects

Costs.

Table (4.17) shows the control of the cost and duration

Answer	Freq.	%
Neutral	1	1.2%
Agree	26	31.3%
Strongly agree	56	67.5%
Total	83	100%

This research confirms that most engineers 67.5% strongly agree that the control of construction project is by controlling the cost and time.

Then 31.3% agrees while 1.2% was neutral.

This result confirms that the majority of the respondents consider occurring this factor frequently during project execution.

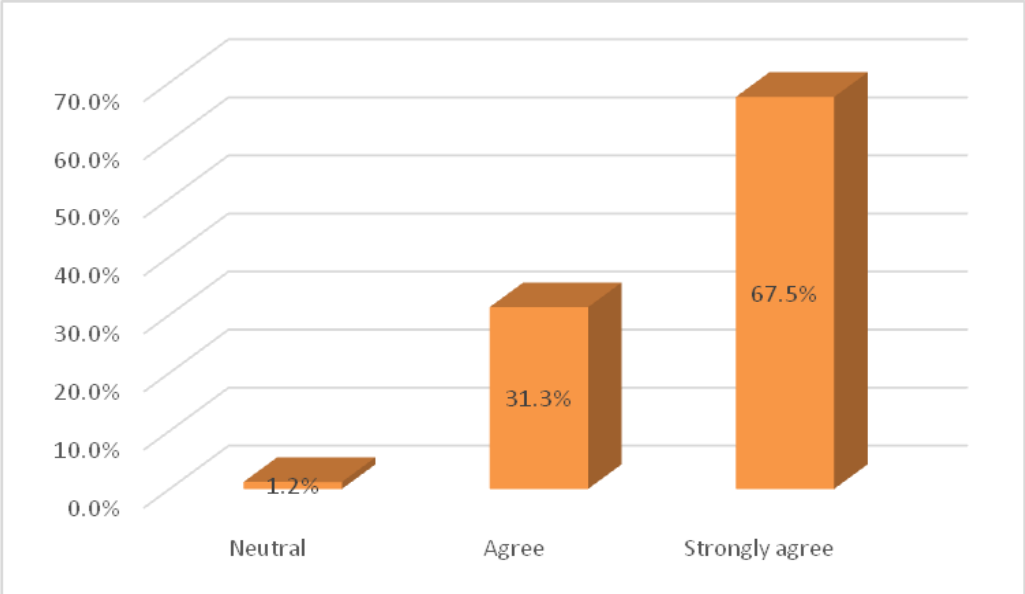

Figure (4.9) shows the control of the cost and duration

Table (4.18) shows the controlling the project state according to updating the cost and project management from the base of cost

Answer	Frequency.	Percent
Neutral	5	6%
Agree	36	43.4%
Strongly agree	42	50.6%
Total	83	100%

50.6 %2 of the engineers strongly agrees with controlling the project state according to updating the cost and project management from the base of cost Then 43.4% agree while 6% neutral.
This result confirms that the majority of the respondents consider occurring this factor frequently during project execution.

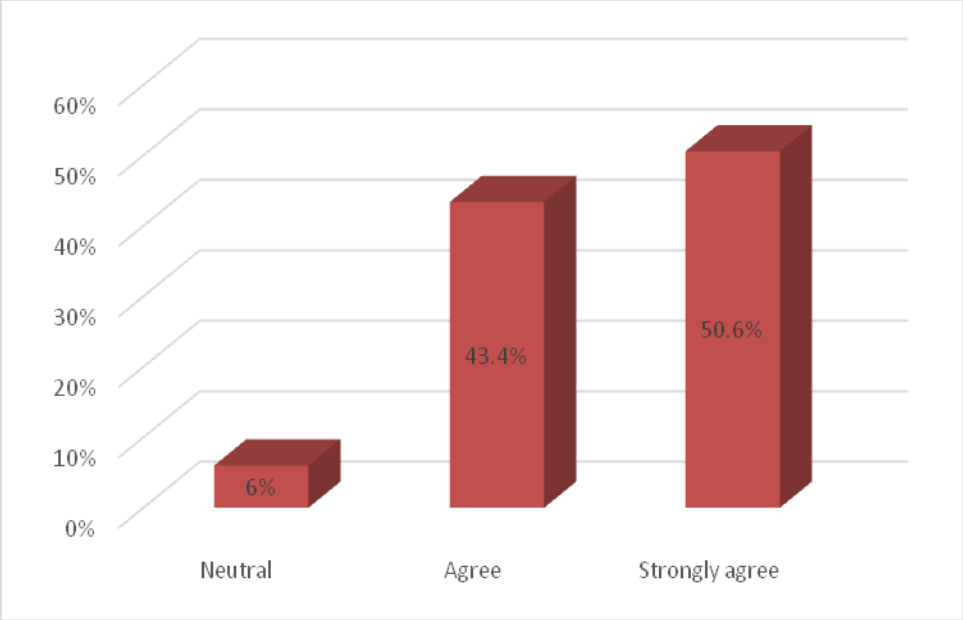

Figure (4.10) shows the controlling the project state according to updating the cost and project management from the base of cost.

Table (4.19) shows the forecasting for the last cost of the project

Answer	Freq.	%
Disagree	1	1.2%
Neutral	15	18.1%
Agree	40	48.2%
Strongly agree	27	32.5%
Total	83	100%

48.2% were strongly agree with forecasting for the last cost of the project then 32.5% strongly agree while 18.1% were neutral and 1.2% disagree.

Most engineers strongly agree that the control of construction project is by forecasting for the last cost of the project.

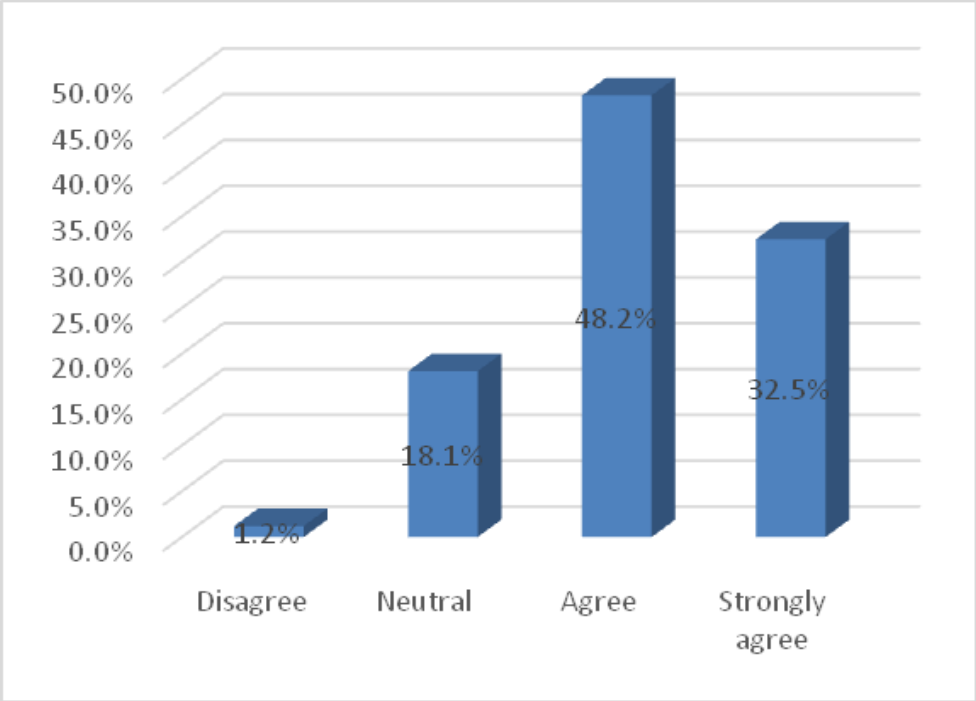

Figure (4.11) shows the forecasting for the last cost of the project.

Table (4.20) shows the signals for the direction of the cost if the unit increase or decrease.

Answer	Freq.	%
Disagree	2	2.4%
Neutral	5	6%
Agree	50	60.2%
Strongly agree	26	31.3%
Total	83	100%

60.2% were agrees with signals for the direction of the cost if the unit increase or decrease then 31.3% strongly agree then 6% neutral and 2.4%disagree.

Most engineers respondent that this factor significantly affects cost control and this confirms the theoretical study of cost control for construction project.

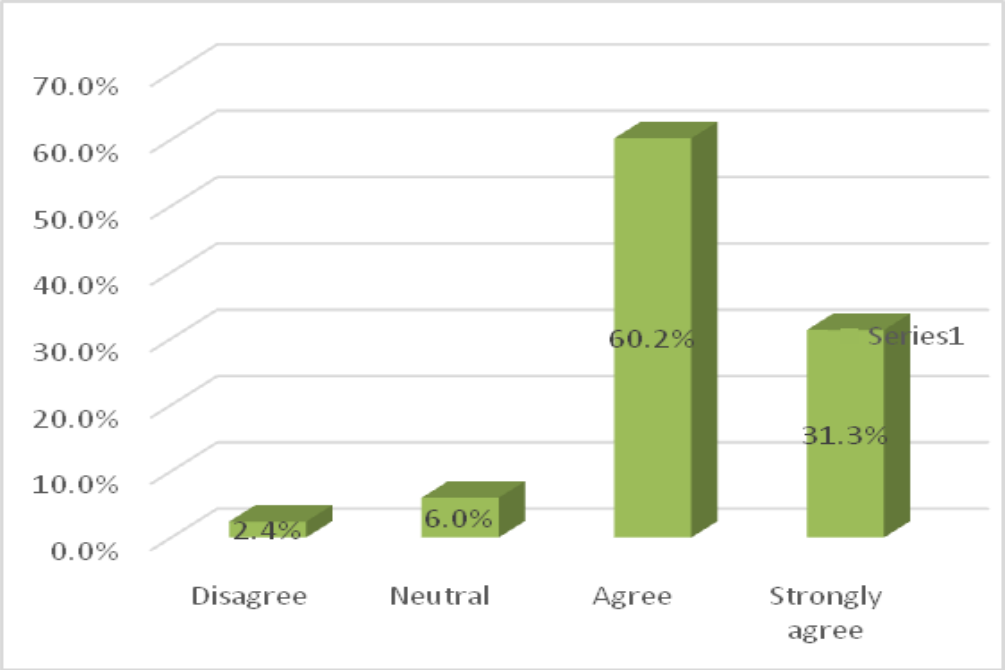

Figure (4.12) shows the signals for the direction of the cost if the unit increase or decrease.

Table (4.21): shows the distribution of type of projects that had high cost and long period and give notification that risk of exceed

Answer	Freq.	%
Disagree	1	1.2%
Neutral	7	8.4%
Agree	42	50.6%
Strongly agree	33	39.8%
Total	83	100%

50.6% were agrees with type of projects that had high cost and long period and give notification that risk of exceed then 39.8% strongly agree while 8.4% neutral and 1.2% disagree .Most engineers respondent that this factor significantly affects cost control and this confirms the theoretical study of cost control for construction project .

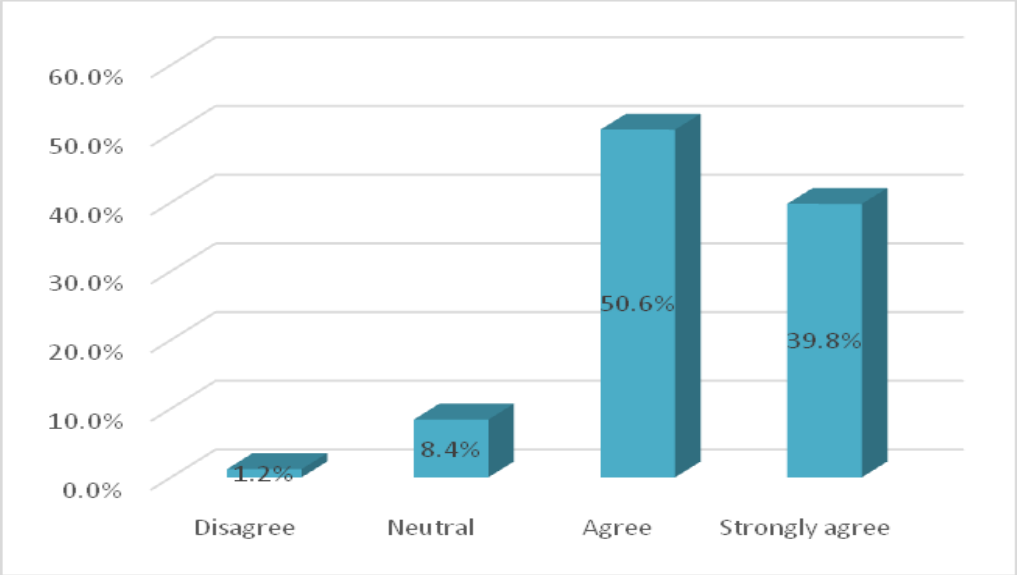

Figure (4.13) shows the distribution of type of projects that had high cost and long period and give notification that risk of exceed.

Table (4.22): shows the updating of the database of the organisation to rating the future plans

Answer	Freq.	%
Disagree	5	6%
Neutral	11	13.3%
Agree	36	43.4%
Strongly agree	31	37.3%
Total	83	100%

43.4% of the engineers agrees with updating of the database of the organisation to rating the future plans then 37.3% strongly agree while 13.3% were neutral and 6% disagree. Most engineers respondent that this factor significantly affects cost control and this confirms the theoretical study of cost control for construction project.

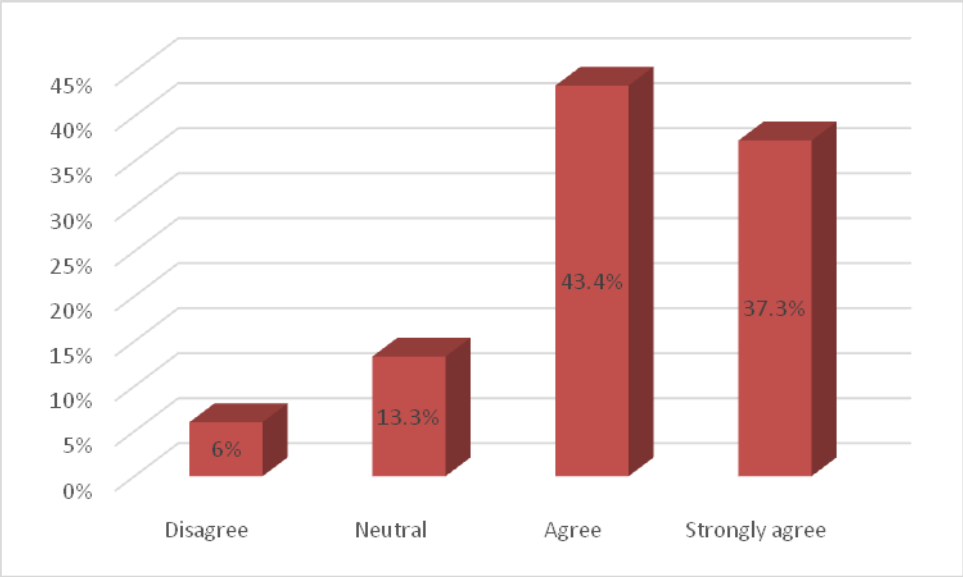

Figure (4.14) shows the updating of the database of the organisation to rating the future plans.

Table (4.23): shows the dealing with the weakness and the defect of the plans

Answer	Freq.	%
Disagree	2	2.4%
Neutral	11	13.3%
Agree	41	49.4%
Strongly agree	29	34.9%
Total	83	100%

49.4% of the engineers were agrees with dealing with the weakness and the defect of the plans then 34.9% strongly disagree while 13.3% neutral and 2.4% disagrees. Most engineers respondent that this factor significantly affects cost control and this confirms the theoretical study of cost control for construction project

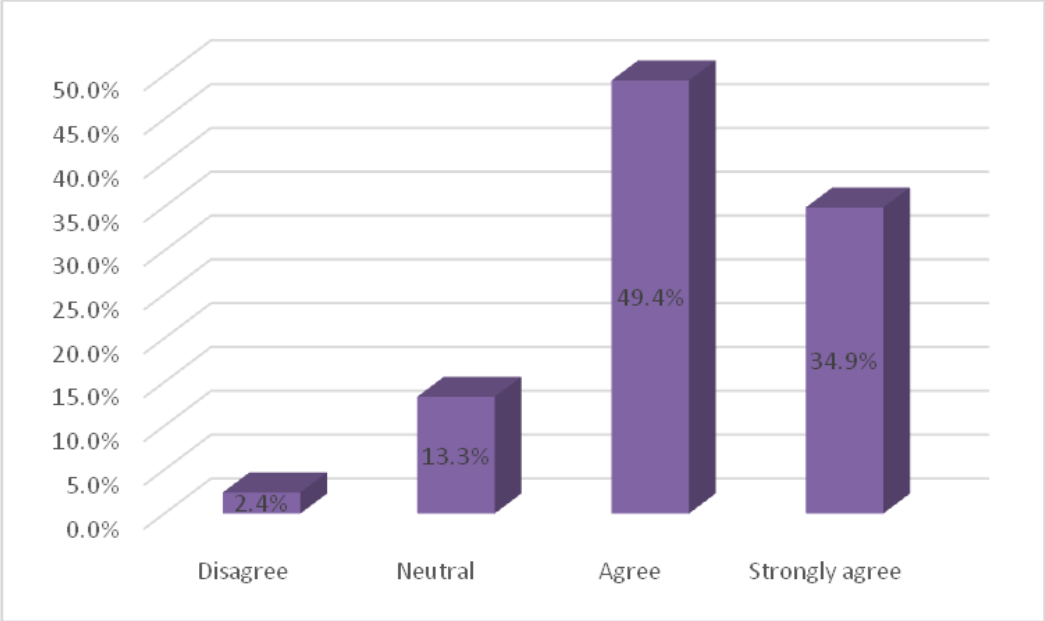

Figure (4.15) shows the dealing with the weakness and the defect of the plans.

