Dedication

To my Parents.
To my Husband.
To my Brothers and Sisters.
To my Teachers to burn candles that illuminate for others.
To my colleagues.
To each of the supported me and encouraged me to complete this work.

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I would like to apologize to those I do not mention by name here; however, I highly valued there kind support.

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ABSTRACT :

The Sudanese construction sector is characterized by many small and large projects and high labor intensity; it is also highly affected by public regulations and public investment, has a significant share in the Sudanese Growth Domestic Product (GDP). The basic problems facing the Sudanese construction industry are concerning of the implementation of project management tools and techniques. The identification of these problems which is about the effect on implementing project management tools and techniques on the Sudanese construction firms. Many construction projects experienced poor implementation in terms of extensive delays and thereby overrideinitial time and cost estimates. The objectives of this study are to identify the major causes affecting this implementation by the Sudanese construction firms; to determine the main factors affect the performance of Sudanese construction firms and in the last to develop a theoretical model which can be used as an internal tool for evaluation of Sudanese construction firms. The main question of this study is about the main activities on project management and what are the tools and techniques which could be used to manage these activities ?what are the main factors that having strong effect on the Sudanese construction firms? and how these factors could affect ? The methodology of the study.adopted both qualitative and quantitative methods in identifying the problem statement , literature review, collect on of data, analysis of data, discussion of result, conclusions and recommendations. Comprehensive literature review had been established together with relevant data about the factors affecting the performance of construction projects from the previous researches. The research ended with a fact that most of the construction companies in Sudan have the knowhow about this tools and techniques, but unfortunately the application of them is very poor.Explanation of the nine criteria for project management and arranged according to importance of core function management and facilitating function management. Tools and techniques proved to be necessary for the application of

the nine criteria for project management. The local construction projects performance is 64.2%, as per results, which indicate the necessary for improvement.The importance of using tools and techniques of project management to increase the Sudanese construction performance.The organized application of tools and techniques in project management result in optimum performance for construction projects. The research recommended that it is so vital for all entities to use such tools and techniques for their obvious benefits.

مستخلص :

يتميز قطاع البناء والتشييد السودانيبالكثير من المشاريع المتوسطة والكبيرة و بالكثافة العمالية العالية ؛ كما يعتمد أيضا بدرجة كبيرة علىالأنظمة و الاستثمارات العامة ،كما أن لديها حصة كبيرة في نمو الناتج القومي الإجمالي السوداني . والمشكلة الأساسية التي تواجه صناعة البناء والتشييد السودانية هي تطبيق أدوات وتقنيات إدارة المشاريع. ، ومن المهم جدا التعرف على هذه الأدوات والتقنيات واثر تطبيقها على أداء مشاريع التشييد السودانية، وهناك الكثير منمشاريع التشييد التي عانت من قلة تطبيق هذه الأدوات والتقنيات مما أدىإلى ضعف الأداء في المشاريع . اشتملت أهداف هذه الدراسة على تعريف أدوات وتقنيات إدارة المشاريع وتأثيرها على أداء المشاريع ومن ثم تحديد النموذج النظري لتقييم تطبيق الأدوات والتقنيات لإدارة المشاريع للشركات السودانية ، ولغرض الوصول إلى ذلك اعتمدت الدراسة على أسئلة مهمة وهي، ماهي النشاطات المهمة لإدارة المشاريع الهندسية و ماهي الأدوات والتقنيات المستخدمة في إدارة هذه النشاطات في المشاريع في الشركات السودانية ؟وما مدى تأثير تطبيق هذه الأدوات والتقنيات على أداء المشاريع في الشركات السودانية ؟. لتحقيق أهداف هذه الدراسة، استخدمت المنهج الوصفي والكمي ، حيث بدأت بتعريف المشكلة ، ومراجعه الأدبيات ،جمع البيانات ،تحليل البيانات للحصول على المعلومات وبالتالي مناقشة النتائجومن ثم الاستنتاجات والتوصيات.

أدتأدبيات البحث والتي جمعت من البحوث السابقة إلى جمع المعلومات حول تأثير تطبيق أدوات وتقنيات إدارة المشاريع الهندسية على أداء مشاريع التشييد في جميع مراحل المشروع ، ومن الأدبيات الدراسات السابقة فرضت عده فرضيات تشمل جميع مراحل المشروعوكانت منهجية البحث في جمع المعلومات عن طريق استخدام الاستبيان كأداة رئيسية لهذه الدراسة . انتهت الأبحاث مع حقيقة أن معظم شركات التشييد في السودان يملكون المعرفة الكافية حول هذه الأدوات والتقنيات ، ولكن للأسف تطبيقهم لها هو سيئ للغاية. وشرح المعايير التسع لإدارة المشاريع وترتيبها وفقا لأهميتها. الأدوات والتقنيات ضرورية جدا لتطبيق المعايير التسعة لإدارة المشاريع. أداء مشاريع التشييد المحلية تقريبا 64.2% وذلك مؤشر على ضعف الأداء وحوجته إلى التطوير والتقدم. الاستخدام الأمثل لإدارة المشاريع ينتج عنه أداء امثل لمشاريع التشييد. أوصت الأبحاث أنه من الأهمية علىجميع الكيانات استخدام هذه الأدوات والتقنيات لفوائدها الواضحة.

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CHAPTER ONE

INTRODUCTION

1.1 Introduction:

The concept of management is as old as the human race itself. The concept of "family", it requires that life to be organized and resources of food to be apportioned in a manner so as to maximize their usefulness. Management, then, is not only an essential element of organized society, but also an integral part of life as determined in Islam. Unfortunately, the role of management has always been taken for granted and under emphasized. Technological advancement, level of production, capital investment and other tangible elements have always been emphasized as contributory factors towards economic growth, rather than managerial skills. As Peter Duckers.*(J.S.chadan (1987).*Management is the crucial factor in economic and social development. It was obvious that the economist's traditional view of development as a function of saving and capital investment was adequate. Saving and capital investment do not produce management and economic development on the country. Management produces economic and social development and with it saving and capital investment.*(J.S.chadan (1987)).*

The area of effective management is currently receiving a lot of attention because the organizations and their internal as well as external environment are becoming more complex. In this dynamic society, management must be able to anticipate changes and their impact and take appropriate measures to deal with these changeKreitner, *(J.S.chadan (1987)).*

1.2 Project management:

So what is project management ?theProject Management Institute defines project management as "the application of knowledge ,skill ,tool, and techniques to project activity to meet project requirement ". All of us consciously implement and manage project almost on daily basis most of these are small simple project with very few activities that we do almost

intuitively without even thinking too much about like making breakfast, washing the car, grocery shopping..etc it is obvious that as the level of complexity of project increase the level of the project management also becomes increasingly more complex and rigorous and will require the people who manage such project to have certain knowledge skill ,experience ,tool and recourses. As project get larger and more complex the process get more scientific and systematic as it become necessary to coordinate and integrate various human inputs and physical component within the four fundamental constraint; scope ,time and quality. Project management is mapped into process groups and knowledge area by the project management institute the five key process groups are initiating ,planning ,executing ,controlling ,and closing most process that we can think of will fall under these five basic processes depending on who we are for example in the construction industry budgeting costing and estimating fall under planning, design can fall under the process of planning if you are the project owner who adopts to procure the facility via conventional contract but it can fall under execution in a design and built contract for the design consultant the design component is the whole project which can in turn be subdivided into the five process for the contract the bidding itself is usually treated as on project it the bid is won then a new project materializes and his process will be different from that of the owner or the consultant what is instable though is that each party has to apply project management achieve it is objectives.