Table (4.24): Identification of risk at the beginning of the project.

Answer	Freq.	%
Disagree	2	2.4%
Neutral	7	8.4%
Agree	39	47%
Strongly agree	35	42.2%
Total	83	100%

47% of the engineers agrees that early risk evaluation in starting project then 42.2% strongly agree while 8.4% neutral and 2.4% disagrees. Most engineers respondent that this factor significantly affects cost control and this confirms the theoretical study of cost control for construction project.

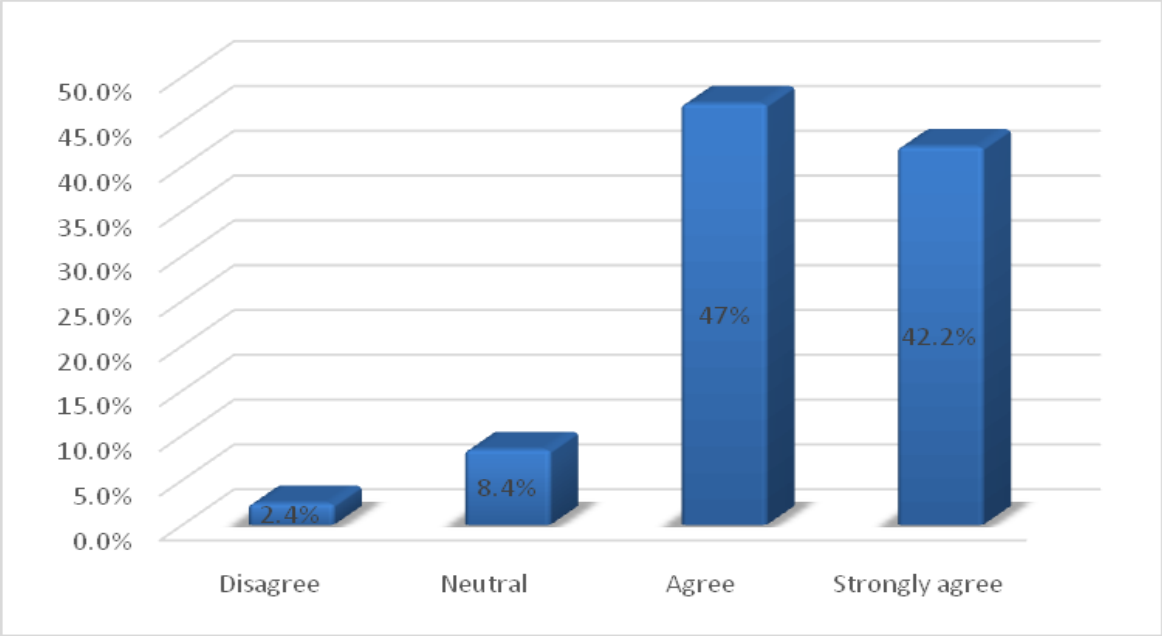

Figure (4.16) shows the early risk evaluation in starting project.

Table (4.25): shows the instrument provision to disparity recognition for the plan to reduce the risk factor.

Answer	Freq.	%
Disagree	2	2.4%
Neutral	15	18.1%
Agree	45	54.2%
Strongly agree	21	25.3%
Total	83	100%

54.2% of the engineers were agrees with the statement instrument provision to disparity recognition for the plan to reduce the risk factor then 25.3% strongly agree while 18.1% neutral and 2.4% disagrees. Most engineers respondent that this factor significantly affects cost control and this confirms the theoretical study of cost control for construction project.

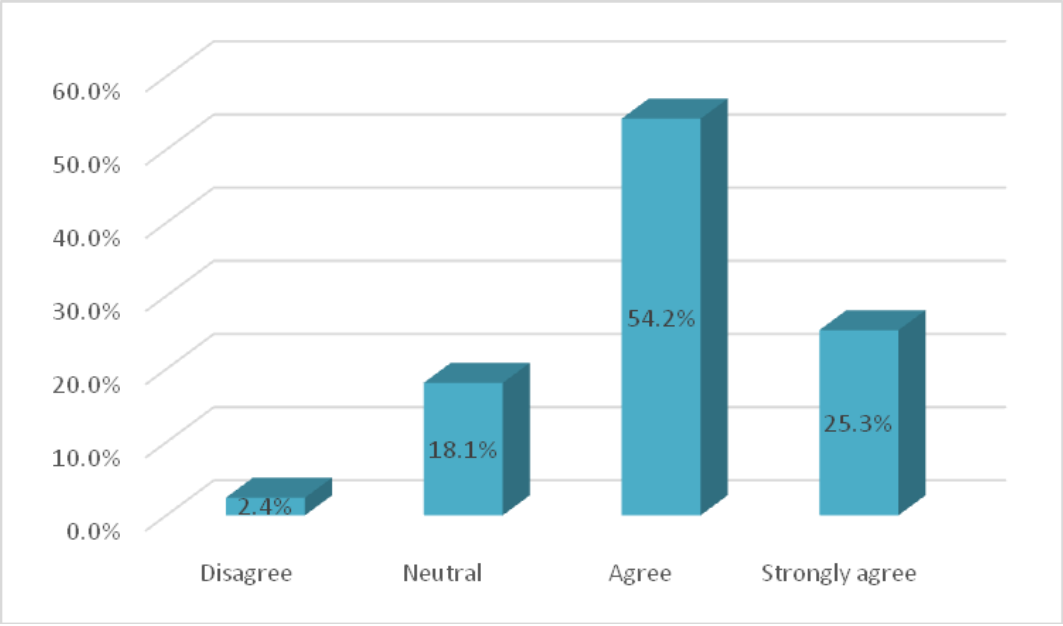

Figure (4.17) shows the instrument provision to disparity recognition for the plan to reduce the risk factor.

Table (4.26): shows the damages reduce in the fulfillment of the findings

Answer	Freq.	%
Disagree	3	3.6%
Neutral	8	9.6%
Agree	46	55.4%
Strongly agree	26	31.3%
Total	83	100%

55.4% of the engineers agrees that damages reduce in the fulfillment of the findings then 31.3% strongly agree while 9.6% neutral and 3.6% disagree.

Most engineers respondent that this factor significantly affects cost control and this confirms the theoretical study of cost control for construction project.

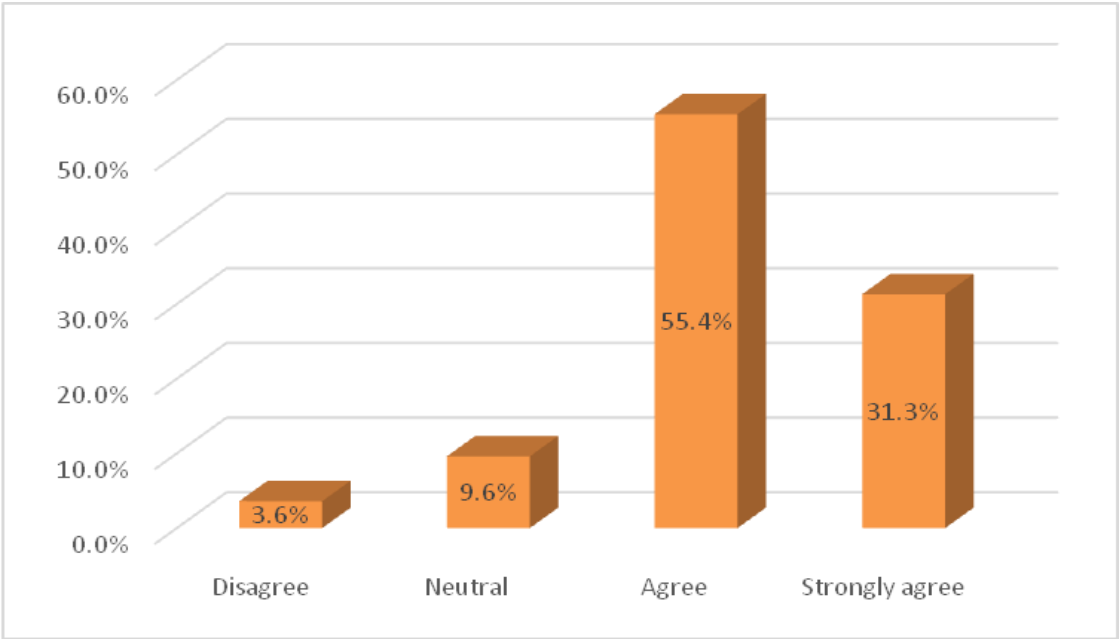

Figure (4.18) shows the damages reduce in the fulfillment of the findings

Table (4.27): Importance Index of factors causing in the hypothesis (1): control and inspect of construction projects costs.

Factor No	Factor description	Strongly agree	agree	neutral	Dis agree	Strongly Dis agree	Importance index
1	control of the cost and duration	56	26	1	0	0	4.7
2	Controlling the project state according to updating the cost and project management from the base of cost	42	36	5	0	0	4.5
3	forecasting for the last cost of the project	27	40	15	1	0	4.1
4	signals for the direction of the cost if the unit increase or decrease	26	50	5	2	0	4.2
5	the signals for the direction of the cost if the unit increase or decrease	33	42	7	1	0	4.3

6	distribution of type of projects that had high cost and long period and give notification that risk of exceed	31	36	11	5	0	4.12
7	the updating of the database of the organization to rating the future plans	31	36	11	5	0	4.12
8	the dealing with the weakness and the defect of the plans	29	41	11	2	0	4.17
9	Identification of risk at the beginning of the project	35	39	7	2	0	4.29
10	instrument provision to disparity recognition for the plan to reduce the risk factor	21	45	15	2	0	4.02
11	the damages reduce in the fulfilment of the findings	26	46	8	3	0	4.15

Importance Index of factors causing in the hypothesis (1):

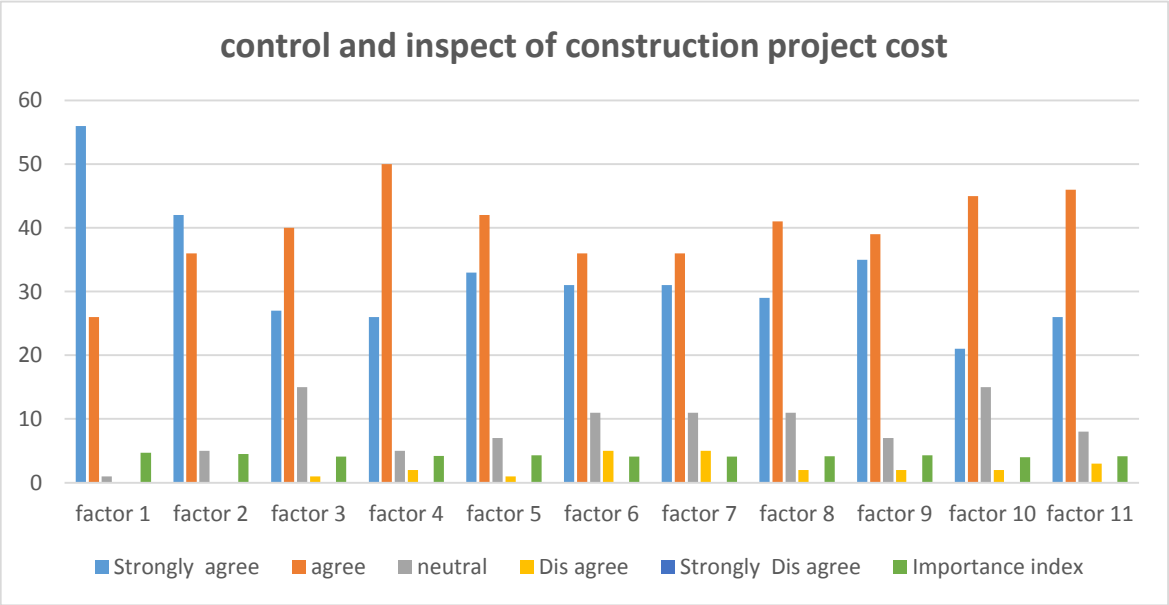

Figure (4. 19) control and inspect of construction projects costs.

Hypothesis (2) Internal and External factors affecting on controlling of the cost and time of the projects.

2.1**External factors**

Table (4.28): The Inflation and impact on the project resources

Answer	Freq.	%
Neutral	1	1.2%
Agree	22	26.5%
Strongly agree	60	72.3%
Total	83	100%

72.3% strongly agrees with the statement inflation and the defect on the project resources then 26.5% agree and 1.2% neutral.

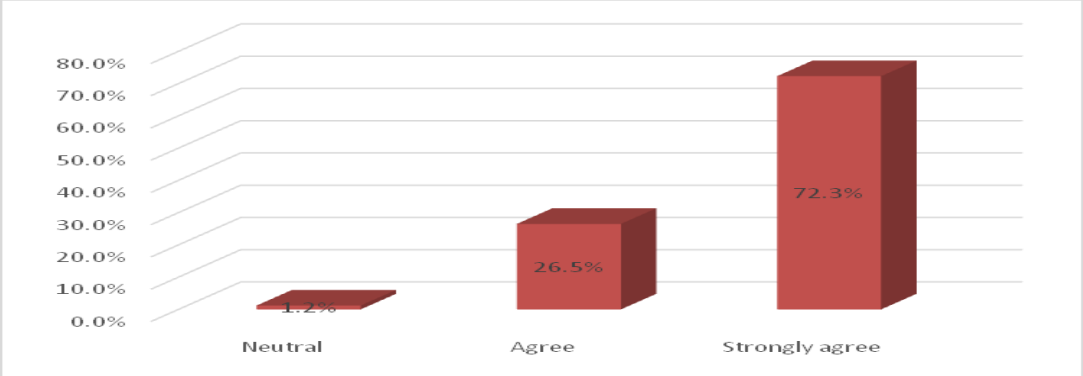

Figure (4.20) shows the inflation and the its defect on the project resources

Table (4.29): Uncertain climatic factors and earth condition

Answer	Freq.	%
Disagree	4	4.8%
Neutral	23	27.7%
Agree	38	45.8%
Strongly agree	18	21.7%
Total	83	100%

45.8%of the engineers agrees with the statement unexpected land circumstance and the climate factor then 21.7% strongly agree while 27.7% neutral and 4 disagree

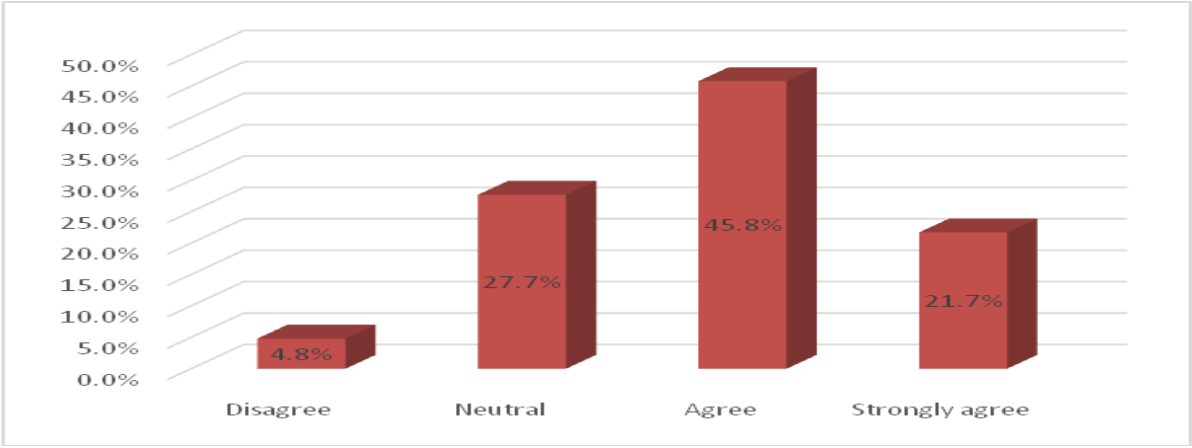

Figure (4.21) shows the unexpected land circumstance and the climate factor

Table (4.30): shows the political security absence and lack of stability

Answer	Freq.	%
Disagree	3	3.6%
Neutral	20	24.1%
Agree	47	56.6%
Strongly agree	13	15.7%
Total	83	100%

56.6%of the engineers agrees that political security absence and lack of stability factors that influence the cost and time controlling of the projects. Then 15.7% strongly agrees while 24.1% neutral and 3.6% disagrees.

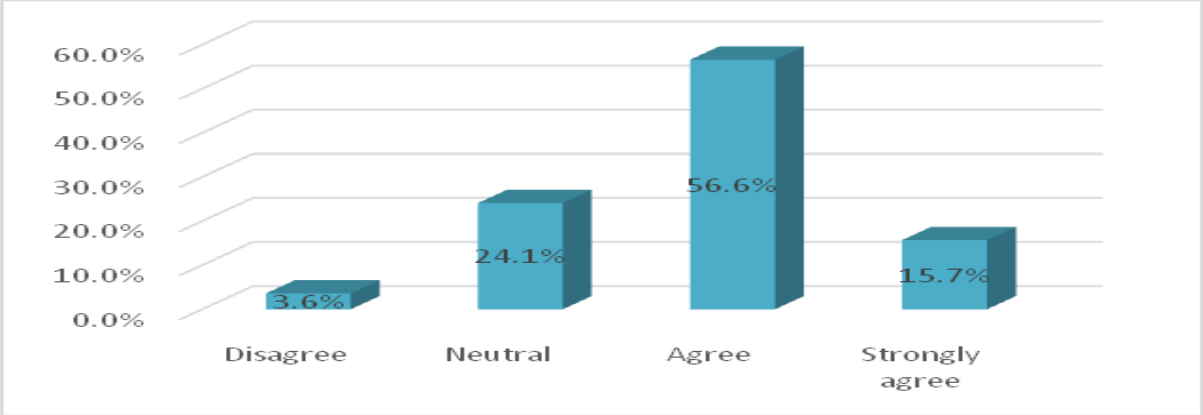

Figure (4.22) shows the political security absence and lack of stability

Table (4.31): updating the asset plan of the organizational processes

Answer	Freq.	%
Disagree	1	1.2%
Neutral	18	21.7%
Agree	53	63.9%
Strongly agree	11	13.3%
Total	83	100%

63.9% of the engineers agrees with the statement updating the plan of the organizational structure operations and project management then 13.3%strongly agree while 21.7% was neutral and 1.2% disagree.