The Project Management Institute also defines knowledge area to support the five process these knowledge area are :project integration management, project scope management project time management project quality management project communication management project risk management project procurement management project human resources management in order to be more specific to the construction industry it would add project construction management to the above list to cover specific knowledge

required for managing construction activities on site many discipline contribute it each knowledge area and so there is no exclusivity of each knowledge area to any discipline there is also significant interaction among the knowledge area in the construction industry for example project cost management involves mainly design ,value engineering and optimization estimating cash flow management contract administration financing and cost control but project scope management project time management project quality management and project procurement management will also have significant impact will the other knowledge area will have impacts of different extents *(Truman D. King, 2012).*

1.3 Sudanese construction industry:

The Sudanese construction sector is characterized by many small and large projects and high labor intensity; it is also highly dependent on public regulations and public investment. The Sudanese construction industry depend on a number of factories and material suppliers who provide building materials and specialist fitting including but not limited to, concrete, sand, cement, plasterboard, timber, electrical fittings, plumbing and heating fittings.

The development in the construction industry is increasing in size, technological complexity, interdependencies and variations in demand from clients. The scope of construction industry is very wide, include residential building, construction of commercial building, irrigation, roads, tunnels, transportation, facility buildings, and heavy engineering construction refer to infrastructure construction and industrial construction that need specialist expertise, that contributes substantially to the economic growth of the country.

The construction sector is an important to the Sudan economy; the construction sector accounted for 3.2% of the country's GDP in 2009 and

grew by about 10% in 2010 in nominal terms, according to the central bank of Sudan' 4% – 7% of total employment. The country faces a large demand for construction *work (sal,2010).* It is widely accepted that a project is successful when it is finished on time, within budget, in accordance with specifications and to stakeholder's satisfaction. Unfortunately, due to many reasons,high project performance and project success are not commonplace in the construction industry, especially in developing countries. Therefore, professional and scholars have been motivated to take extensive efforts to meet this challenge. As a result, several studies has been undertaken on factors affecting delays, cost overrun, quality, safety, productivity and problems in specific types of projects.

A research done by *Stephen M. Rowlinson (1998)* specified that project participants, project procedures, human aspect and environment may affect project performance. These factors may be contributed from different parties who involved in the construction project, and each of them will play their individual roles in giving success to the project. The team of construction project normally formed by the client, design professionals guided by architects, civil and structural engineer, etc, construction professionals which formed by main contractors and sub-contractors, supplier, surveyor and etc.

So, the researcher believes that the performance of projects is the sum of consists of the performance in all stages regarding time, cost and quality.The construction industry is dynamic in nature due to the increasing uncertainties in technology, budgets, and development processes. Nowadays, building projects are becoming much more complex and difficult.

Success criteria which relate to building often differ from project to another project depending on project participants, scope of services, project size,

sophistication of the owner related to the design of facilitates, technological implementations, and variety of other factors.

1.4 Risk in construction industry :

According to the variety of risk in construction industry, which alwaysproduce uncertainties in project environment, it is advisable tostudy and analyze every stage of the effect of each stage on the other.

1.5 Problem statement :

Successful construction industry plays an important role of the country development. For the last few years, the Sudanese construction industry havea boom in size, complexity and high demand by clients. This remand causes construction project to be more difficult for referring to project objectives and project constrains. The basic problem facing the Sudanese construction projects is the usage of project management tools and techniques on construction sites.

1.6 Aims of study :

This study aims to investigate the implementation of project management tools and techniques in the Sudanese Construction Industry and to assess effect of this implementation on the project performance.

1.7 Objective of the study :

1- To identify the major project management activities and what tools and techniques can be used on activity such of executed by Sudanese Construction industry.
2- To determine the project management tools and techniques many strongly effect Sudanese Construction activities.

3- To develop the theoretical model which can be used as an internal tool for the evaluation of project management tools and technique which may improve the construction project performance.

1.8 Research questions :

To obtain these objectives, three questions were adopted as research questions as followes:-

1- What are the optimal project management process activities?

2- What tools and techniques thatcommonly used in different process activities?

3- How are tools and techniques used in the Sudanese construction industry and what is their effect on project performance?

1.9 Limitation of study :

This study investigated the factors which may affect the implementation of project management tools and techniques in the field of construction management, in 2010 - 2015 year, so the population of study is considered to be the main civil engineering contractors in Khartoum state, Sudan.

1.10 Scope of the study :

This study focuses on the usage of tools and techniques in projects from the point of project management. The application of these tools and techniques,in general, is of a very useful output, so the research try to investigate about this statement in the local construction industry. Also the issue of increasing project performance is to be discussed in the light of using such tools and techniques.In conclusion,the study is intentionally elaborate the effect of using tools and techniques of management on project performance.

1.11 Research methodology :

The methodology of this study started from identifying the problem statement, literature review, collecting data, analysis of results, discussion of results, conclusions and recommendations. One important way to strength a research design is to use both qualitative and quantitative methods. Figure (1-1) shows a flowchart of the research methodology in order to achieve the objectives of the study. Comprehensive literature review has been established together with information on the factors that causes poor implementation of project management tools and techniques on construction project from the previous researchers.

1.12 Research hypotheses:

This research depends on the following hypotheses:

1. The general awareness about the nine area of knowledge is vital.

2. Tools and techniques of project management are widely applied in the Sudanese construction firms.

3. Using project management tools and techniques. Affect the construction performance.

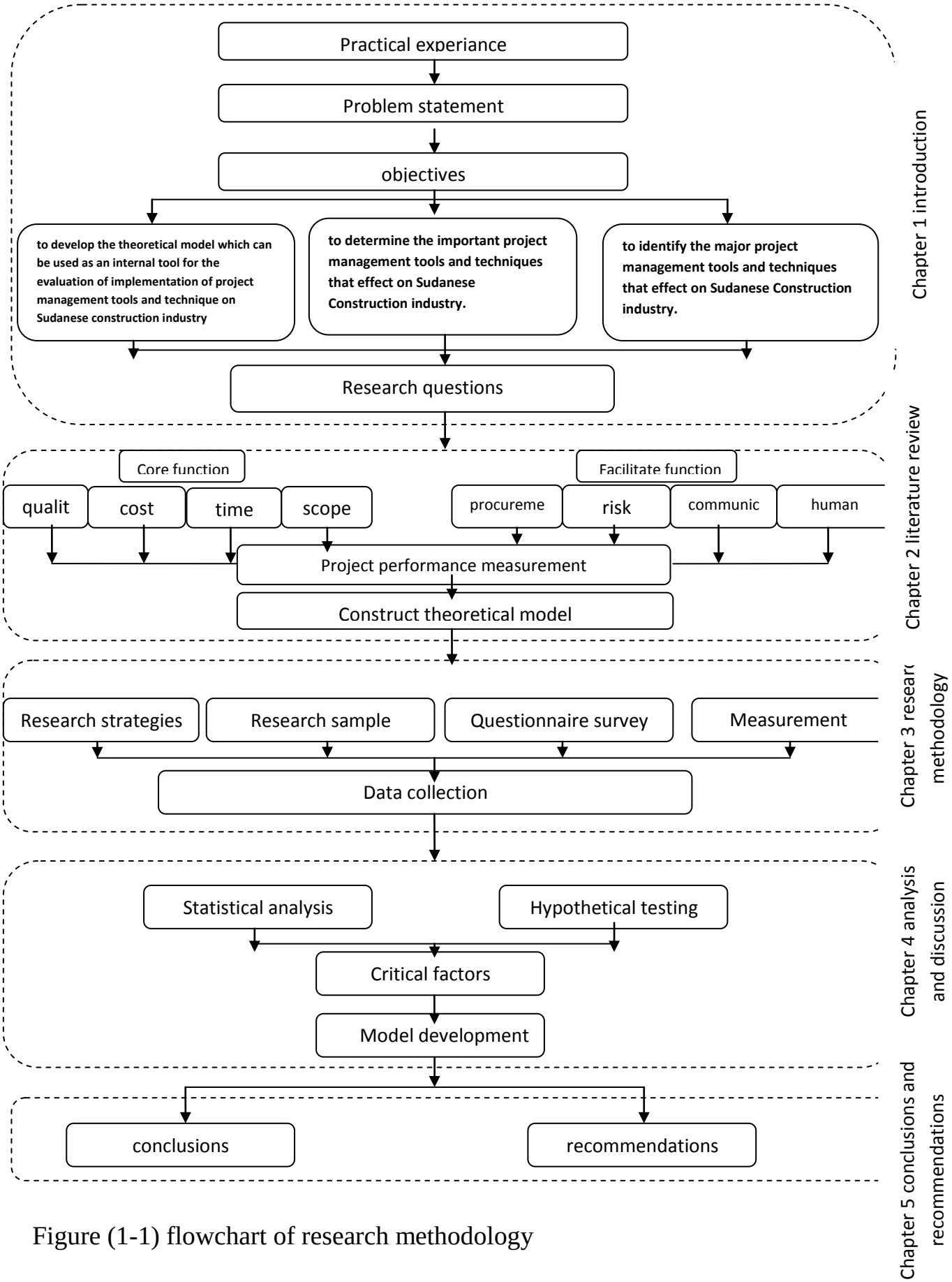

Figure (1-1) flowchart of research methodology

CHAPTER TWO

LITERATURE REVIEW

2.1Introduction :

Construction industry is one of the major industries in the global world, it is the creator of the built environment within which most other economic sectors take place. Providing work for a significant proportion of the labor market and accounting for a significant share of the world Gross Domestic Product (GDP). Building and other construction products have a pervasive influence on social activity in modern society. The built environment of society express its cultural values, and is a major influence on the visual beauty or squalor people experience. However, houses, roads, factories, offices, schools, hospital are also part of complex physical infrastructure of daily life.

Project management is the application of knowledge, skills, tools, and techniques to project activities to meet project requirements. This application of knowledge requires the effective management of appropriate processes. A process is a set of interrelated actions and activities performed to achieve a pre specified product, result, or service. Each process is characterized by its inputs, the tools and techniques that can be applied, and the resulting outputs.

2.2 Project Management Knowledge :

Project management is essential because of the growing demand for complex, sophisticated, customized goods and services and the exponential expansion of human knowledge. The former depends on the integration of product design with production / distribution and the latter allows a number of academic disciplines to contribute to the development of goods and services.

Core function of management:scope management, time management, cost management, and quality management.

Facilitating function management: human resources management, communication management, risk management, and procurement management.And integration between this function lead to enterprise success.

2.2.1 PROJECT SCOPE MANAGEMENT:

Table (2-1) tools and techniques of scope management

Knowledge area	Activities	Tools and Techniques
Scope management	Collect Requirements	.1 Interviews .2 Focus groups .3 Facilitated workshops .4 Group creativity techniques .5 Questionnaires and surveys .6 Observations .7 Prototypes
	Define Scope	.1Expert judgment .2 Product analysis .3 Alternatives identification
	Create WBS	.1 Decomposition
	Verify Scope	.1 Inspection
	Control Scope	.1 Variance analysis

Project Scope Management is the processes required to ensure that the project comprehended the work required, and only the work required, to complete the project successfully. Managing the project scope is primarily concerned with defining and controlling what is included and what is not in the project. The Project Scope Management processes, which include the following: *(Lock,2004) (Zouein and Tommelenb, 1994).*

A-CollectionRequirements :

The process of defining and documenting stakeholders' needs to meet the project objectives.Here below are some commonly tools and techniques:

1- Interviews: An interview is a formal or informal approach to discover information from stakeholders by talking to them directly. It is typically performed by asking prepared and spontaneous questions and recording the responses*(Lock,2004)*.

2-Focus groups: Focus groups bring together prequalified stakeholders and subject matter experts to learn about their expectations and attitudes about a proposed product, service, or result. A trained moderator guides the group through an interactive discussion, designed to be more conversational than a one on- one interview.

3-Facilitated Workshops: Requirements workshops are focused sessions that bring key cross-functional stakeholders together to define product requirements. Workshops are considered a primary technique for quickly defining cross-functional requirements and reconciling stakeholder differences*(Lock,2004)*.