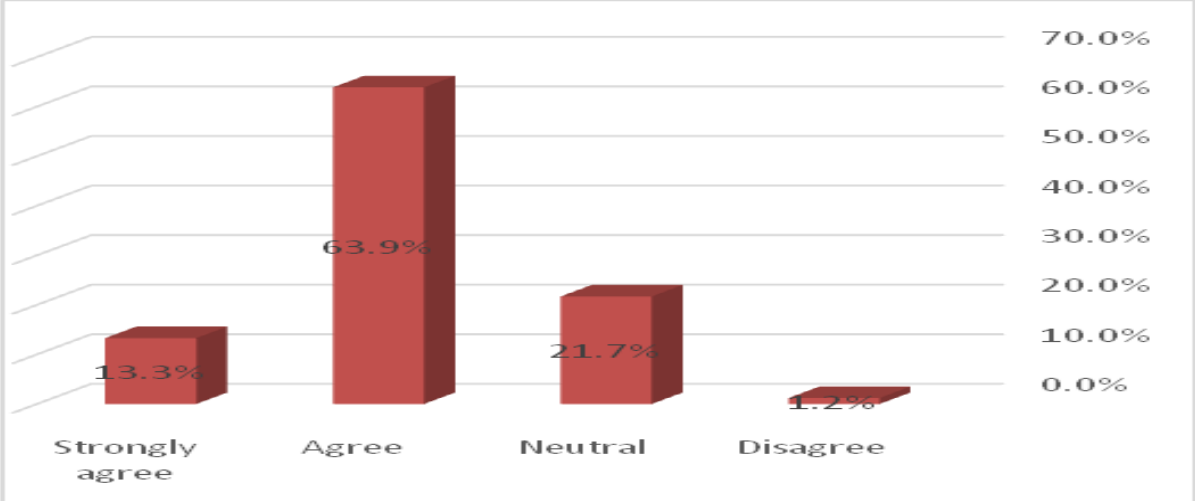

Figure (4.23) shows the updating the plan of the organizational structure operations and project management.

2.2Internal factors.

Table (4.32): Timelines are unrealistic and achievable

Answer	Freq.	%
Disagree	9	10.8%
Neutral	22	26.5%
Agree	32	38.6%
Strongly agree	20	24.1%
Total	83	100%

38.6% of the engineers agrees with time plan not for achieving and not reality then 24.1% strongly agree while 26.5% were neutral and 10.8% disagrees.

Internal factors. Timelines are unrealistic and achievable

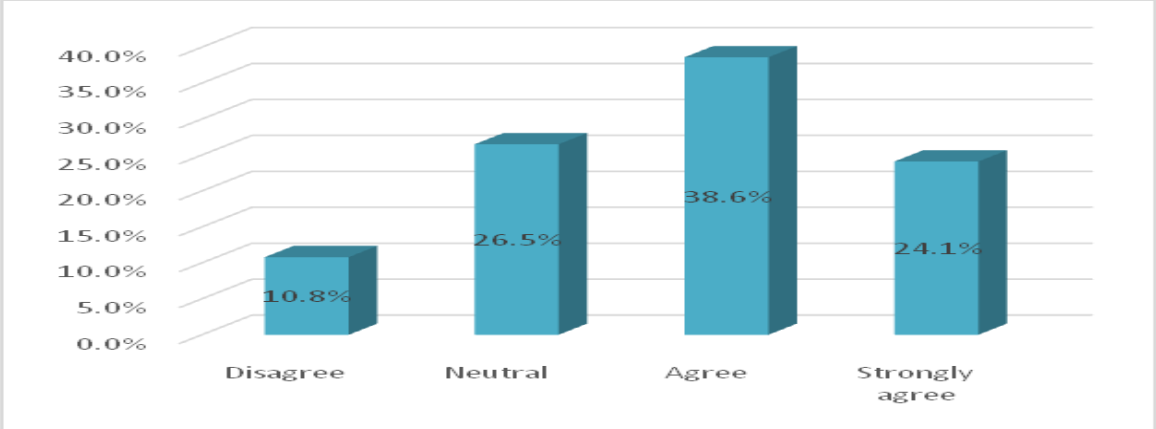

Figure (4.24).b shows the time plan not for achieving and not reality.

Table (4.33): shows the designs changes and changes requests

Answer	Freq.	%
Disagree	2	2.4%
Neutral	14	16.9%
Agree	50	60.2%
Strongly agree	17	20.5%
Total	83	100%

60.2% of the engineers agrees with the designs changes and changes requests then 20.5% strongly agree while 16.9% neutral and 2.4% disagree.

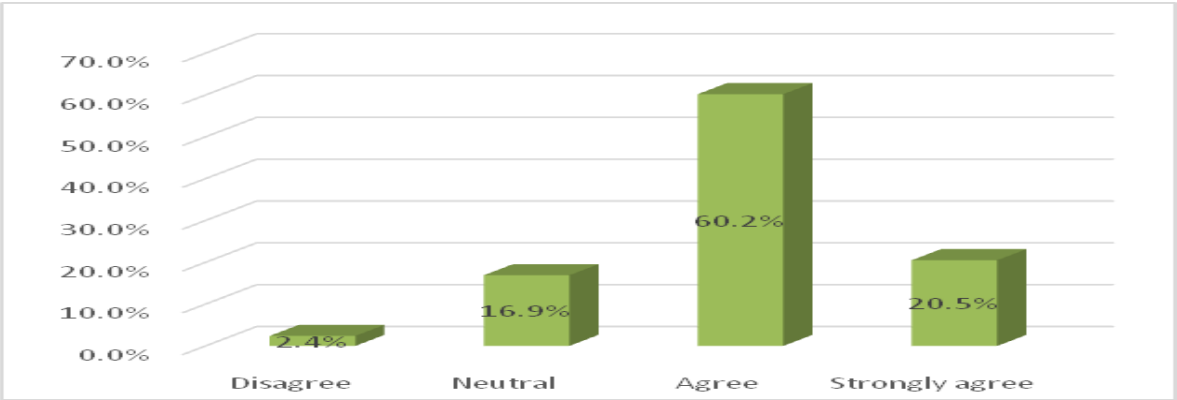

Figure (4.25) shows the designs changes and changes requests

Table (4.34): b shows the choose of the not qualified contractor

Answer	Freq.	%
Disagree	6	7.2%
Neutral	8	9.6%
Agree	39	47%
Strongly agree	30	36.1%
Total	83	100%

47% of the engineers choose the answer agree with the statement choose of the not qualified contractor for implementation process then 36.1% strongly agree while 9.6% were neutral and 7.2% disagrees.

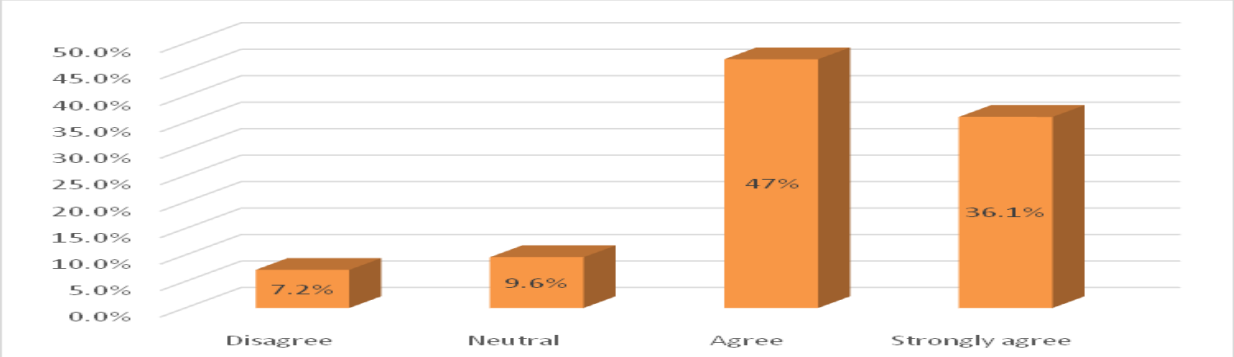

Figure.(4.26) choose of the not qualified contractor for implementation process

Table (4.35): shows the misjudgment of the project cost and lateness decision making by project team

Answer	Freq.	%
Disagree	7	8.4%
Neutral	7	8.4%
Agree	46	55.4%
Strongly agree	23	27.7%
Total	83	100%

The misjudgment of the project cost and lateness decision make from the work group; 55.4% of the engineers agrees with the statement while 27.7% strongly agrees then 8.4% were neutral and 8.4% disagree respectively.

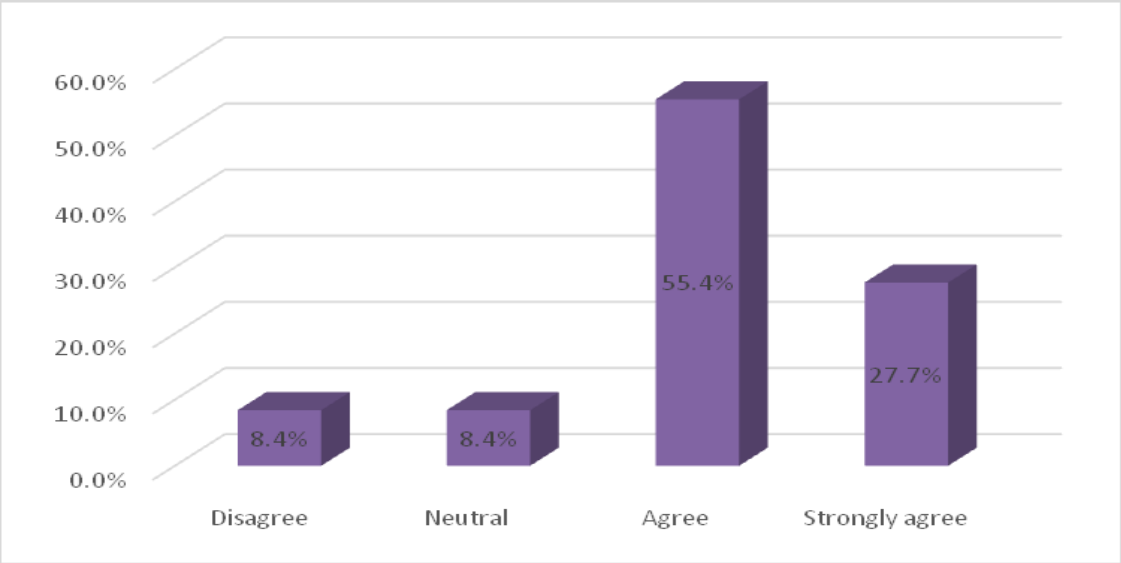

Figure (4.27) shows the misjudgment of the project cost and lateness decision make from the work group.

Table (4.36): shows the not track work e performance and expect time plan

Answer	Freq.	%
Strongly disagree	2	2.4%
Disagree	8	9.6%
Neutral	9	10.8%
Agree	39	47%
Strongly agree	25	30.1%
Total	83	100%

47% agree with the not following the performance and expect time plan then 30.1% strongly agree while 10.8% neutral and 9.6% disagree then 2.4% strongly disagree.

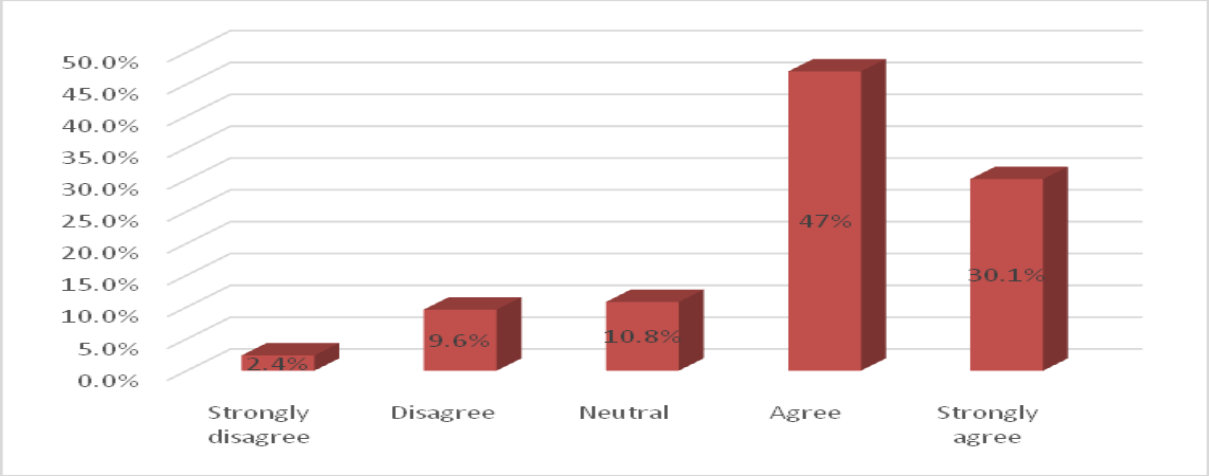

Figure (4.28) shows the not following the performance and expect time plan

Table (4.37) shows the weakness in supervision and location management worst.

Answer	Freq.	%
Disagree	9	10.8%
Neutral	10	12%
Agree	26	31.3%
Strongly agree	38	45.8%
Total	83	100%

45.8% strongly agrees with the item weakness in supervision and location management worst then 31.3% agree while 12% were neutral and 10.8% disagree.

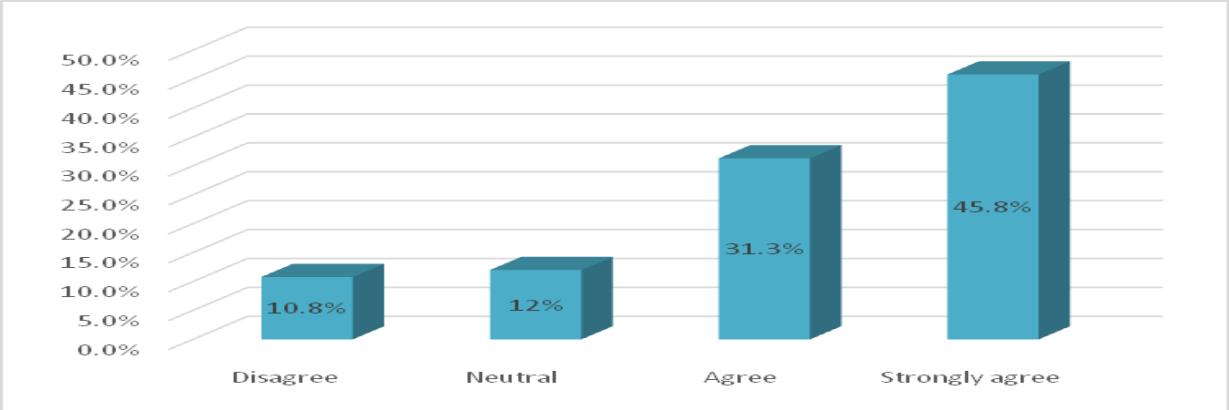

Figure (4.29) shows the weakness in supervision and location management worst.

Table (4.38) shows the choosing alternatives for the equipment's and tools

Answer	Freq.	%
Disagree	3	3.6%
Neutral	19	22.9%
Agree	54	65.1%
Strongly agree	7	8.4%
Total	83	100%

65.1% agrees with the choosing alternatives for the equipment's and tools then 8.4% agree while 22.9% and 3.6% disagrees.

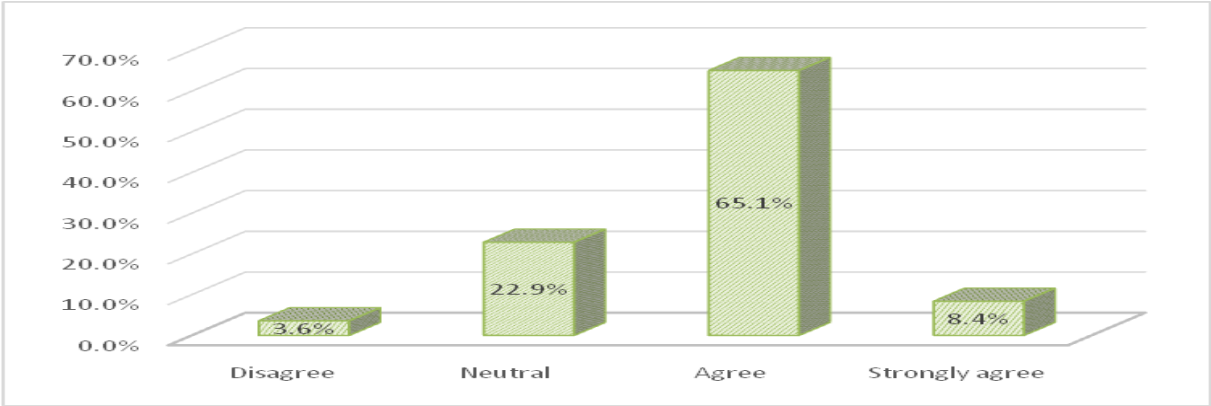

Figure (4.30) shows the choosing alternatives for the equipment's and tools

Table (4.39) buying the material according to quantity guessed in guideline

Answer	Freq.	%
Disagree	4	4.8%
Neutral	19	22.9%
Agree	45	54.2%
Strongly agree	15	18.1%
Total	83	100%

54.2% agrees with statement buying the material according to quantity guessed in guideline then 18.1% strongly agree while 22.9% neutral and 4.8% disagrees.