4- Group Creativity Techniques: Several group activities can be organized to identify project and product requirements. Some of the group creativity techniques that can be used are:

Brainstorming **:**A technique used to generate and collect multiple ideas related to project and product requirements.

Nominal group technique **:**This technique enhances brainstorming with a voting process used to rank the most useful ideas for further brainstorming or for prioritization.

The Delphi Technique **:**A selected group of experts answers questionnaires and provides feedback regarding the responses from each round of requirements gathering *(Robert K. Wysodci, Rudd McGary2000).*

5- Questionnaires and Surveys: Questionnaires and surveys are written sets of questions designed to collect information from a wide number of respondents *(Robert K. Wysodci, Rudd McGary2000)*.

6- Observations: Observations provide a direct way of viewing individuals in their environment and how they perform their jobs or tasks and carry out processes.

7-Prototypes: Prototyping is a method of obtaining early feedback on requirements by providing a working model of the expected product before actually building it *(Robert K. Wysodci, Rudd McGary2000)*.

B- Definition of the Scope:

The process of developing a detailed description of the project and product.The tools and techniques used in the stage are follows:

1- Expert Judgment: Expert judgment is often used to analyze the information needed to develop the project scope statement.

2- Product Analysis: For projects that have a product as a deliverable, as opposed to a service or result, product analysis can be an effective tool. Product analysis includes techniques such as product breakdown, systems analysis, requirements analysis, systems engineering, value engineering, and value analysis.

3- Alternatives Identification: Identifying alternatives is a technique used to generate different approaches to execute and perform the work of the project. A variety of general management techniques can be used such as brainstorming, lateral thinking, pair wise comparisons, etc.

C- Creation of WBS:

The process of subdividing project deliverables and project work into smaller, more manageable components (Jakson,2010). The Tools and Techniques used are:

1-Decomposition:Decomposition is the subdivision of project deliverables into smaller, more manageable components until the work and deliverables are defined to the work package level. Decomposition of the total project work into work packages generally involves the following activities *(PMBOK GUIDE 2008)*:

- Identifying and analyzing the deliverables and related work,

- Structuring and organizing the WBS,
- Decomposition the upper WBS levels into lower level detailed components,
- Developing and assigning identification codes to the WBS components, and
- Verifying that the degree of decomposition of the work is necessary and sufficient.

D- Verification ofScope :

The process of formalizing acceptance of the completed project deliverables.The tools and techniques used are:

1- Inspection:Inspection includes activities such as measuring, examining, and verifying to determine whether work and deliverables meet requirements and product acceptance criteria. Inspections are sometimes called reviews, product reviews, audits, and walkthroughs.

E-Control Scope:

The process of monitoring the status of the project, product scope and managing changes to the scope baseline. the term scope can refer to:

- Product scope**:**The features and functions that characterize a product, o result.
- Project scope: The work that needs to be accomplished to deliver a product, service, or result with the specified features and functions.The tools and techniques used are :

1- Variance Analysis:Project performance measurements are used to assess the magnitude of variation from the original scope baseline *(PMBOK GUIDE 2008*).

2.2.2PROJECT TIME MANAGEMENT

Table (2-2) tools and techniques of time management

Knowledge area	Activities	Tools and Techniques
	Define	.1 Rolling wave planning
	Activities	.2 Templates

		.1 Precedence diagramming
TIME		method (PDM)
MANAGEMENT	Sequence	.2 Dependency determination
	Activities	.3 Applying leads and lags
		.4 Schedule network templates
		.1Alternatives analysis
	Estimate Activity	.2 Published estimating data
	Resources	.3Bottom-up estimating
		.4 Project management software
		.1 Analogous estimating
TIME	Estimate Activity	.2 Parametric estimating
MANAGEMENT	Durations	.3 Three-point estimates
		.4 Reserve analysis
		.1 Schedule network analysis
		.2 Critical path method
	Develop Schedule	.3 Critical chain method
		.4 Resource leveling
		.5 Schedule compression
		.1 Performance reviews
	Control Schedule	.2 Variance analysis

.3 Schedule compression

.4 Scheduling tool

Project Time Management includes the processes required to manage timely completion of the project. which are as follows:

A- Definition ofActivities :

The process of identifying the specific actions to be performed to produce the project deliverables *(PM. YannisBakouros.Vassiliskelessidis 2000).*The tools and techniques used are :

1- Rolling Wave Planning :Rolling wave planning is a form of progressive elaboration planning where the work to be accomplished in the near term is planned in detail and future work is planned at a higher level of the WBS.

2- Templates: A standard activity list or a portion of an activity list from a previous project is often usable as a template for a new project. The related activity attributes information in the templates can also contain other descriptive information useful in defining activities.

B- Sequence Activities :

The process of identifying and documenting relationships among the project activities.The Tools and Techniques used are :

1-Precedence Diagramming Method (PDM):PDM is a method used in Critical Path Method (CPM) for constructing a project schedule network diagram that uses boxes or rectangles, referred to as nodes, to represent activities, and connects them with arrows that show the logical relationships that exist between them.

2- Dependency Determination:Three types of dependencies are used to define the sequence between the activities:

- Mandatory dependencies**:**Mandatory dependencies are those that are contractually required or inherent in the nature of the work.

- Discretionary dependencies: The project team determines which dependencies are discretionary during the process of sequencing the activities.
- External dependencies**:**The project management team determines which dependencies are external during the process of sequencing the activities.

3- Application of Leads and Lags:The project management team determines the dependencies that may require a lead or a lag to accurately define the logical relationship.

4- Schedule Network Templates:Standardized schedule network diagram templates can be used to expedite the preparation of networks of project activities. They can include an entire project or only a portion of it.

C- Estimation Activity Resources :

The process of estimating the type and quantities of material, people, equipment, or supplies required to perform each activity. The tools and techniques used are:

1-Alternatives Analysis:Many schedule activities have alternative methods of accomplishment. They include using various levels of resource capability or skills, different size or type of machines, and make-or-buy decisions regarding the resource .

2-Published Estimating Data:Several companies routinely publish updated production rates and unit costs of resources for an extensive array of labor trades, material, and equipment for different countries and geographical locations within countries.

3- Bottom-Up Estimating:When an activity cannot be estimated with a reasonable degree of confidence, the work within the activity is decomposed into more detail.

4- Project Management Software:Project management software has the capability to help plan, organize, and manage resource pools and develop resource estimates.

D- Estimation Activity Durations :

The process of approximating the number of work periods needed to complete individual activities with estimated resources.the tools and techniques are used :

2-Analogous Estimating:Analogous estimating uses parameters such as duration, budget, size, weight, and complexity, from a previous, similar project, as the basis for estimating the same parameter or measure for a future project.