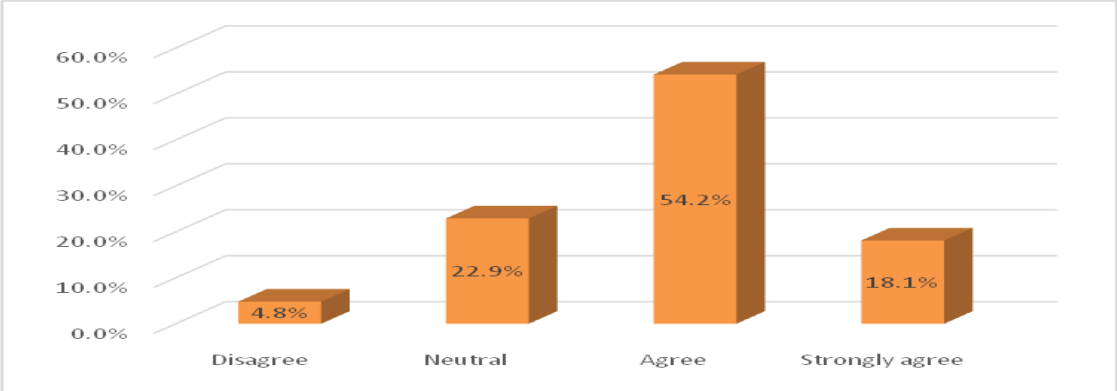

Figure (4.31) buying the material according to quantity guessed in guideline

Table (4.40) shows the prices change

Answer	Freq.	%
Disagree	6	7.2%
Neutral	20	24.1%
Agree	34	41%
Strongly agree	23	27.7%
Total	83	100%

41% agrees with the prices change while 27.7% agree then 24.1% neutral and 7.2% disagree.

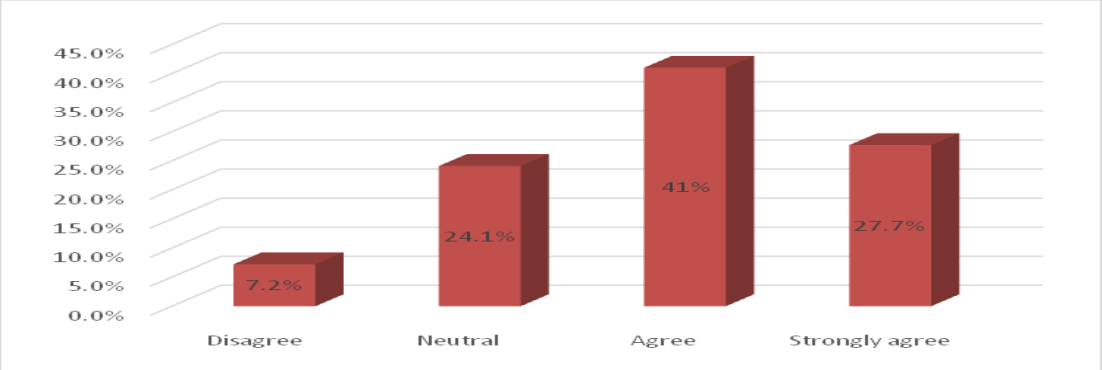

Figure (4.32). Shows the prices change

Table (4.41) Importance Index of factors causing in the hypothesis (2): Internal and External factors affecting on controlling of the cost and time of the projects.

Factor No	Factor description	Strongly agree	agree	neutral	Dis agree	Strongly Dis agree	Importance index
Factor 1	The Inflation and impact on the project resources	60	22	1	0	0	4.7
Factor 2	Uncertain climatic factors and earth condition	18	38	23	4	0	3.84
Factor 3	the political security absence and lack of stability	13	47	20	3	0	3.84

Factor 4	updating the asset plan of the organizational processes and project management	11	53	18	1	0	3.9
Factor 5	Timelines are unrealistic and achievable	20	32	22	9	0	3.8
Factor 6	the designs changes and changes requests	17	50	14	2	0	4.0
Factor 7	the choose of the not qualified contractor for implementation process	30	39	8	2	0	4.02
Factor 8	the misjudgment of the project cost and lateness decision making by project team	23	46	7	7	0	4.02
Factor 9	the not track work e performance and expect time plan	25	39	9	8	0	3.9

Factor 10	the weakness in supervision and location management worst	38	26	10	9	0	4.1
Factor 11	the choosing alternatives for the equipment's and tools	7	54	19	3	0	3.7
Factor 12	buying the material according to quantity guessed in guideline	15	45	19	4	0	3.9
Factor 13	the prices change	23	34	20	6	0	3.9

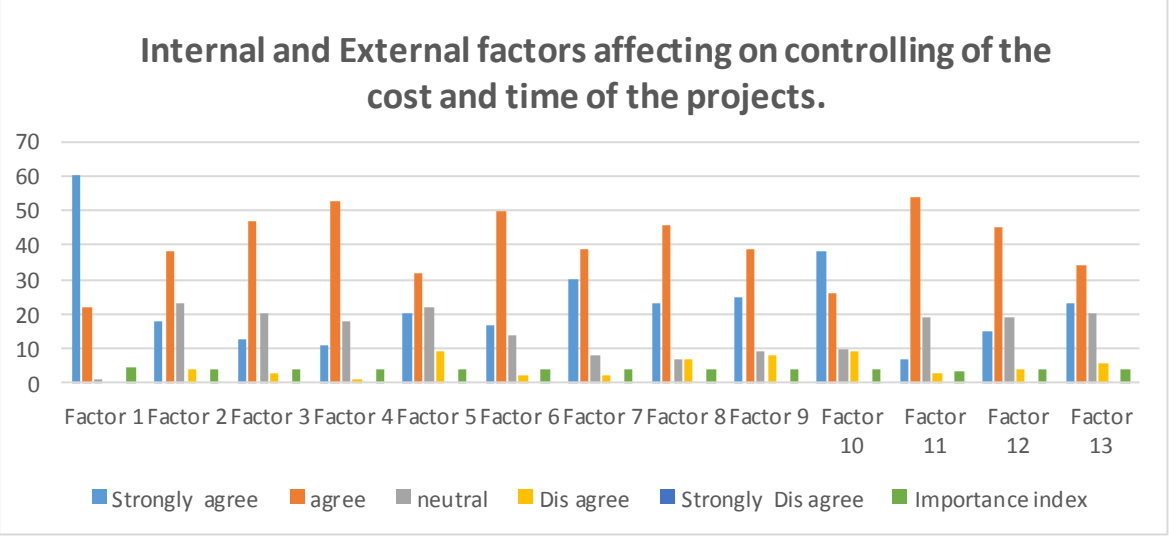

Figure (4.33). Factors affecting on controlling of the cost and time

Hypothesis (3) Earned value and analyses the cost and profit

Table (4.42) shows the better way to control the project methods and forecasting for the future

Answer	Freq.	%
Neutral	2	2.4%
Agree	31	37.3%
Strongly agree	50	60.2%
Total	83	100%

60.2%of the engineers strongly agree with the better way to control the project methods and forecasting for the future then 37.3% agree and 2.4%were neutral.

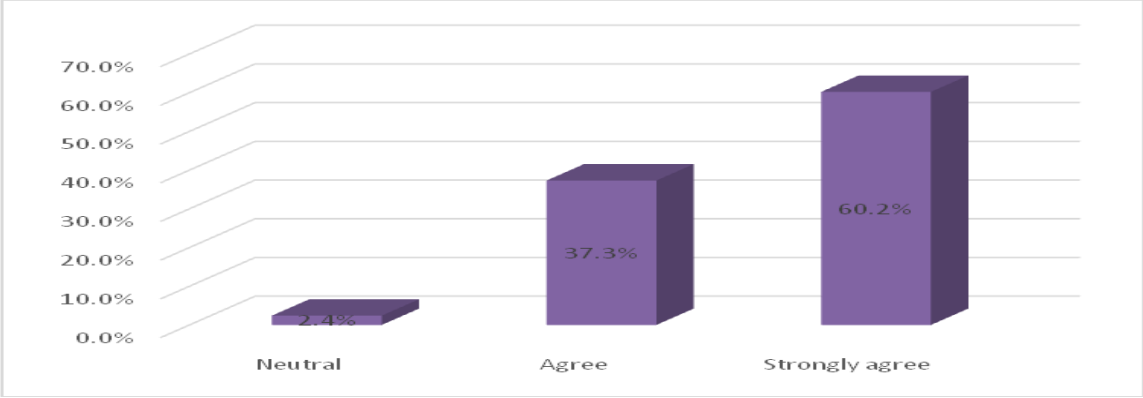

Figure (4.34). Shows the better way to control the project methods and forecasting for the future.

Table (4.43) the work determination of project side-track with the resource

Answer	Freq.	%
Neutral	6	7.2%
Agree	34	41%
Strongly agree	43	51.8%
Total	83	100%

51.8% strongly agree with the work with determination of project side-track with the source then 41% agree and 7.2% neutral.

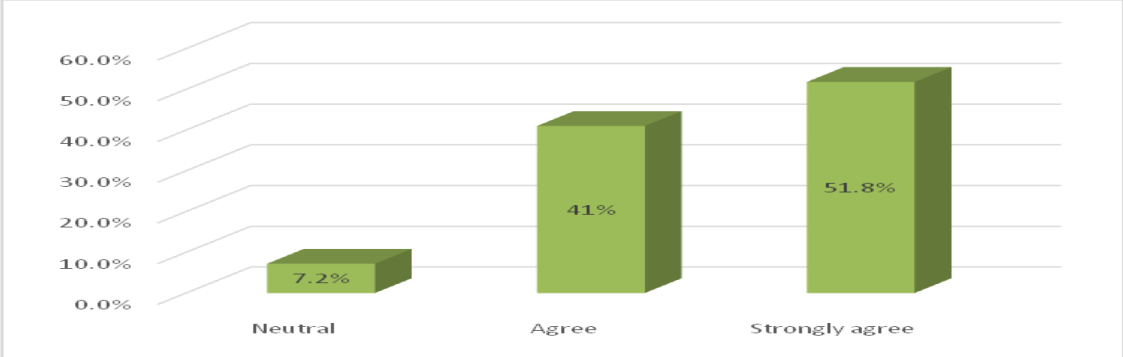

Figure (4.35) the work determination of project side-track with the resource.

Table (4.44) shows one of the project management methodology for use and one of the best uses for controlling and following the projects

Answer	Freq.	%
Neutral	4	4.8%
Agree	35	42.2%
Strongly agree	44	53%
Total	83	100%

53% strongly agree with the statement one of the project management methodology for use and one of the best uses for controlling and following the projects then 42.2% agree and 4.8%neutral.

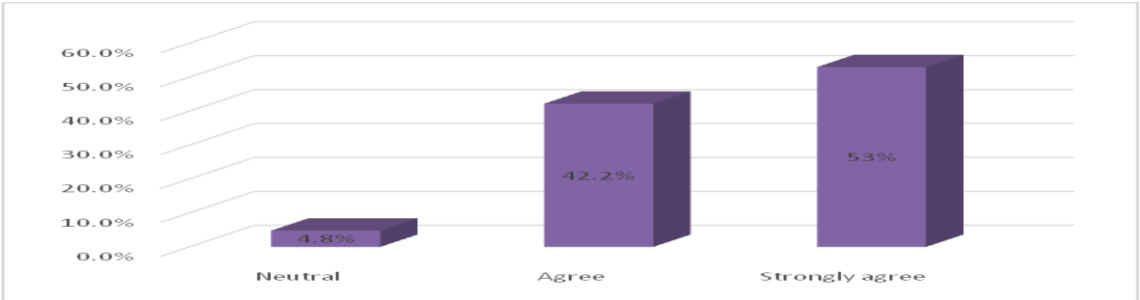

Figure (4.36) shows one of the project management methodology for use and one of the best uses for controlling and following the projects

Table (4.45) using technical for controlling and the state of progress and the future forecasting

Answer	Freq.	%
Disagree	1	1.2%
Neutral	5	6%
Agree	39	47%
Strongly agree	38	45.8%
Total	83	100%

47% agrees with using technical for controlling and the state of progress and the future forecasting then 45.8% strongly agree while 6% and 1.2%disagree.

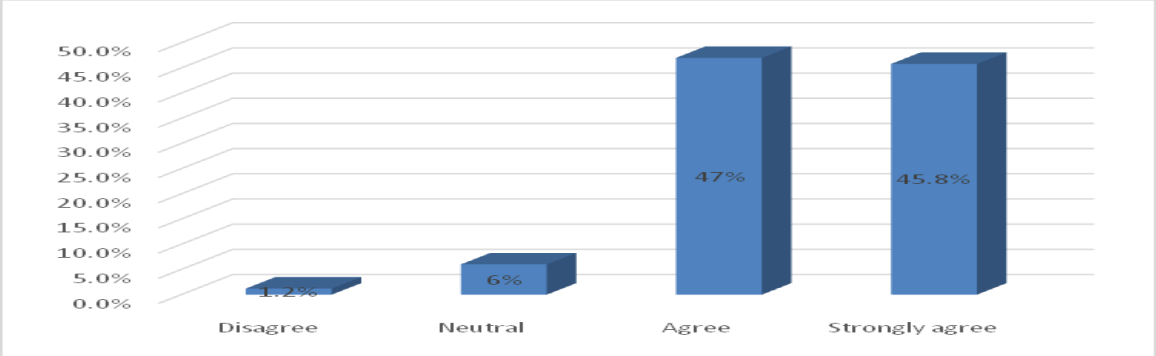

Figure (4.37) using technical for controlling and the state of progress and the future forecasting.

Table (4.46) analyzing the cost and profit determines.

Answer	Freq.	%
Disagree	2	2.4%
Neutral	12	14.5%
Agree	49	59%
Strongly agree	20	24.1%
Total	83	100%

(59%) agrees that analysing the cost and profit determines if the investing or the decision was right then (24.1%) strongly agrees while (14.5%) neutral and (2.4%) disagree.

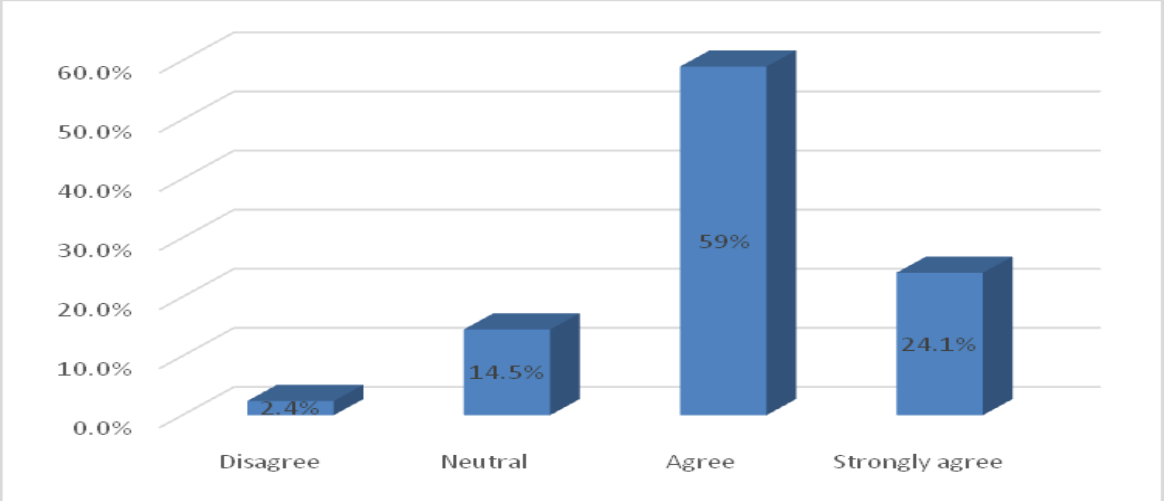

Figure (4.38) shows analyzing the cost and profit determines if the investing or the decision was right

Table (4.47) shows to provide the basis can depending on compare between the projects

Answer	Freq.	%
Disagree	1	1.2%
Neutral	21	25.3%
Agree	39	47%
Strongly agree	22	26.5%
Total	83	100%

(47%) of the engineers agree to provide the basis can depending on compare between the projects then (26.5%) strongly agree while (25.3%) neutral and (1.2%) disagree.

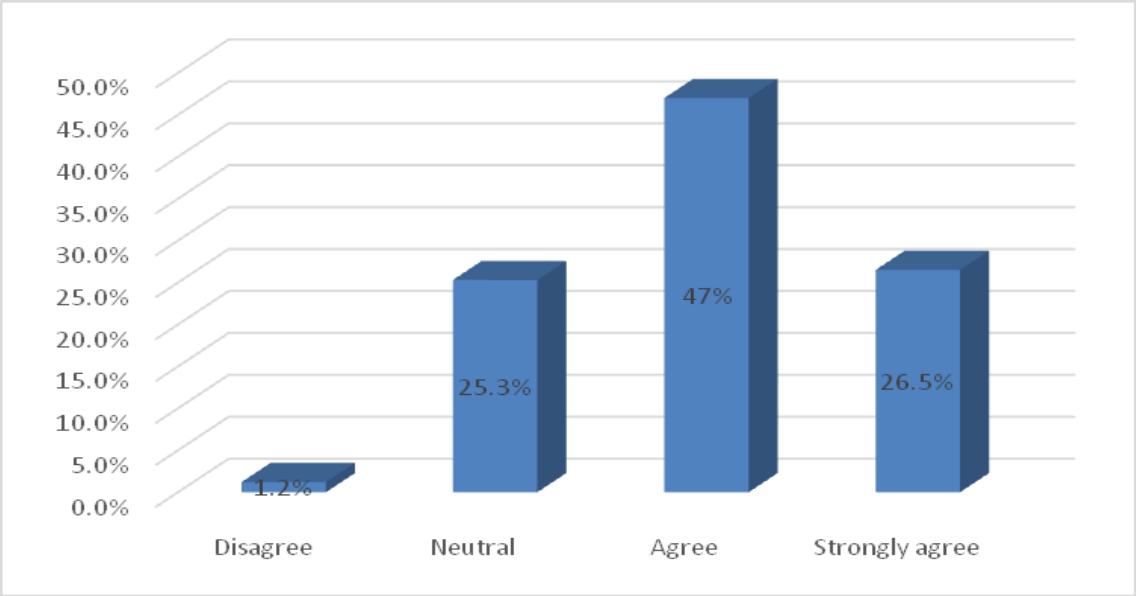

Figure (4.39) shows to provide the basis can depending on compare between the projects.

Table (4.48) shows compare between expected total cost for any choice in compatible with expected total profit and determination the quantity

Answer	Freq.	%
Disagree	1	1.2%
Neutral	21	25.3%
Agree	48	57.8%
Strongly agree	13	15.7%
Total	83	100%

(57.8%) agree with the statement compare between expected total cost for any choice in compatible with expected total profit and determination the quantity then (15.7%) strongly agree while (25.3%) neutral and (1.2%) disagree.

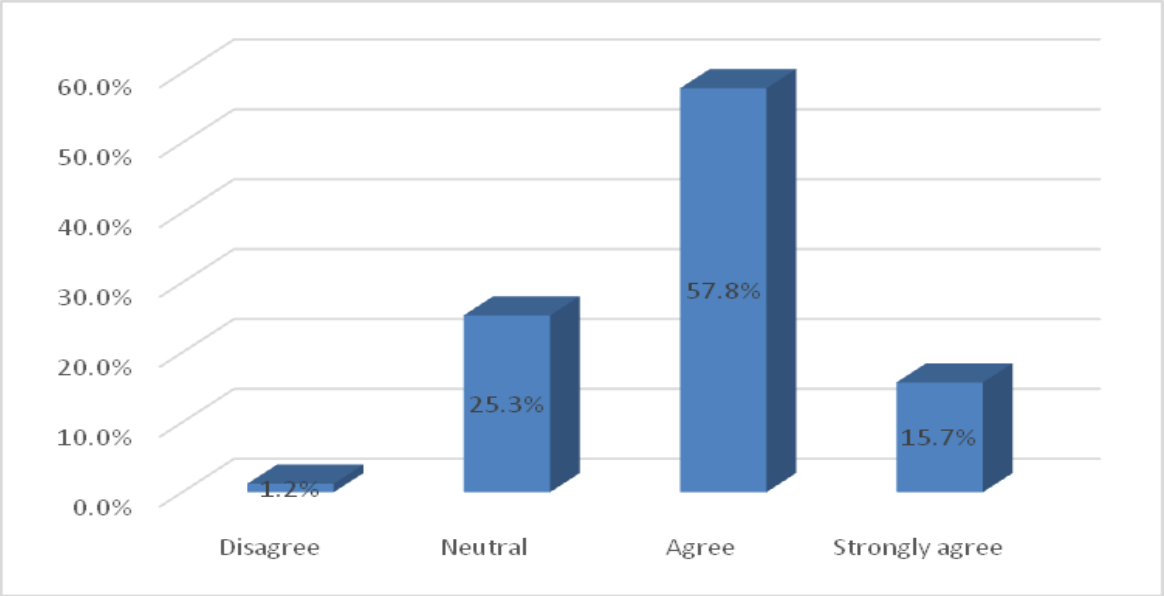

Figure (4.40) shows compare between expected total cost for any choice in compatible with expected total profit and determination the quantity.

Table (4.49) shows analyses to measure expected balance in the percentage of profit and alternative choices

Answer	Freq.	%
Disagree	1	1.2%
Neutral	18	21.7%
Agree	47	56.6%
Strongly agree	17	20.5%
Total	83	100%

(56.6%) agrees with item analyses to measure expected balance in the percentage of profit and alternative choices (20.5%) strongly agree (21.7%) neutral and (1.2%) disagree.

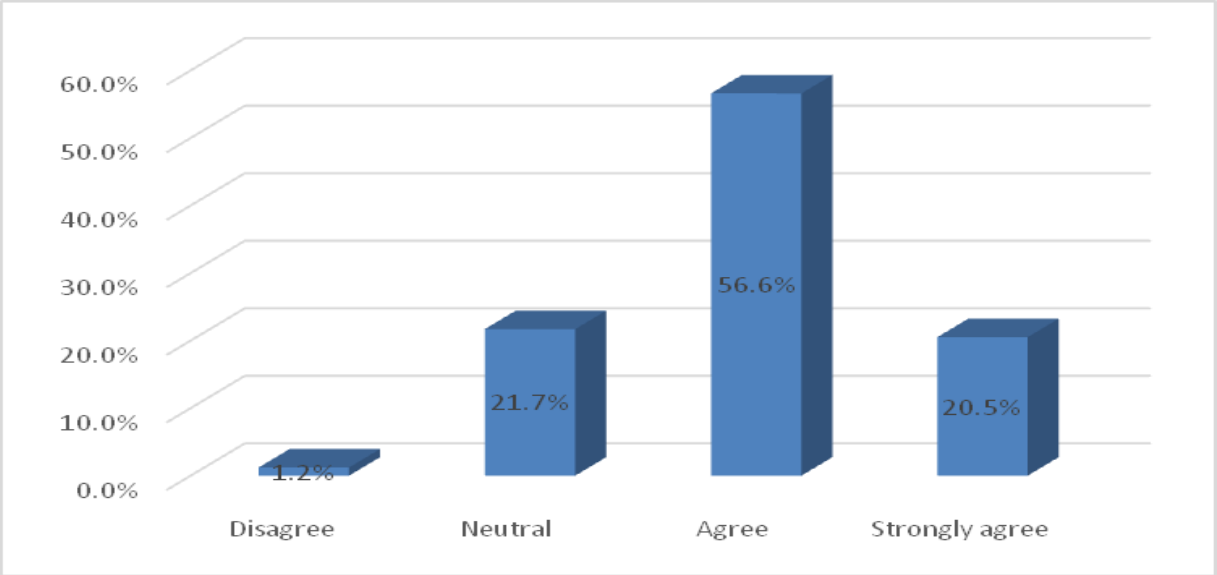

Figure (4.41) shows analyses to measure expected balance in the percentage of profit and alternative choices.

Table (4.50) shows analyses cost and profit expression, the term of cost and profit phrase in cash and control it for the time value of cash

Answer	Freq.	%
Neutral	22	26.5%
Agree	36	43.4%
Strongly agree	25	30.1%
Total	83	100%

(43.4%) agrees with analyses cost and profit expression, the term of cost and profit phrase in cash and control it for the time value of cash (30.1%) strongly agree and (26.5%) neutral.

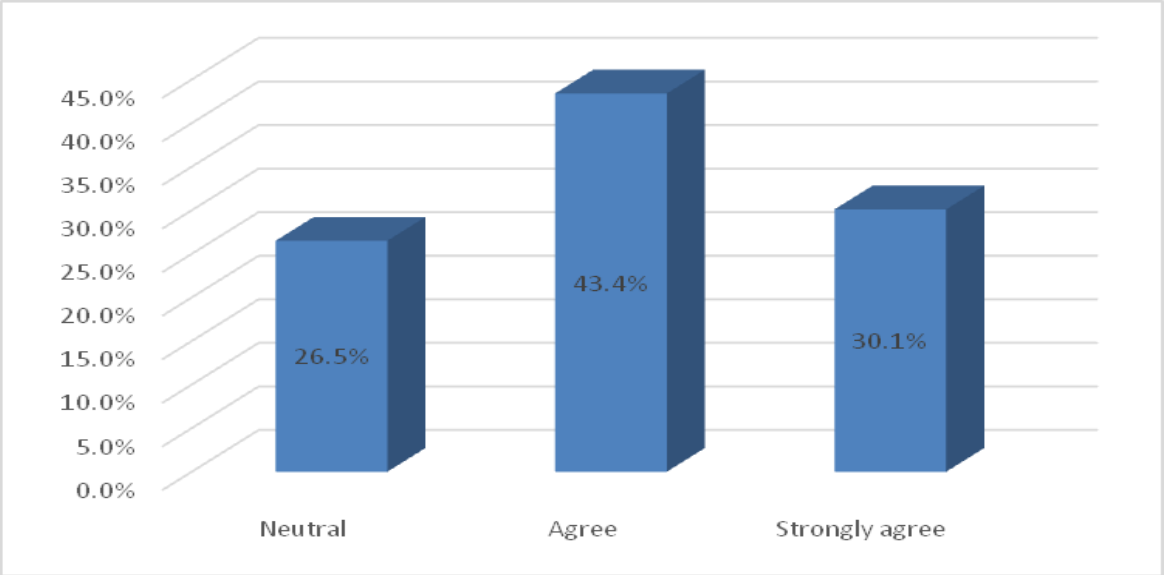

Figure (4.42) shows analyses cost and profit expression, the term of cost and profit phrase in cash and control it for the time value of cash.

Table (4.51) shows analyses cost and profit to evaluate the perfect rate for the cost recently and future are difficult to achieve it

Answer	Freq.	%
Disagree	4	4.8%
Neutral	19	22.9%
Agree	31	37.3%
Strongly agree	29	34.9%
Total	83	100%

(37.3%) agrees with the statement analyses cost and profit to evaluate the perfect rate for the cost recently and future are difficult to achieve it then (34.9%) strongly agree while (22.9%) neutral. and (4.8%) disagree

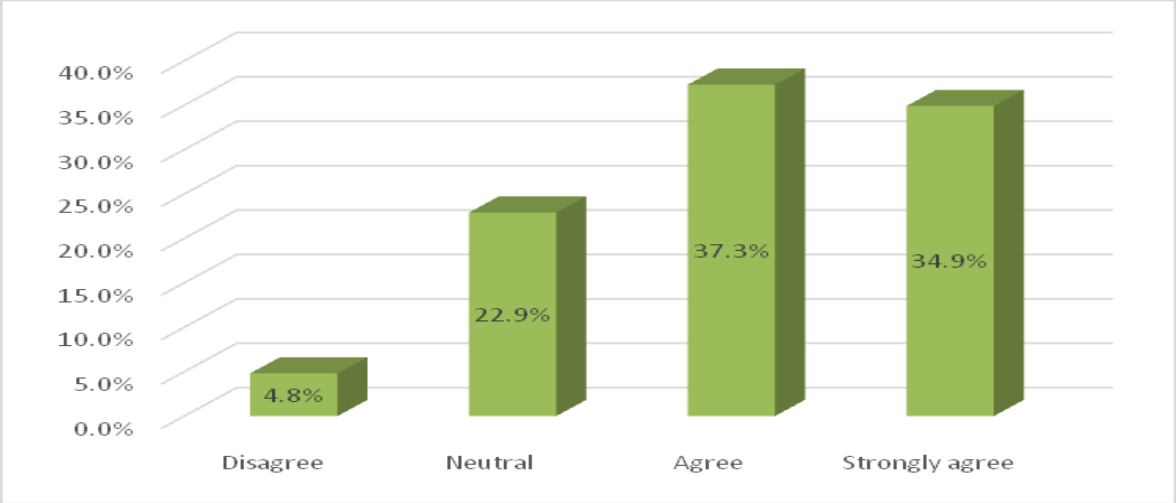

Figure (4.43) shows analyses cost and profit to evaluate the perfect rate for the cost recently and future are difficult to achieve it.

Table (4.52) Importance Index of factors causing in the Hypothesis (3) earned value and analyses the cost and profit

A: Earned value

Factor No	Factor description	Strongly agree	agree	neutral	Dis agree	Strongly Dis agree	Importance index
Factor 1 Earned value	Earned value the better way to control the project methods and forecasting for the future	50	31	2	0	0	4.58
Factor 2 Earned value	Earned value determination of project side-track with the resource	43	34	6	0	0	4.45

Factor 3 Earned value	Earned value one of the project management methodology for use and one of the best uses for controlling and following the projects	44	35	4	0	0	4.48
Factor 4 Earned value	Earned value using technical for controlling and the state of progress and the future forecasting	38	39	5	1	0	4.37
Factor 5 cost analyses	analyses the cost and profit analyzing the cost and profit determines if the investing or the decision was right	20	49	12	2	0	3.80
Factor 6 cost analyses	Cost analyses provide the basis can depending on compare between the projects	22	39	21	1	0	4.00
Factor 7 cost analyses	Cost analyses compare between expected total cost	13	48	21	1	0	3.90

	for any choice in compatible with expected total profit and determination the quantity						
Factor 8 cost analyses	Cost analyses to measure expected balance in the percentage of profit and alternative choices	17	47	18	1	0	3.96
Factor 9 cost analyses	Cost analyses expression, the term of cost and profit phrase in cash and control it for the time value of cash	25	36	22	0	0	4.04
Factor 10 cost analyses	Cost analyses evaluate the perfect rate for the cost recently and future are difficult to achieve it	29	31	19	4	0	4.02

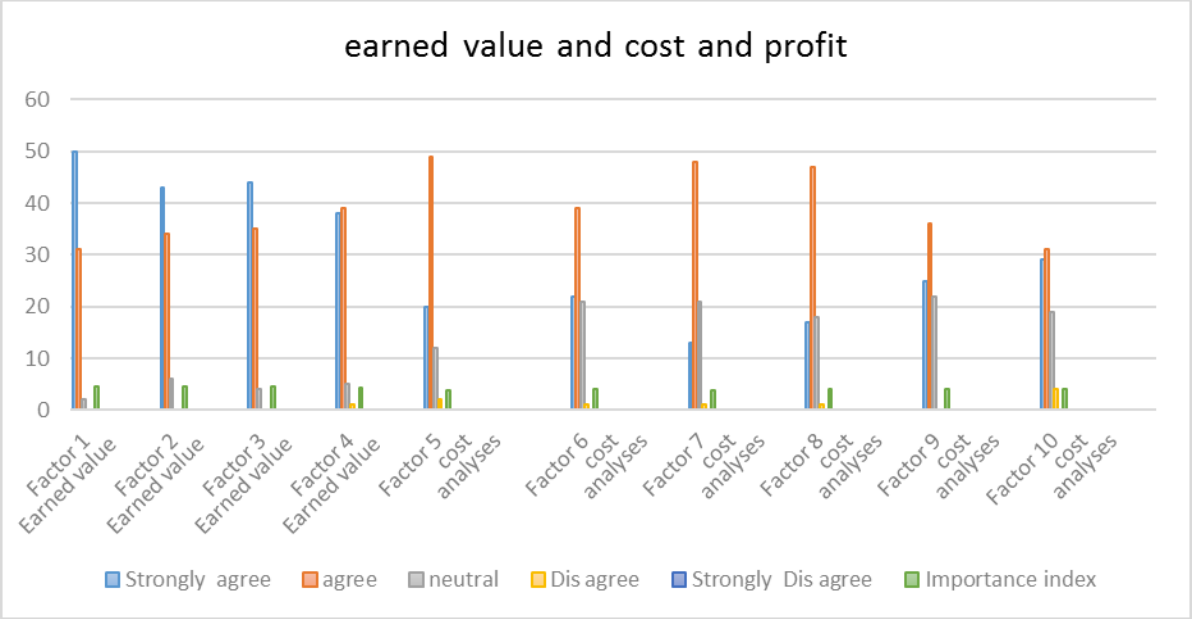

Figure (4.44) shows Importance Index of factors causing in the Hypothesis (3) earned value and analyses the cost and profit.

Hypothesis 4 project performance.

- advantages of use the performance measurement

Table (4.53) shows focus on main topics and provide the organization clear concept for cost and quality and performance in a year in a limit duration

Answer	Freq.	%
Disagree	3	3.6%
Neutral	2	2.4%
Agree	39	47%
Strongly agree	39	47%
Total	83	100%

(47%) strongly agree and agrees respectively with the statement focus on main topics and provide the organization clear concept for cost and quality and performance in a year in a limit duration then (2.4%) neutral and (3.6%) disagree.