3- Parametric Estimating: Parametric estimating uses a statistical relationship between historical data and other variables to calculate an estimate for activity parameters, such as cost, budget, and duration.

4-Three-Point Estimates:The accuracy of activity duration estimates can be improved by considering estimation uncertainty and risk. This concept originated with the Program Evaluation and Review Technique (PERT).

5-Reserve Analysis:Duration estimates may include contingency reserves, (sometimes referred to as time reserves or buffers) into the overall project schedule to account for schedule uncertainty.

E-DevelopmentSchedule :

The process of analyzing activity sequences, durations, resource requirements, and schedule constraints to create the project schedule.the Tools and Techniques used

1- Schedule Network Analysis:Schedule network analysis is a technique that generates the project schedule. It employs various analytical techniques, such as critical path method, critical chain method, what-if analysis, and resource leveling to calculate the early and late start and finish dates for the uncompleted portions of project activities*(PMBOK GUIDE 2008)*.

2- Critical Path Method:The critical path method calculates the theoretical early start and finish dates, and late start and finish dates, for all activities without regard for any resource limitations, by performing a forward and backward pass analysis through the schedule network (Pmbok guide, 2008).

3-Critical Chain Method:Critical chain is a schedule network analysis technique that modifies the project schedule to account for limited resources *(PMBO. Knowledge,2008).*

4- Resource Leveling:Resource leveling is a schedule network analysis technique applied to a schedule that has already been analyzed by the critical path method.
5- Schedule Compression:Schedule compression shortens the project schedule without changing the project scope, to meet schedule constraints, imposed dates, or other schedule objectives.

F- Control Schedule :

The process of monitoring the status of the project to update project progress and managing changes to the schedule baseline.The Tools and Techniques used are:
1-Performance Reviews:Performance reviews measure, compare, and analyze schedule performance such as actual start and finish dates, percent complete, and remaining duration for work in progress.
2-Variance Analysis:Schedule performance measurements (SV, SPI) are used to assess the magnitude of variation to the original schedule baseline.
3-Schedule Compression:Schedule compression techniques are used to find ways to bring project activities that are behind into alignment with the plan.
4-Scheduling Tool:Schedule data is updated and compiled into the schedule to reflect actual progress of the project and remaining work to be completed.

2.2.3 PROJECT COST MANAGEMENT :

Table (2-3) tools and techniques of cost management

Knowledge area	Activities	Tools and Techniques
		.1 Analogous estimating
		.2 Parametric estimating
		.3 Bottom-up estimating
COST	Estimate	.4 Reserve analysis

MANAGEMENT	Costs	.5 Cost of quality
		.6 Project management estimating software
		.7 Vendor bid analysis
	Determine Budget	.1 Cost aggregation
		.2 Historical relationships
	Control Costs	.1 Earned value management
		.2 Forecasting
		.3 To-complete performance index (TCPI)
		.4 Performance reviews

Project Cost Management includes the processes involved in estimating, budgeting, and controlling costs so that the project can be completed within the approved budget. the Project Cost Management processes which include the following *(Azhar.et.al, 2001):*

A- EstimationCosts :

The process of developing an approximation of the monetary resources needed to complete project activities *(Azhar.et.al, 2001)*.The tools and techniques used are

1- Analogous Estimating :Analogous cost estimating uses the values of parameters, such as scope, cost, budget, and duration or measures of scale such as size, weight, and complexity, from a previous.

Similar project as the basis for estimating the same parameter or measure for a current project*(PMBOK GUIDE 2008*) *(Azhar.et.al, 2001)*.

2- Parametric Estimating :Parametric estimating uses a statistical relationship between historical data and other variables to calculate an estimate for activity parameters, such as cost, budget, and duration.

3- Bottom-Up Estimating :Bottom-up estimating is a method of estimating a component of work. The cost of individual work packages or activities is estimated with the greatest level of specified detail.

4- Cost of Quality (COQ) :Assumptions about costs of quality may be used to prepare the activity cost estimate *(Jacson, 2010).*

5- Project Management Estimating Software :Project management cost estimating software applications, computerized spreadsheets, simulation, and statistical tools are becoming more widely accepted to assist with cost estimating *(Azhar.et.al, 2001).*

6- Vendor Bid Analysis :Cost estimating methods may include analysis of what the project should cost, based on the responsive bids from qualified vendors.

B- Determine Budget :

The process of aggregating the estimated costs of individual activities orwork packages to establish an authorized cost baseline.The tools and techniques used are:

1-Cost Aggregation :Cost estimates are aggregated by work packages in accordance with the WBS.

2- Historical Relationships :Any historical relationships that result in parametric estimates or analogous estimates involve the use of project characteristics (parameters) to develop mathematical models to predict total project costs *(Azhar.et.al, 2001)*.

C-Control Costs :

The process of monitoring the status of the project to update the project budget and managing changes to the cost baseline *(Humphreys,2005).*

The tools and techniques used are :

1-Earned Value Management :Earned value management (EVM) in its various forms is a commonly used method of performance measurement. It integrates project scope, cost, and schedule measures to help the project management team assess and measure project performance and progress.*(Azhar.et.al,2001) (Pmbok guide, 2008),*

2- Forecasting:As the project progresses, the project team can develop a forecast for the estimate at completion (EAC) that may differ from the budget at completion (BAC) based on the project performance *(Pmbok guide, 2008),*.

3- To-Complete Performance Index (TCPI):The to-complete performance index (TCPI) is the calculated projection of cost performance that must be achieved on the remaining work to meet a specified management goal, such as the BAC or the EAC *(PMBOK GUIDE 2008) (Azhar.et.al,2001)*.

4- Performance Reviews :Performance reviews compare cost performance over time, schedule activities or work packages overrunning and under running the budget, and estimated funds needed to complete work in progress. If EVM is being used, *(Pmbok guide, 2008)*

2.2.4 PROJECT QUALITY MANAGEMENT :

Table (2-4) tools and techniques of quality management

Knowledge area	Activities	Tools and Techniques
QUALITY MANAGEMENT	Plan Quality	.1 Cost-benefit analysis .2 Cost of quality .3 Control charts .4 Statistical sampling .5 Flowcharting
	Perform	.1 Quality audits

Quality Assurance	.2 Process analysis
	.1 Histogram
	.2 Pareto chart
Perform	.3 Run chart
Quality Control	.4 Inspection
	.5 Approved change requests
	Review

Project Quality Management includes the processes and activities of the performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the needs for which it was undertaken *(Robert K.Wysocki Rudd McGary 2000).*which include the following:

A- Plan Quality :

The process of identifying quality requirements and/or standards for the project and product, and documenting how the project will demonstrate compliance.The tools and techniques used are:

1- Cost- Benefit Analysis**:** The primary benefits of meeting quality requirements can include less rework, higher productivity, lower costs, and increased stakeholder satisfaction *(Levy, 2010).*

2- Cost of Quality (COQ): Cost of quality includes all costs incurred over the life of the product by investment in preventing nonconformance to requirements, appraising the product or service for conformance to requirements, and failing to meet requirements (rework) (Jackson, 2010).