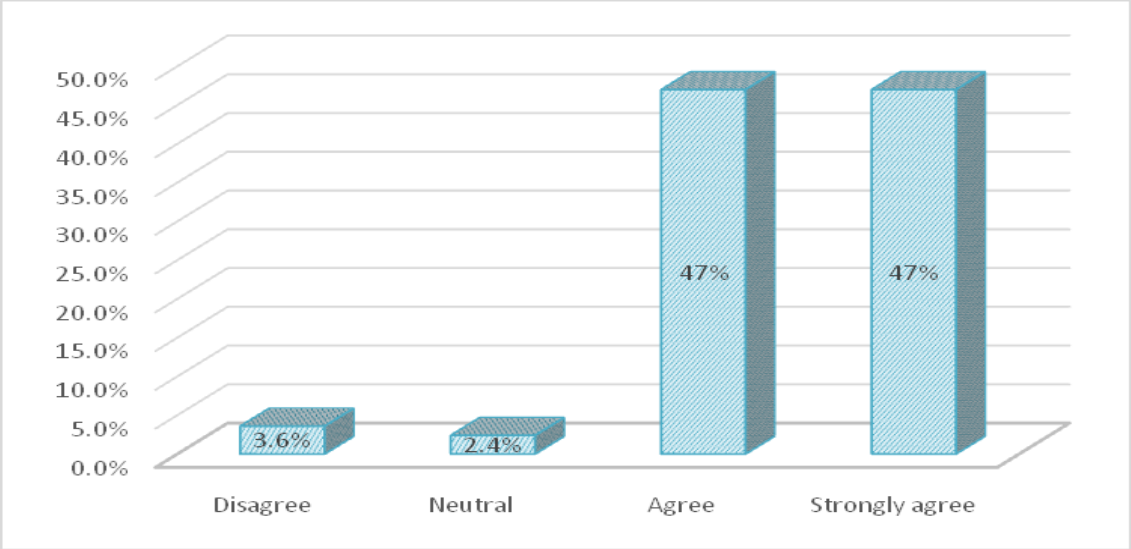

Figure (4.45) shows focus on main topics and provide the organization clear concept for cost and quality and performance in a year in a limit duration

Table (4.54) shows develop the programs and the policies in the management and the implementation of project

Answer	Freq.	%
Disagree	3	3.6%
Neutral	4	4.8%
Agree	41	49.4%
Strongly agree	35	42.2%
Total	83	100%

(49.4%) agrees with develop the programs and the policies in the management and the implementation of project then (42.2%) strongly agree while (4.8%) neutral and (3.6%) disagree.

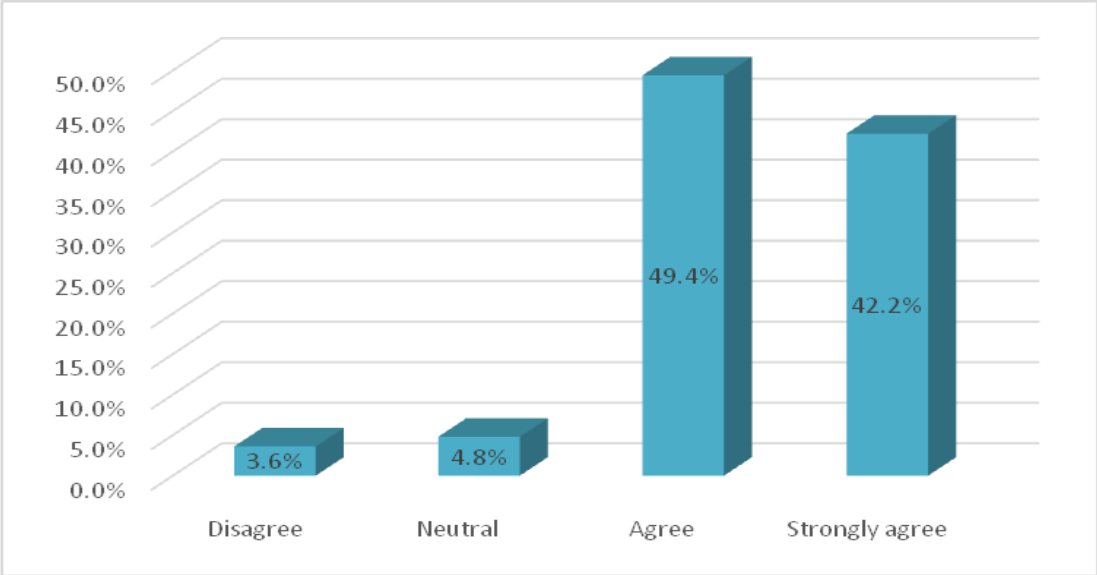

Figure (4.46) shows develop the programs and the policies in the management and the implementation of project

Table (4.55) shows obtainable the information who had a value to the performance of the recently team and the achievement verified to reach to the basics targets as it planed

Answer	Freq.	%
Disagree	1	1.2%
Neutral	6	7.2%
Agree	44	53%
Strongly agree	32	38.6%
Total	83	100%

(53%) agrees with obtainable the information who had a value to the performance of the recently team and the achievement verified to reach to the basics targets as it planed (38.6%) strongly agrees then (7.2%) neutral and (1.2%) disagree.

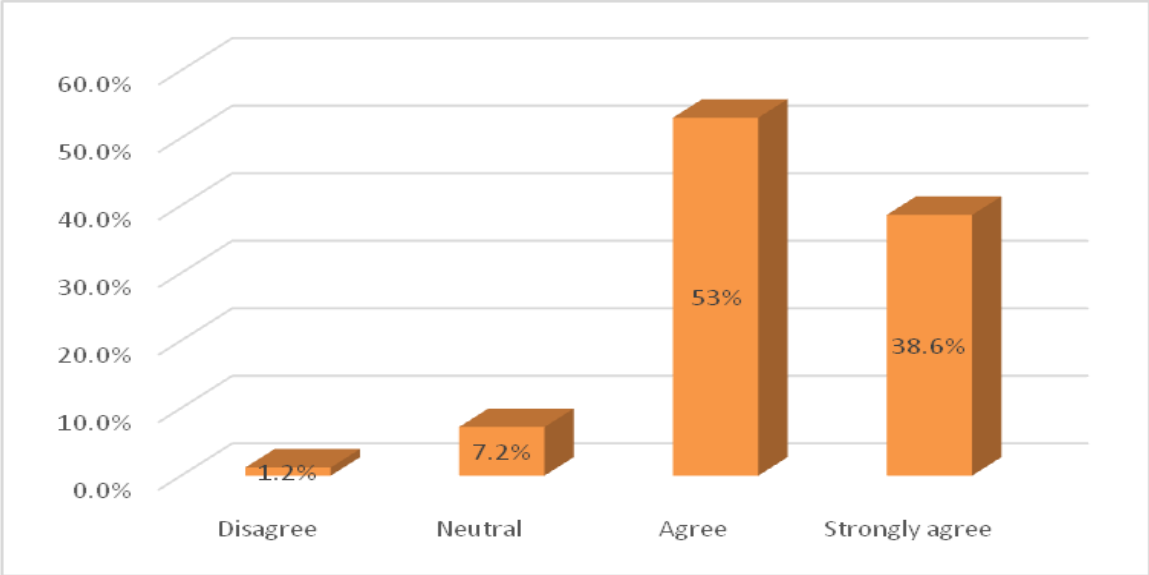

Figure (4.47) shows obtainable the information who had a value to the performance of the recently team and the achievement verified to reach to the basics targets as it planed

- **Indicators that uses for measure the performance of project building, cost and quality**

Table (4.56) shows time, cost and quality

Answer	Freq.	%
Disagree	9	10.8%
Neutral	30	36.1%
Agree	24	28.9%
Strongly agree	20	24.1%
Total	83	100%

(36.1%) of the engineers sees neutral answer for the item period, cost and quality then (28.9%) agree while (24.1%) strongly agree and (10.8%) disagree.

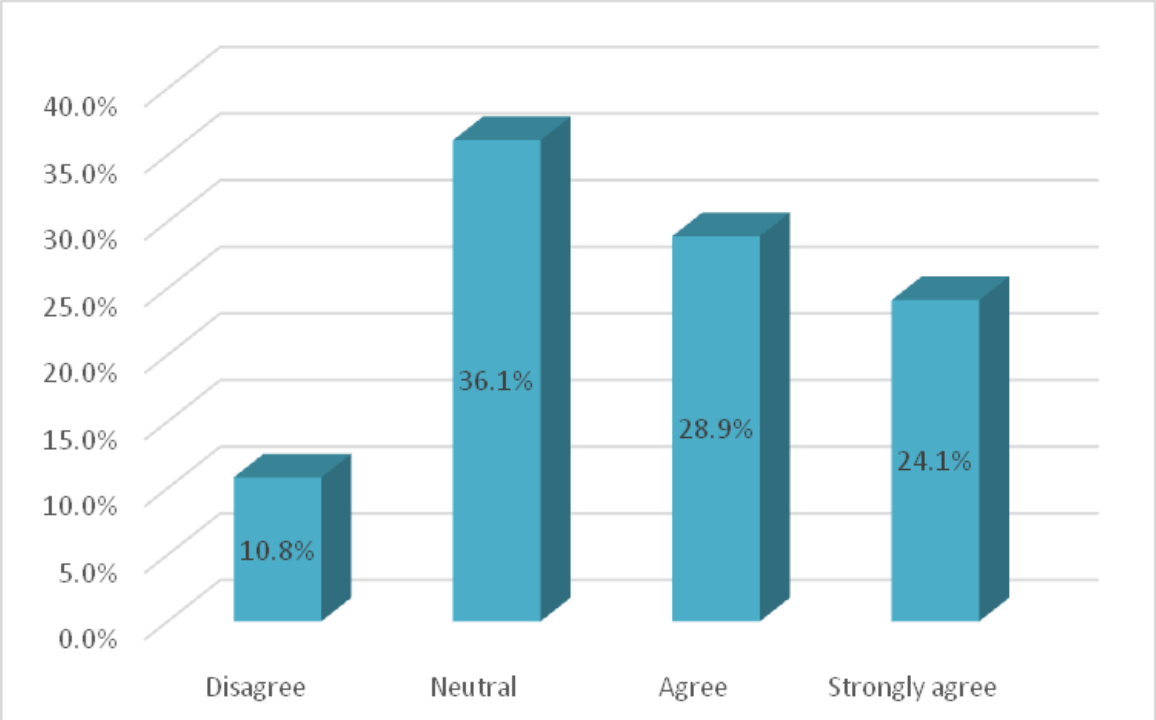

Figure (4.48) shows indicators that uses for measure the performance of project building, cost and quality.

Table (4.57) shows cost and quality

Answer	Freq.	%
Disagree	6	7.2%
Neutral	20	24.1%
Agree	39	47%
Strongly agree	18	21.7%
Total	83	100%

(47%) agrees with the item cost and quality then (21.7%) strongly agrees while (24.1%) neutral and (7.2%) disagrees.

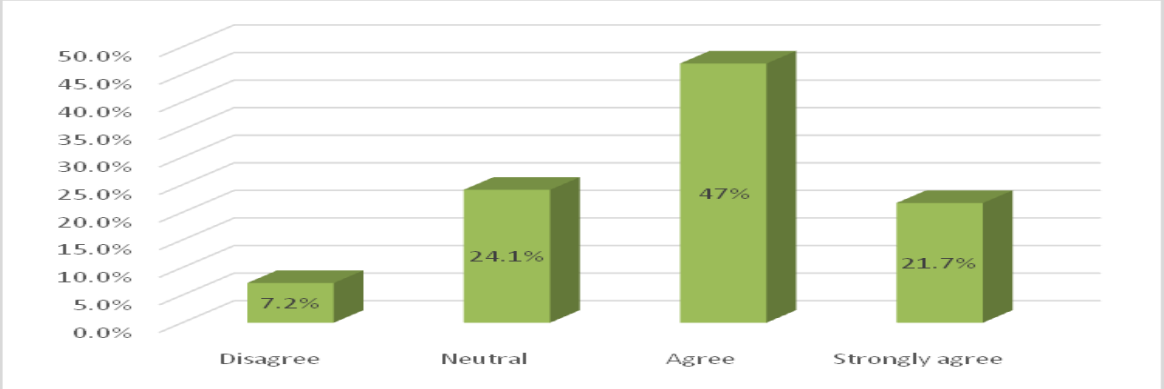

Figure (4.49) shows cost and quality

Table (4.58) shows safety and client satisfaction

Answer	Freq.	%
Disagree	27	32.5%
Neutral	22	26.5%
Agree	16	19.3%
Strongly agree	18	21.7%
Total	83	100%

(21.7%) strongly agrees with the item safety and client satisfaction while (19.3%) agree then (32.5%) disagree and (26.5%) neutral.

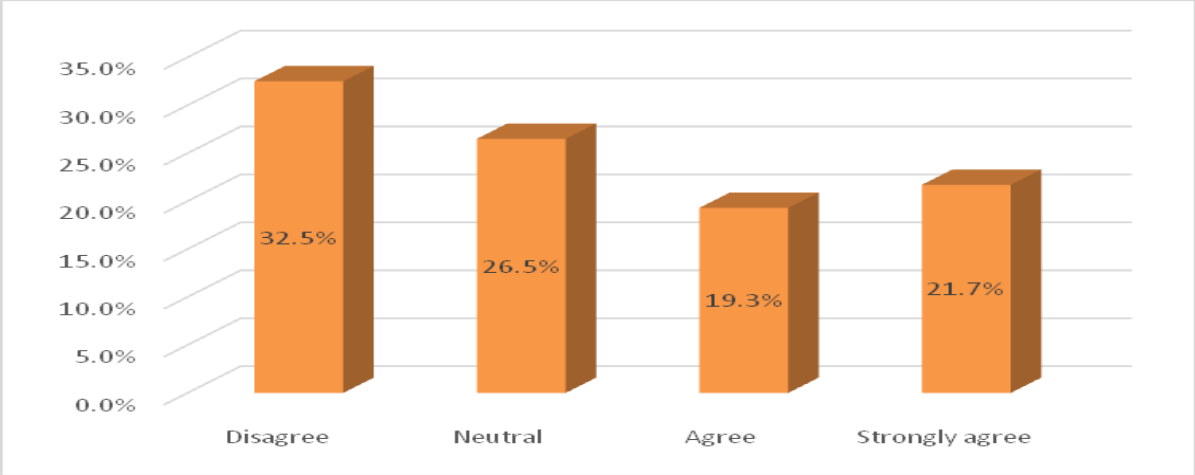

Figure (4.50) shows safety and client satisfaction

Table (4.59) shows produce and profit

Answer	Freq.	%
Strongly disagree	2	2.4%
Disagree	1	1.2%
Neutral	3	3.6%
Agree	25	30.1%
Strongly agree	52	63.6%
Total	83	100%

(63.6%) strongly agree with the item produce and profit while (30.1%) agrees then (3.6%) neutral and (1.2%) disagree while (2.4%) strongly disagree.

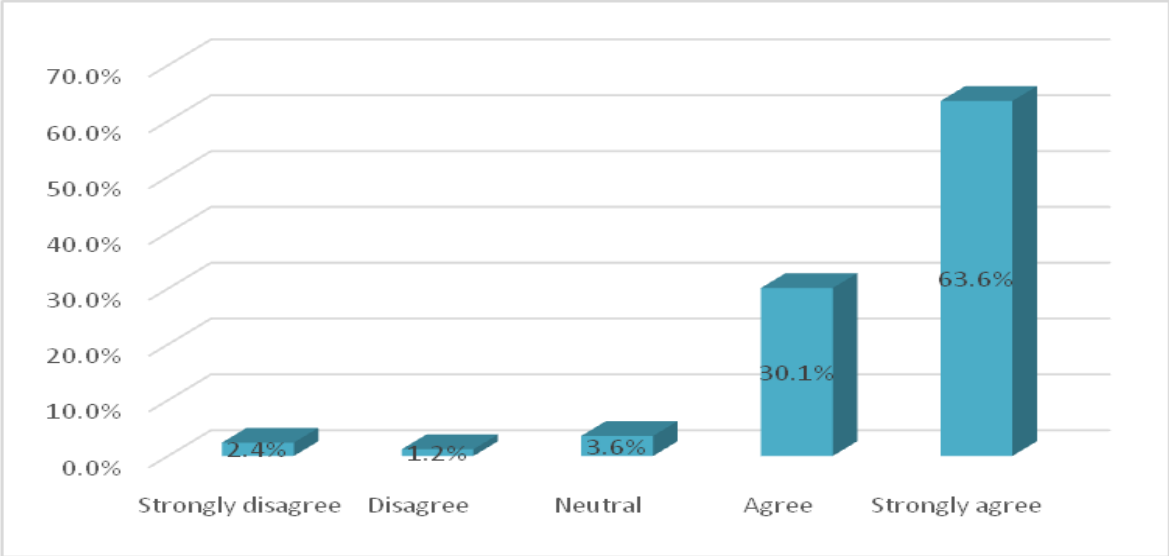

Figure (4.51) shows produce and profit

Table (4.60) Importance Index of factors causing in the Hypothesis (4) project performance.