3- Control Charts: Control charts are used to determine whether or not a process is stable or has predictable performance. Upper and lower specification limits are

based on requirements of the contract. They reflect the maximum and minimum values allowed *(Levy, 2010).*

4- Statistical Sampling: Statistical sampling involves choosing part of a population of interest for inspection Sample frequency and sizes should be determined during the Plan Quality process so the cost of quality will include the number of tests, expected scrap, etc. There is a substantial body of knowledge on statistical sampling*(Levy, 2010)*.

5-Flowcharting: A flowchart is a graphical representation of a process showing the relationships among process steps. There are many styles, but all process flowcharts show activities, decision points, and the order of processing *(Project management office implementation).*

B-Performance of Quality Assurance :

The process of auditing the quality requirements and the results from quality control measurements to ensure appropriate quality standards and operational definitions are used.The tools and techniques used are:

1- Quality AuditsA quality audit is a structured, independent review to determine whether project activities comply with organizational and project policies, processes, and procedures. The objectives of a quality audit are *(Levy, 2010)* (*Banmett, 2003) :*

- Identify all the good/best practices being implemented,
- Identify all the gaps/shortcomings,
- Share the good practices introduced or implemented in similar projects in the organization and/ or industry,
- Proactively offer assistance in a positive manner to improve implementation of processes to help the team raise productivity,
- Highlight contributions of each audit in the lessons learned repository of the organization.

3- Process AnalysisProcess analysis follows the steps outlined in the process improvement plan to identify needed improvements. This analysis also examines

problems experienced, constraints experienced, and non-value-added activities identified during process operation.

C- Performance of Quality Control :

The process of monitoring and recording results of executing the quality activities to assess performance and recommend necessary change. Modern quality management complements project management. Both disciplines recognize the importance of:

- Customer satisfaction:Understanding, evaluating, defining, and managing expectations so that customer requirements are met.
- Prevention over inspection:One of the fundamental tenets of modern quality management states that quality is planned, designed, and built in—not inspected in. The cost of preventing mistakes is generally much less than the cost of correcting them when they are found by inspection.
- Continuous improvement: The plan-do-check-act cycle is the basis for quality improvement as defined by Ishikawa's and modified by Deming. In addition, quality improvement initiatives undertaken by the performing organization, such as TQM and Six Sigma, should improve the quality of the project's management as well as the quality of the project's product.

D- Management Responsibility.

Success requires the participation of all members of the project team, but remains the responsibility of management to provide the resources needed to succeed. *(Levy, 2010)*(*Banmett, 2003).*The tools and techniques used are:

1- Cause and Effect Diagrams:Cause and effect diagrams, also called Ishikawa diagrams or fishbone diagrams, illustrate how various factors might be linked to potential problems or effects.

2- Histogram:A histogram is a vertical bar chart showing how often a particular variable state occurred. Each column represents an attribute or characteristic of a problem/situation. The height of each column represents the relative frequency of the characteristic.

3-Pareto Chart:A Pareto chart, also referred to as a Pareto diagram, is a specific type of histogram, ordered by frequency of occurrence. Rank ordering is used to focus corrective action. This is commonly referred to as the 80/20 principle, where 80% of the problems are due to 20% of the causes. Pareto diagrams can also be used to summarize various types of data for 80/20 analyses.

4- Run Chart:Similar to a control chart without displayed limits, a run chart shows the history and pattern of variation. A run chart is a line graph that shows data points plotted in the order in which they occur. Run charts show trends in a process over time, variation over time, or declines or improvements in a process over time. Trend analysis is often used to monitor:

- Technical performance.
- Cost and schedule performance.

5-Inspection: An inspection is the examination of a work product to determine whether it conforms to documented standards. The results of an inspection generally include measurements and may be conducted at any level.

6- Approved Change Requests ReviewAll approved change requests should be reviewed to verify that they were implemented as approved.*(Levy, 2010)* (*Banmett, 2003) (Pmbok guide, 2008).*

2.2.5 PROJECT HUMAN RESOURCE MANAGEMENT :

Table (2-5) tools and techniques of human resources management

Knowledge area	Activities	Tools and Techniques
HUMAN RESOURCE	Develop Human Resource Plan	.1 Organization charts and position descriptions .2 Networking .3 Organizational theory

MANAGEMENT	Acquire Project Team	.1 Pre-assignment .2 Negotiation .3 Acquisition
	Develop Project Team	.1 Interpersonal skills .2 Training .3 Team-building activities .4 Ground rules .5 Co-location .6 Recognition and rewards
	Manage Project Team	.1 Observation and conversation .2 Project performance appraisals .3 Conflict management .4 Issue log .5 Interpersonal skills

Project Human Resource Management includes the processes that organize, manage, and lead the project team. The project team is comprised of the people with assigned roles and responsibilities for completing the project. The type and number of project team members can change frequently as the project progresses. Project team members may also be referred to as the project's staff. While the specific roles and responsibilities for the project team members are assigned, the

involvement of all team members in project planning and decision making can be beneficial.*(Bennet, 2003) (Levy, 2010).*

which are as follows:

A- Development of Human Resource Plan:

The process of identifying and documenting project roles, responsibilities, and required skills, reporting relationships, and creating a staffing management plan.

The tools and techniques used are :

1- Organization Charts and Position Descriptions: Various formats exist to document team member roles and responsibilities. Most of the formats fall into one of three types : hierarchical, matrix, and text-oriented.

2- Networking: Networking is the formal and informal interaction with others in an organization, industry, or professional environment.

3- Organizational Theory: Organizational theory provides information regarding the way in which people, teams, and organizational units behave.

B- Acquiring Project Team :

The process of confirming human resource availability and obtaining the team necessary to complete project assignments.*(Bennet, 2003) (Levy, 2010).*

The tools and techniques used are:

1- Pre-Assignment: When project team members are selected in advance they are considered pre-assigned. This situation can occur if the project is the result of specific people being promised as part of a competitive proposal, if the project is dependent upon the expertise of particular persons, or if some staff assignments are defined within the project charter.

2-Negotiation: Staff assignments are negotiated on many projects. For example, the project management team may need to negotiate with:

- Functional managers to ensure that the project receives appropriately competent staff in the required time frame, and that the project team members will be able, willing, and authorized to work on the project until their responsibilities are completed,

- Other project management teams within the performing organization to appropriately assign scarce or specialized human resources, and
- External organizations, vendors, suppliers, contractors, etc., for appropriate, scarce, specialized, qualified, certified, or other such specified human resources. *(Bennet, 2003) (Levy, 2010).*

3- Acquisition: When the performing organization lacks the in-house staff needed to complete a project, the required services may be acquired from outside sources. This can involve hiring individual consultants or subcontracting work to another organization.

C-Developing Project Team :

The process of improving the competencies, team interaction, and the overall team environment to enhance project performance.The tools and techniques used are:

1- Interpersonal Skills: These are sometimes known as "soft skills," and are particularly important to team development. The project management team can greatly reduce problems and increase cooperation by understanding the sentiments of project team members, anticipating their actions, acknowledging their concerns, and following up on their issues.

2- Training: Training includes all activities designed to enhance the competencies of the project team members. Training can be formal or informal.

3-Team-Building Activities:Team-building activities can vary from a five-minute agenda item in a status review meeting to an off-site, professionally facilitated experience designed to improve interpersonal relationships. The objective of team-building activities is to help individual team members work together effectively.

4- Ground Rules: Ground rules establish clear expectations regarding acceptable behavior by project team members. Early commitment to clear guidelines decreases misunderstandings and increases productivity.

5- Co-location: Co-location involves placing many or all of the most active project team members in the same physical location to enhance their ability to perform as a team. Co-location can be temporary, such as at strategically important times during the project, or for the entire project.

6- Recognition and Rewards: Part of the team development process involves recognizing and rewarding desirable behavior. The original plans concerning ways in which to reward people are developed during the Develop Human Resource Plan process.

D- Management Project Team :

The process of tracking team member performance, providing feedback, resolving issues, and managing changes to optimize project performance. Managing and leading the project team also includes, but is not limited to:

- Influencing the project team
- Professional and ethical behavior. *(Tett and Mayer, 1993).*

The tools and techniques used are:

1- Observation and Conversation: Observation and conversation are used to stay in touch with the work and attitudes of project team members

2- Project Performance Appraisals: Objectives for conducting performance appraisals during the course of a project can include clarification of roles and responsibilities, constructive feedback to team members, discovery of unknown or unresolved issues, development of individual training plans, and the establishment of specific goals for future time periods.

3- Conflict Management: Conflict is inevitable in a project environment. Sources of conflict include scarce resources, scheduling priorities, and personal work styles. the conflict management process:

- Conflict is natural and forces a search for alternatives,
- Conflict is a team issue,
- Openness resolves conflict,
- Conflict resolution should focus on issues, not personalities, and

- Conflict resolution should focus on the present, not the past.

4- Issue Log: Issues arise in the course of managing the project team. A written log documents and helps monitor who is responsible for resolving specific issues by a target date.

5- Interpersonal Skills: Project managers use a combination of technical, human, and conceptual skills to analyze situations and interact appropriately with team members. Some of the interpersonal skills the project managers use most often are briefly covered below.

- Leadership:Successful projects require strong leadership skills. Leadership is important through all phases of the project life cycle.
- Influencing:Since project managers often have little or no direct authority over their team members in a matrix environment, their ability to influence stakeholders on a timely basis is critical to project success. Key influencing skills include:
  - ○ Ability to be persuasive and clearly articulate points and positions,
  - ○ High levels of active and effective listening skills,
  - ○ Consideration of the various perspectives in any situation, and
  - ○ Gathering relevant and critical information to address important issues and reach agreements while maintaining mutual trust.
- Effective decision making: This involves the ability to negotiate and influence the organization and the project management team. *(Bennet, 2003) (Levy, 2010) (Adams and Bond, 2000).*

2.2.6 PROJECT COMMUNICATIONS MANAGEMENT:

Table (2-6) tools and techniques of communication management

Knowledge area	Activities	Tools and Techniques
	Identify	.1 Stakeholder analysis

	Stakeholders	.2 Expert judgment
		.1 Communication
	Plan	Requirements analysis
	Communications	.2 Communication technology
		.3 Communication models
		.4 Communication methods
COMMUNICATIONS MANAGEMENT	Distribute	.1 Communication methods
	Information	.2 Information distribution
		tools
	Manage Stakeholder	.1 Interpersonal skills
	Expectations	.2 Management skills
	Report	.1 Variance analysis
	Performance	.2 Forecasting methods

Project Communications Management includes the processes required to ensure timely and appropriate generation, collection, distribution, storage, retrieval, and ultimate disposition of project information. Project managers spend the majority of their time communicating with team members and other project stakeholders,whether they are internal (at all organizational levels) or external to the organization. Effective communication creates a bridge between diverse stakeholders involved in a project, connecting various cultural and organizational backgrounds, different levels of expertise, and various perspectives and interests

the project execution or outcome. the Project Communications Management processes which include the following *(Celia L. Desmond, 2004)*:

A- IdentificationStakeholders :

The process of identifying all people or organizations impacted by the project, and documenting relevant information regarding their interests, involvement, and impact on project success.The tools and techniques used are:

1- Stakeholder Analysis: Stakeholder analysis is a technique of systematically gathering and analyzing quantitative and qualitative information to determine whose interests should be taken into account throughout the project. Stakeholder analysis generally follows the steps described below *(Celia L. Desmond, 2004)*:

- Step 1:Identify all potential project stakeholders and relevant information, such as their roles, departments, interests, knowledge levels, expectations, and influence levels.
- Step 2:Identify the potential impact or support each stakeholder could generate, and classify them so as to define an approach strategy.
- Step 3:Assess how key stakeholders are likely to react or respond in various situations, in order to plan how to influence them to enhance their support and mitigate potential negative impacts.

B- Plan Communications :

Plan Communications is the process of determining the project stakeholder information needs and defining a communication approach. The Plan Communications process responds to the information and communications needs of the stakeholders. The tools and techniques used are:

1- Communication Requirements Analysis: The analysis of the communication requirements determines the information needs of the project stakeholders. These requirements are defined by combining the type and format of information needed with an analysis of the value of that information. *(Celia L. Desmond, 2004).*

2- Communication Technology: The methods used to transfer information among project stakeholders can vary significantly.

3- Communication Models: A basic model of communication, demonstrates how information is sent and received between two parties, defined as the sender and the receiver.