Factor No	Factor description	Strongly agree	agree	neutral	Dis agree	Strongly Dis agree	Importance index
Factor 1	advantages of use the performance measurement focus on main topics and provide the organization clear concept for cost, quality and performance in a year in a limit duration	39	39	2	3	0	4.3
Factor 2	advantages of use the performance develop the programs and the policies in the management and the implementation of project	35	41	4	3	0	4.3
Factor 3	advantages of use the performance	32	44	6	1	0	4.29

	obtainable the information who had a value to the performance of the recently team and the achievement verified to reach to the basics targets as it planed						
Factor 4	indicators that uses for measure the performance of project building time, cost and quality	20	24	30	9	0	3.66
Factor 5	indicators that uses for measure the performance of project cost and quality	18	39	20	6	0	3.83
Factor 6	indicators that uses for measure the performance of project safety and client satisfaction	18	16	22	27	0	3.3

Factor 7	indicators that uses for measure the performance of project produce and profit	52	25	3	1	2	4.47

Advantages of use the performance measurement

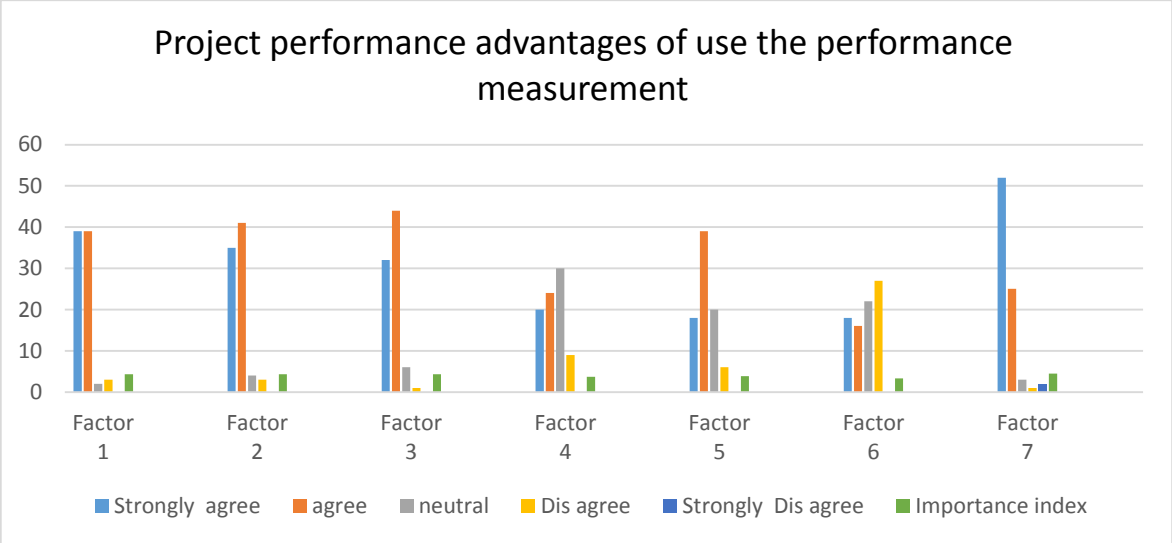

Figure (4.52) shows Importance Index of factors causing in the Hypothesis (4) project performance.

4.3 SUMMARY:

We conclude from the analysis based on the results of the questionnaire that:

By using the ki square test, all expressions were found to have a moral value of more than 5%, thus accepting the hypothesis that the key to effective control of the cost of construction projects is to have the parties to the construction project through:

- Cost and time control 98.8%

- Monitoring project status by updating project costs and managing changes to the cost baseline 94%
- Forecasting final labor cost of 80.7%
- Give a reference to the direction of each cost symbol, whether the unit cost increases or decreases 95.5%
- Identify types of work that have excessive time and costs and give a signal to the seriousness of those abuses 90.4%
- Updating the company database used to estimate future works 80.7%
- Dealing with weaknesses and faults in the plan 84.3%
- Early identification of risks at the beginning of the project 84.2%
- Provide means to recognize variance from the plan until corrective action and risk reduction are taken 79.5%
- Reduce the losses that occur when achieving desired results 86.7%
- Inflation and impact on project resources 98.8%
- Climate factors and unforeseen earth conditions 67.5%
- Political insecurity and instability 81.3%
- Updates of the plan of the assets of the operations and the management of the Project 77.2%
- Unrealizable and unrealistic timetables 72.7%
- Design changes and change requests 80.7%
- Selection of non-qualified contractors to participate in the implementation process 83.1%
- Misrepresentation of actual project cost and slow decision making by project team 83.1%
- Failure to track work performance information and schedule expectations 77.1%
- Poor supervision and mismanagement of the site 77.1%

- Selection of substitutes for materials and equipment 73.5%
- Purchase of materials according to the standard quantities calculated in the
- Tables 72.3%
- Price change 68.7%

Using the Ki square test, all expressions had a moral value of more than 5%. Therefore, the acceptance ratios of the hypothesis that indicate the comparison of the cost and time control between the Earned value and the cost analysis as a comparative method are as follows:

- The Earned value gained from the most successful methods of monitoring the project and forecasting what will be in the future 9.7.5%
- Earned value is one of the most widely used project management methodologies and one of the best Practices used for project monitoring and follow-up is 92.8%
- The Earned value works to identify the deviation of the project and determine the source of 85.2%
- The Earned value is a technique used to track the progress and status of the project and forecast its future performance 92.8%
- Cost analysis determines whether the investment or decision taken in order 83.1%
- Cost analysis provides a reliable basis for comparing projects 73.5%
- Cost analysis to compare the total expected cost of each option against the expected total benefits and quantify 73.5%
- Cost analysis is an analysis to measure the balance between profit and cost ratio for the selection of alternatives 67.1%
- In terms of cost and benefit analysis, interest and costs are expressed in monetary terms and are set to the time value of money 73.5%

- In cost and benefit analysis, an ideal assessment of current and future costs and benefits is difficult to achieve. 72.2%

It is clear that managed value management is a powerful tool that supports project management, scope, schedule and budget.

- Performance measurement focuses on key topics and provides the organization with a clear idea of costs, quality and overall performance in a limited time period 94%
- Performance measurement the programs, policies and procedures used in the management and implementation of the project are developed by 91.6%
- Performance measurement provides valuable information on the performance of the current project team and achievements achieved to reach the basic goals as planned 91.6%
- Indicators used to measure Performance (time, cost and quality) 53%.
- Indicators used to measure performance (cost and quality) 63.7%
- Indicators used to measure performance (safety and customer satisfaction) 41%.
- Indicators used to measure performance (productivity and profitability) 93.7%
- From the above it is clear that the strategic use of performance standards, measures, progress reports and continuous quality improvement efforts to ensure the desired results

Chapter Five

Recommendations and Consolation

Chapter Five

Recommendations and Consolation

5.1 Conclusion

- The key to effective control of construction projects is to have the parties to the construction project through Cost and time control, Monitoring project status by updating project costs and managing changes to the cost baseline, Forecasting final labor cost
- Earned value is one of the most widely used project management methodologies and one of the best Practices used for project monitoring and follow-up It is gained from the most successful methods of monitoring the project and forecasting what will be in the future also technique used to track the progress and status of the project and forecast its future performance.
- Cost analysis determines whether the investment or decision taken in order and provides a reliable basis for comparing projects its compare the total expected cost of each option against the expected total benefits and quantify.
- Project forecasting is the key to project failure or success as it allows corrective action to be taken before the expected value of the end of the project exceeds a certain limit

The cost analysis tries to measure the positive and negative results of the project and puts them on a common time basis using the probabilities of probability. This is attributed to the uncertainty of the success of the project and often avoids the risk of trying and does not take into account differences in the degree of uncertainty

And a robust approach to quantifying the performance of work in terms of cost deflection and schedule deviation and to estimate actual completion time and actual cost at completion

- Performance measurement provides valuable information on the performance of the current project team and achievements achieved to reach the basic goals as planned

5.2 Recommendations:

1. The need to develop a methodology for best practices to manage government projects and ensure implementation according to the budgets allocated and timetables for each project, and support and development of the project industry in Sudan to reach the standards of international excellence. Strategic planning based on the development of long-term visions and translate them into a general plan that represents the reference to planning and scheduling projects in the work plans and updating them to keep abreast of economic and political changes, and develop the project management methodology for best practices and the commitment of all government institutions and the private sector, And address the conflict of their policies affecting projects.
2. The necessity of preparing engineering standards and standard specifications for achieving sustainable development and determining the level of engineering details, drawings and technical specifications of contracts, in order to achieve ease and clarity in the implementation mechanism. When formulating contracts, the economic situation and the issue of price volatility, especially the financial flow of the project, must be taken into consideration
3. Consolidation of procedures and practices, project management methodology and tools for the issuance of model reports based on indicators of performance, quality and cost, review of all governmental regulations and procedures, especially the system of public competition, and address what is inconsistent with the methodology of project management.
4. Taking care of the technical and administrative structures that are qualified to carry out the tasks and procedures according to the methodology of project management, in order to achieve clarity of the powers and responsibilities of all its employees and training and qualifying the engineers and technicians working in the projects through the specialized training programs with the

degree of benefit and motivating those who excel in managing the projects financially and morally.

5. Implement projects to serve the country and provide adequate financial resources to support the implementation of program and project management.

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Appendices

بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of graduate Studies – Civil Engineering

A questionnaire on comparison of cost and time control using Earned value management and Cost Analysis methodology on the building projects at Khartoum state.

Guidelines:

- The aim of this study is to use a measurement model where construction practitioners can use it for results to evaluate methods of project discipline during the construction phase
- Your dedication to this questionnaire contributes to the achievement of the objective of this study in the hope that interest will be of benefit to all.
- Information to be received will used for scientific research purposes only this questionnaire is part of a supplementary research for master's degree in construction management.

Explanation:

Cost –benefit analysis (CBA):

Systematic process through which the benefits and costs of project, decision or a policy are to be calculated and compared to for the purpose of the:

1. Determining whether the investment or decision that has been made is sound.
2. Provide a reliable basis in the comparison of projects and the process is built on the process is built on the basis of the comparison between the expected total cost of each option versus the total expected to see whether the benefits exceed costs and quantifies .

Earned Value Management (EVM).

1. A technique used to track progress and project status and forecast its future performance.
2. The earned systematically integrates cost measurement timesheet, and scope accomplishments into the project .And it's also called the value of the amount of work that has already been off to a certain point in time and is currently the most preferred project management technology in the world. EVM provides methodological organizations for integrating project and schedule scope management.

Section One: (General information)

Name : - ——————————————————————

Company or organization ——————————————————————

Academic Qualification									
	Others		PhD		Master		Bachelor		Diploma
Nature of work									
			Other		Consultants		Contractor		Owner
Work type									
					Other		Private sector		Public sector
Work duration									
	More than years		16 to 20 years		11 to 15 years		5 to 10 years		Less than5 years
Average of applying the projects									
More than 5		3 to Less than 5years		2to Less than 3 years		1 to Less than2 years		1years21/		Less than 1/2years
1. Number of projects that applied by the organization									
	More than 20		16 to 20 year		11 to 15 year		5 to 10 year		Less than 5
plan Number of projects according to the duration									
	51% to 80%y		31% to50%		11% to 30%		5% to 10 %		Less than 5
Completed project according to the cost plan									
	51% to 80%		31% to 50%		10% to 30%		5% to10%		1less than5

Section Two: control and inspect of construction projects

Be through:

N	Description	Strongly agree	agree	Some times	Dis agree	Strongly dis agree
1	the control of the cost and duration					
2	controlling the project state according to updating the cost and project management from the base of cost					
3	the forecasting for the last cost of the project					
4	the signals for the direction of the cost if the unit increase or decrease					
5	the distribution of type of projects that had high cost and long period and give notification that risk of exceed					
6	the updating of the database of the organization to rating the future plans					
7	the dealing with the weakness and the defect of the plans					
8	the early risk evaluation in starting project					
9	the instrument provision to disparity recognition for the plan to reduce the risk factor					
10	Reduce losses that occur when you achieve desired result					

Section Three: Internal and external factors causing on controlling of the cost and the period of the projects.

In your opinion, what are the right answer please tick (□)

External factor:

N	Description	Strongly agree	agree	Some times	Dis agree	Strongly dis agree
1	the inflation and the its defect on the project resources					
2	The unexpected land circumstance and the climate factor					
3	the political security absence and lack of stability					
4	the updating the plan of the organizational structure operations and project management					
Internal factor						
1	the time plan not for achieving and not reality					
2	the designs changes and changes requests					
3	the choose of the not qualified contractor for implementation process					
4	the misjudgment of the project cost and lateness decision make from the work group					

5	not following the performance and expect time plan					
6	the weakness in supervision and location management worst					
7	choosing alternatives for the equipment's and tools					
8	buying the material according to quantity guessed in guideline					
9	the prices change					

Section Four: Earned value and analyses the cost and profit

Earned value as systematic method to control the cost analysis and interest as a corresponding method

In your opinion, what are the right answer please tick √)

N	Description	Strongly agree	agree	Sometimes	Dis agree	Strongly dis agree
he earned value						
1	The better way to control the project methods and forecasting for the future					
2	shows the work with determination of project side-track with the source					
3	one of the project management methodology for use and one of the best uses for controlling and following the projects					
4	using technical for controlling and the state of progress and the future forecasting					
analyses the cost and profit						
5	analyzing the cost and profit					

	determines if the investing or the decision was right					
6	provide the basis can depending on compare between the projects					
7	compare between expected total cost for any choice in compatible with expected total profit and determination the quantity					
8	analyses to measure expected balance in the percentage of profit and alternative choices					
9	analyses cost and profit expression, the term of cost and profit phrase in cash and control it for the time value of cash					
10	shows analyses cost and profit to evaluate the perfect rate for the cost recently and future are difficult to achieve it					

Section Five: project performance

In your opinion, what are the right answer please tick .(√)

N	Description	Strongly agree	agree	Sometimes	Dis agree	Strongly dis agree
advantages of use the performance measurement						
1	focus on main topics and provide the organization clear concept for cost and quality and					

	performance in a year in a limit duration					
2	develop the programs and the policies in the management and the implementation of project					
3	obtainable the information who had a value to the performance of the recently team and the achievement verified to reach to the basics targets as it planed					
indicators that uses for measure the performance of project building, cost and quality						
1	Time, cost and quality					
2	cost and quality					
3	safety and client satisfaction					
4	produce and profit					

جامعة السودان للعلوم والتكنولوجيا
كلية الدراسات العليا
ماجستير إدارة التشييد

مقارنة التحكم في التكلفة والزمن باستخدام إدارة القيمة المكتسبة ومنهج تحليل التكلفة

لمشاريع البناء في ولاية الخرطوم

موجهات:

- تهدف الدراسة إلي استخدام نموذج للقياس حيث يمكن لممارسي البناء استخدامه لغرض النتائج لتقييم طرق ضبط المشروع خلال مرحلة التشييد .
- تكرمكم بملء هذا الاستبيان يسهم في تحقيق أهداف هذه الدراسة آملين في أن تعم الفائدة للجميع.
- المعلومات التي سترد ستستخدم لأغراض البحث العلمي فقط

هذا الاستبيان هو جزء من بحث تكميلي لنيل درجة الماجستير في أدارة التشييد.

توضيح:

تحليل التكلفة والفائدة (CBA):

هي عملية منهجية يمكن من خلالها حساب فوائد وتكاليف مشروع أو قرار أو سياسة ما والمقارنة بينها بغرض :

1- تحديد ما إذا كان الاستثمار أو القرار الذي تم اتخاذه سليماً

2- توفير أساس يمكن الاعتماد علية في المقارنة بين المشروعات **و** وتُبنى هذه العملية علي أساس المقارنة بين التكلفة الإجمالية المتوقعة لكل خيار في مقابل الفوائد الإجمالية المتوقعة ، لمعرفة ما إذا كانت الفوائد تفوق التكاليف وتحديد كمياتها.

إدارة القيمة المكتسبة (EVM):هي تقنية تُستخدم لتتبع التقدم وحالة المشروع والتنبؤ بأدائه المستقبلي. تقومEVMبشكل منهجي بدمج قياس التكلفة والجدول الزمني وإنجازات النطاق في المشروع.

وأيضا يطلق عليها القيمة التي تعبر عن كمية العمل الذي تم إجازتة بالفعل حتى نقطة معينة من الزمن

وهو حاليا أكثر تقنيات إدارة المشاريع المفضلة في العالم. تقدم EVM للمنظمات المنهجية اللازمة لدمج إدارة نطاق المشروع والجدول الزمني والتكلفة.

القسم الأول : (أسئلة عامة)

2. **الاسم:**

3. **اسم المؤسسة أو الشركة:**

4. **المؤهل العلمي**										
دبلوم		بكالوريوس		ماجستير		دكتوراه		أخري (حدد)		
5. **طبيعة العمل**										
مالك		مقاول		إستشاري		أخري (حدد)				
6. **نوع العمل**										
قطاع خاص		قطاع عام		أخري (حدد)						
7. **سنوات الخبرة العمل**										
أقل من 5		10-5		15-11		20-16		أكثر من 20		
8. **متوسط فترة التنفيذ للمشاريع (بالأعوام)**										
أقل من 1/2		1-1/2		1–اقل من 2		2-اقل من3		3- اقل من5		5 وأكثر
9. **عدد المشاريع التي تقوم المؤسسة بتنفيذها سنويا**										
أقل من 5		10-5		15-11		20-16		أكثر من 20		
9. **كم تبلغ عدد المشاريع التي تم تنفيذها وفقاً للجدول الزمني في مؤسستكم**										
اقل من 5%		% 10- %5		% 30- %11		% 50- %31		% 80- %51		
10. **كم تبلغ عدد المشاريع التي تم تنفيذها وفقاً للتكلفة المخططة لها في مؤسستكم**										
اقل من 5%		% 10- %5		% 30- %11		% 50- %31		% 80- %51		

القسم الثاني : (الضبط و التحكم في التكلفة لمشاريع التشييد) :
يكون من خلال :

الرقم	العبـــــــــــــــــــــارة	اوافق بشدة	اوافق	احيانا	لااوافق	لااوافق بشدة
1	ضبط التكلفة والزمن					
2	مراقبة حالة المشروع من خلال تحديث تكاليف المشروع وإدارة التغييرات على خط الأساس للتكلفة					
3	التنبؤ بتكلفة العمل النهائية					
4	إعطاء إشارة إلى اتجاه كل رمز للتكلفة ، أي ما إذا كانت تكلفة الوحدة المعنية تتزايد أو تتناقص					
5	تحديد أنواع العمل التي لها وقت وتكاليف مفرطة وإعطاء إشارة إلى مدى خطورة تلك التجاوزات					
6	تحديث قاعدة بيانات الشركة التي تستخدمها لتقدير الأعمال المستقبلية					
7	التعامل مع نقاط الضعف و أماكن الخلل في الخطة					
8	التحديد المبكر للمخاطر في بداية المشروع					
9	توفير وسائل للاعتراف بالتفاوت من الخطة حتى يتم اتخاذ الإجراءات التصحيحية وتقليل المخاطر					
10	تقليل الخسائر التي تحدث عند تحقيق النتائج المرغوبة					

القسم الثالث : (العوامل الخارجية والداخلية المؤثرة على التحكم فى التكلفة والزمن للمشروع) :

(فضلا أشر بعلامة ( ) علي الإجابة التي تمثل وجهة نظرك بدقة) .

الرقم	العبـــــــــــــــــــــارة	أوافق بشدة	أوافق	أحيانا	لا أوافق	لا أوافق بشدة
أ / العوامل الخارجية						
1	التضخم وتاثيرة علي موارد المشروع					
2	العوامل المناخية وظروف الأرض غير المتوقعة					
3	انعدام الأمن السياسي وعدم الاستقرار					
4	تحـديـثات خطة أصول العمليات التنظيمية و إدارة المشروع					
ب / العوامل الداخلية						
1	جداول زمنية غير قابلة للتحقيق وغير واقعية					
2	تغييرات التصميم و طلبات التغيير					
3	اختيار مقاولين غير مؤهلين للمشاركة في عملية التنفيذ					
4	سوء تقدير التكلفة الفعلية للمشروع وبطء اتخاذ القرار من قبل فريق المشروع					
5	عدم تتبع معلومات أداء العمل وتوقعات الجدول الزمني					
6	ضعف الإشراف وسوء إدارة الموقع					
7	اختيار البدائل للمواد والمعدات					
8	شراء المواد وفقاً للكميات المعيارية المخمنة في الجداول					
9	تغيير الأسعار					

القسم الرابع: القيمة المكتسبة و تحليل التكلفة والفائدة.
القيمة المكتسبة كأسلوب منهجي للتحكم في تكلفة وزمن المشروع و تحليل التكلفة والفائدة كأسلوب مناظر له

(فضلا أشر بعلامة ( ) علي الإجابة التي تمثل وجهة نظرك بدقة) .

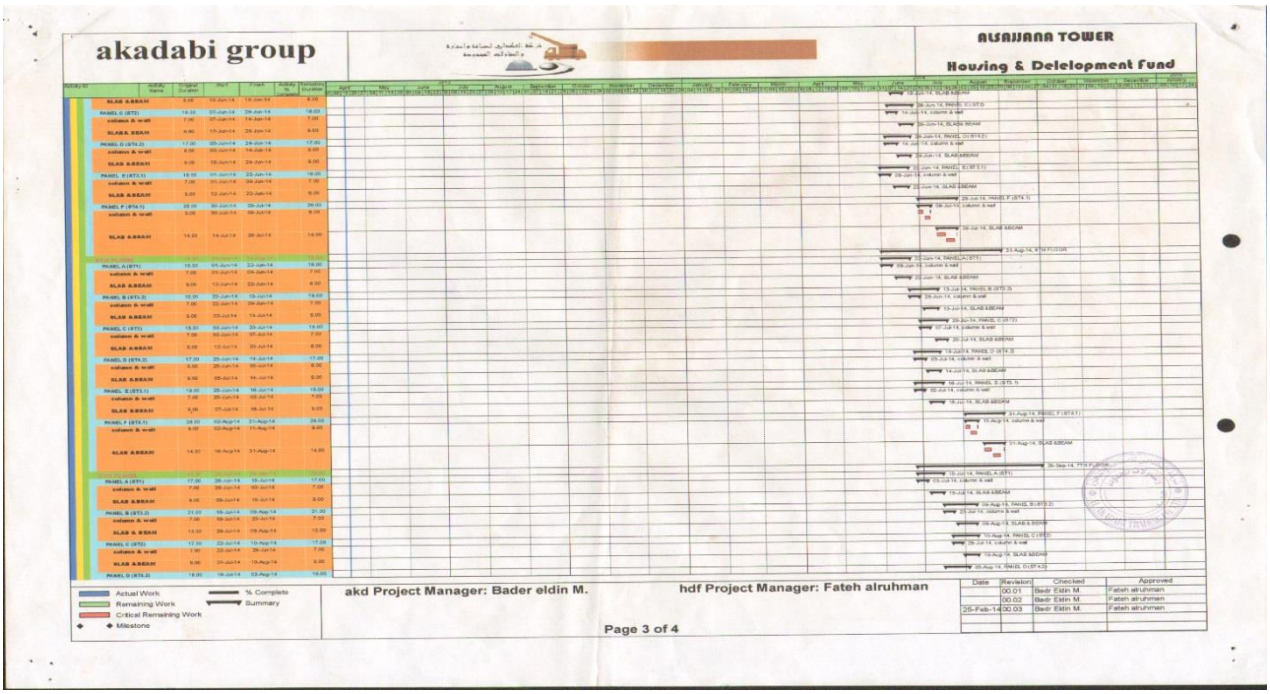
الرقم	العبـــــــــــــارة	أوافق بشدة	أوافق	أحيانا	لا أوافق	لا أوافق بشدة
الـــــقيمـــــة المكتســـــبة						
1	من انجح طرق مراقبة المشروع والتبوء بما سيكون علية مستقبلاً.					
2	تعمل علي تحديد انحراف المشروع وتحديد مصدرة.					
3	تعتبر واحدة من منهجيات إدارة المشروع الأكثر استخداما وتعتبر واحدة من أفضل الممارسات المستخدمة للمراقبة ومتابعة المشاريع .					
4	تقنية تُستخدم لتتبع التقدم وحالة المشروع والتنبؤ بأدائه المستقبلي					
تحـــــــليل التكـــلفة والفـــــائدة						
1	يحدد ما إذا كان الاستثمار أو القرار الذي تم اتخاذه سليماً					
2	لتوفير أساس يمكن الاعتماد علية في المقارنة بين المشروعات					
3	المقارنة بين التكلفة الإجمالية المتوقعة لكل خيار في مقابل الفوائد الإجمالية المتوقعة وتحديد كمياتها					
4	تحليل لقياس التوازن المتوقع بين نسبة الأرباح والتكاليف لاختيار البدائل					
5	في مصطلح تحليل التكلفة والفائدة، يتم التعبير عن الفوائد والتكاليف بمصطلحات نقدية ويتم ضبطها على القيمة الوقتية للنقود					
6	في تحليل التكلفة والفائدة الحصول على تقييم مثالي للتكاليف والفوائد الحالية والمستقبلية أمر يصعب تحقيقه.					

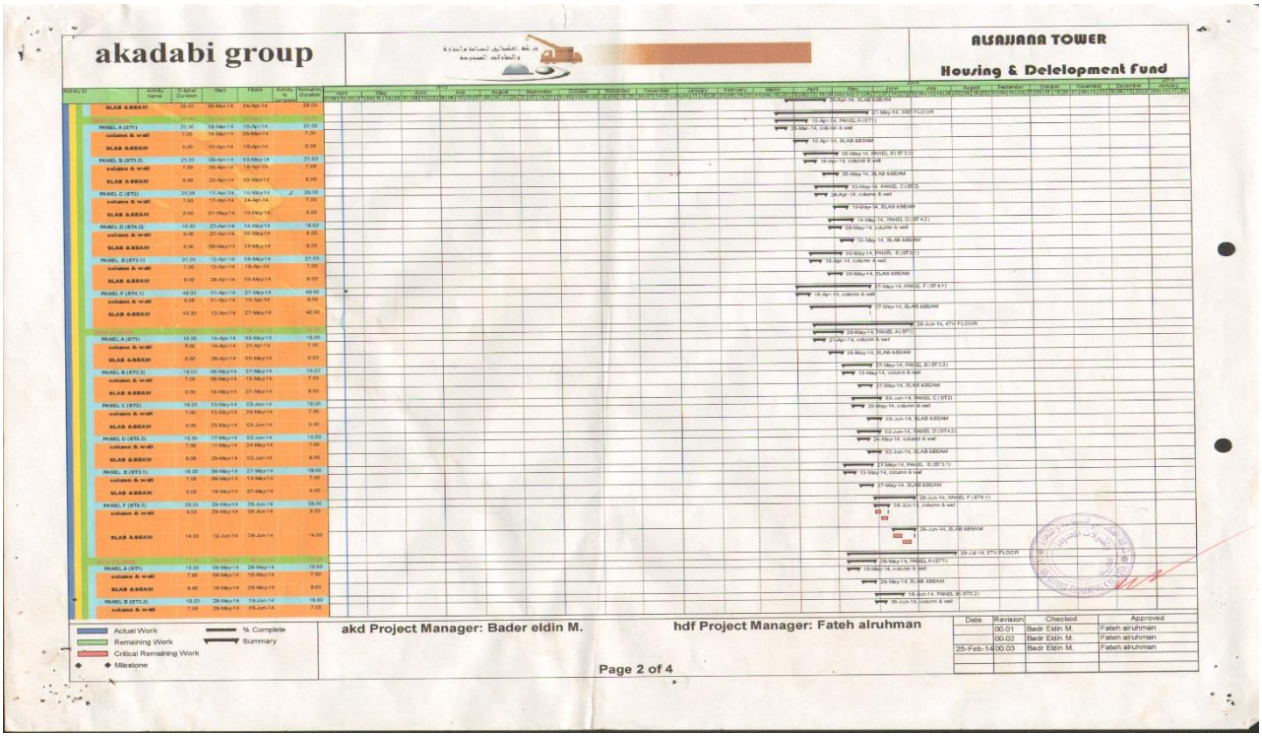
القسم الخامس (أداء المشروع) :

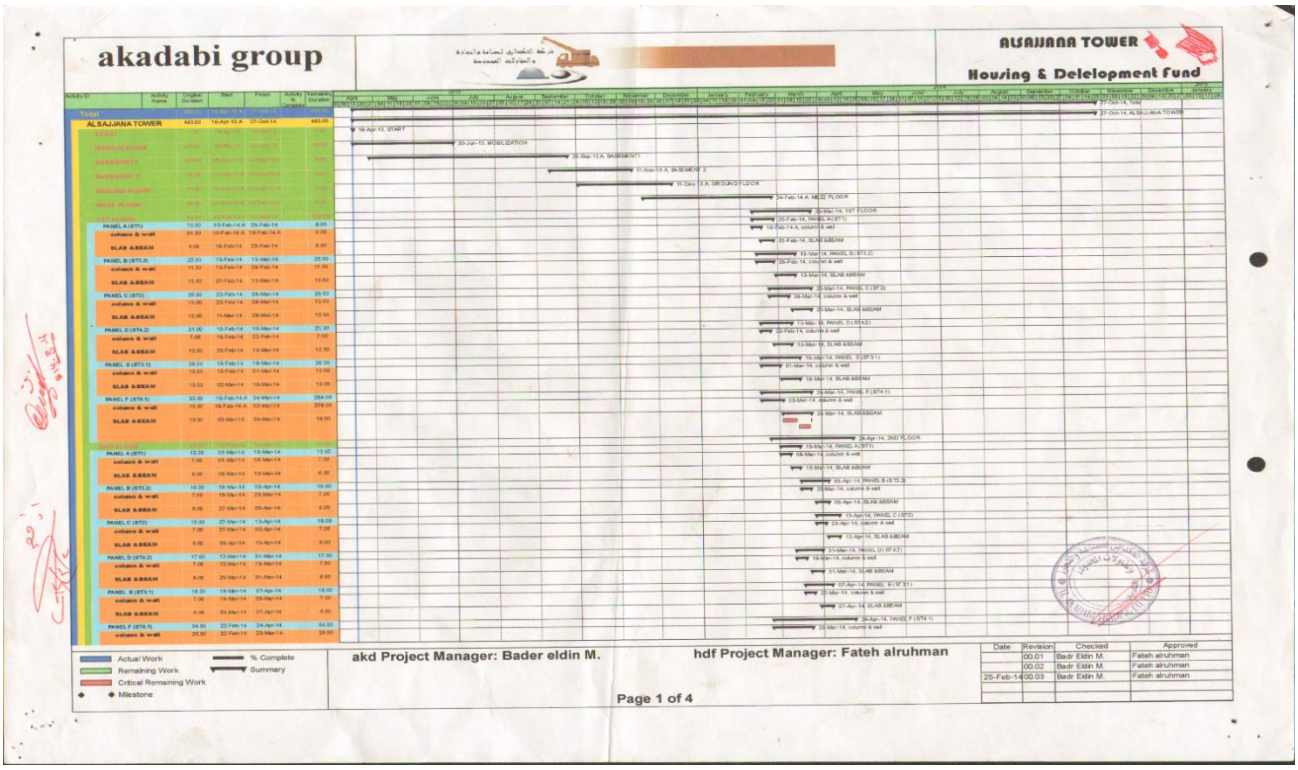
(فضلا أشر بعلامة ( ) علي الإجابة التي تمثل وجهة نظرك بدقة) .

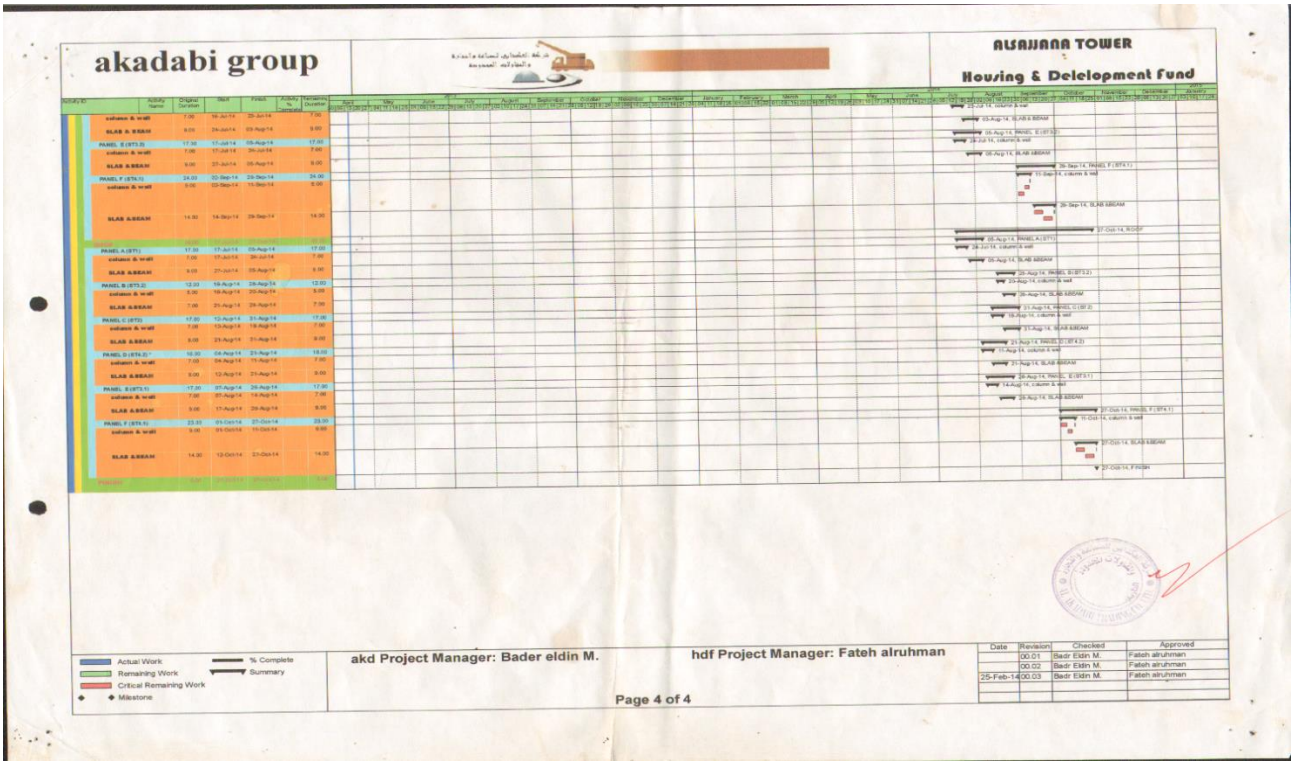
الرقم	العبـــــــارة	أوافق بشدة	أوافق	أحيانا	لا أوافق	لا أوافق بشدة
فوائد استخدام قياس الأداء في المشاريع						
1	التركيز على المواضيع الرئيسية ومد المؤسسة بفكرة واضحة عن التكاليف والجودة والأداء العام في فترة زمنية محدودة					
2	تطوير البرامج والسياسات والإجراءات المستخدمة في الإدارة والتنفيذ للمشروع					
3	توفير معلومات ذات قيمة عن أداء فريق المشروع الحالي والإنجازات المتحققة للوصول إلي الأهداف الأساسية كما هو مخطط له.					
المؤشرات المستخدمة فعلياً في قياس أداء مشروعات التشييد						
1	الزمن والتكلفة والجودة.					
2	التكلفة والجودة					
3	السلامة ورضا العميل .					
4	الإنتاجية والربحـــية.					

Schedule of the two phases of the concrete structure and building works






akadabi group
ALSAJJANA TOWER
Housing & Delelopment Fund
Actual Work
Remaining Work
Critical Remaining Work
Milestone
% Complete
Summary
akd Project Manager: Bader eldin M.
hdf Project Manager: Fateh alruhman
Date
Revision
Checked
Approved
00.01
Badr Eldin M.
Fateh alruhman
00.02
Badr Eldin M.
Fateh alruhman
25-Feb-14
00.03
Badr Eldin M.
Fateh alruhman
Page 1 of 4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