4- Communication Methods: There are several communication methods used to share information among project stakeholders. These methods can be broadly classified into:

- Interactive communication:Between two or more parties performing a multidirectional exchange of information.
- Push communication**:**Sent to specific recipients who need to know the information. This ensures that the information is distributed but does not certify that it actually reached or was understood by the intended audience.
- Pull communication**:** Used for very large volumes of information, or for very large audiences, that requires the recipients to access the communication content at their own discretion. *(Celia L. Desmond, 2004)(PMBOK GUIDE 2008*).

C- DistributionInformation :

The process of making relevant information available to project stakeholders as planned. The tools and techniques used are:

1- Communication Methods: Individual and group meetings, video and audio conferences, computer chats, and other remote communications methods are used to distribute information.

2- Information Distribution Tools: Project information can be distributed using a variety of tools, including:

- Hard-copy document distribution, manual filing systems, press releases, and shared-access electronic databases;
- Electronic communication and conferencing tools, such as e-mail, fax, voice mail, telephone, video and web conferencing, websites and web publishing; and
- Electronic tools for project management, such as web interfaces to scheduling and project management software, meeting and virtual office support software, portals, and collaborative work management tools. *(Celia L. Desmond, 2004)*

D- Management Stakeholder Expectations :

The process of communicating and working with stakeholders to meet their needs and addressing issues as they occur.

The tools and techniques used are:

1- Interpersonal Skills: The project manager applies appropriate interpersonal skills to manage stakeholder expectations

2- Management Skills:Management is the act of directing and controlling a group of people for the purpose of coordinating and harmonizing the group towards accomplishing a goal beyond the scope of individual effort.

E- Report Performance :

The process of collecting and distributing performance information, including status reports, progress measurements, and forecasts *(PMBOK GUIDE 2008*).The tools and techniques used are:

1- Variance Analysis: Variance analysis is an after-the-fact look at what caused a difference between the baseline and the actual performance. The process for performing variance analysis may vary depending on the application area, the standard used, and the industry.

2- Forecasting Methods: Forecasting is the process of predicting future project performance based on the actual performance to date. Forecasting methods may be classified in different categories:

- Time series methods:Time series methods use historical data as the basis for estimating future outcomes.
- Causal/econometric methods**:**Some forecasting methods use the assumption that it is possible to identify the underlying factors that might influence the variable that is being forecasted.
- Judgmental methods: Judgmental forecasting methods incorporate intuitive judgments, opinions, and probability estimates. Examples of methods in this category are composite forecasts, surveys, Delphi method, scenario building, technology forecasting, and forecast by analogy.

- Other methods:Other methods may include simulation, probabilistic forecasting, and ensemble forecasting. *(Celia L. Desmond, 2004)(PMBOK GUIDE 2008*). *(Celia L. Desmond, 2004)(PMBOK GUIDE 2008*)

2.2.7 PROJECT RISK MANAGEMENT :

Table (2-7) tools and techniques of risk management

Knowledge area	Activities	Tools and Techniques
RISK MANAGEMENT	Plan Risk Management	.1 Planning meetings and Analysis
	Identify Risks	.1 Documentation reviews .2 Information gathering techniques .3 Checklist analysis .4 Assumptions analysis
	Perform Qualitative Risk Analysis	.1 Risk probability and Impact assessment .2 Probability and impact matrix .3 Risk data quality assessment .4 Risk categorization .5 Risk urgency assessment

		.6 Expert judgment
	Perform Quantitativ	.1 Data gathering and representation techniques
	Risk Analysis	.2 Quantitative risk analysis And modeling techniques
		.3 Expert judgment
		.1 Strategies for negative risks or threats
RISK	Plan Risk	.2 Strategies for positive
MANAGEMENT	Responses	risks or opportunities
		.3 Contingent response strategies
		.4 Expert judgment
		.1 Risk reassessment
	Monitor and	.2 Risk audits
	Control Risks	.3 Variance and trend analysis
		.5 Reserve analysis

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and monitoring

and control on a project. The objectives of Project Risk Management are to increase the probability and impact of positive events, and decrease the probability and impact of negative events in the project. *(PMBOK GUIDE 2008*) *(Levy, 2010) (Bannett, 2003).*

A-Risk ManagementPlan :

The process of defining how to conduct risk management activities for a project.

The company used tools and techniques are as follows:

1- Planning Meetings and Analysis: Project teams hold planning meetings to develop the risk management plan. Attendees at these meetings may include the project manager, selected project team members and stakeholders, anyone in the organization with responsibility to manage the risk planning and execution activities *(PMBOK GUIDE 2008*),

B- Identification ofRisks :

The process of determining which risks may affect the project and documenting their characteristics.The company used Tools and Techniques are as follows:

1- Documentation Reviews: A structured review may be performed of project documentation, including plans, assumptions, previous project files, contracts, and other information.

2- Information Gathering Techniques: Examples of information gathering techniques used in identifying risk can include:

- Brainstorming.The goal of brainstorming is to obtain a comprehensive list of project risks.
- Delphi technique.The Delphi technique is a way to reach a consensus of experts. Project risk experts participate in this technique anonymously.
- Interviewing**.** Interviewing experienced project participants, stakeholders, and subject matter experts can identify risks.

- Root cause analysis.Root cause analysis is a specific technique to identify a problem, discover the underlying causes that lead to it, and develop preventive action. *(Pmbok guide, 2008)*

3- Checklist Analysis: Risk identification checklists can be developed based on historical information and knowledge that has been accumulated from previous similar projects and from other sources of information. *(Levy, 2010)(Bannett, 2003).*

4- Assumptions Analysis: Every project and every identified project risk is conceived and developed based on a set of hypotheses, scenarios, or assumptions.

C- Performing Qualitative Risk Analysis :

The process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact.The company used tools and techniques are as follows:

1- Risk Probability and Impact Assessment: Risk probability assessment investigates the likelihood that each specific risk will occur. Risk impact assessment investigates the potential effect on a project objective such as schedule, cost, quality, or performance, including both negative effects for threats and positive effects for opportunities.

2- Probability and Impact Matrix: Risks can be prioritized for further quantitative analysis and response based on their risk rating. Usually, these risk-rating rules are specified by the organization in advance of the project and included in organizational process assets

3- Risk Data Quality Assessment: A qualitative risk analysis requires accurate and unbiased data if it is to be credible. Analysis of the quality of risk data is a technique to evaluate the degree to which the data about risks are useful for risk management.

4- Risk Categorization: Risks to the project can be categorized by sources of risk (e.g., using the RBS), the area of the project affected (e.g., using the WBS), or

other useful category (e.g., project phase) to determine areas of the project most exposed to the effects of uncertainty.

5- Risk Urgency Assessment: Risks requiring near-term responses may be considered more urgent to address. Indicators of priority can include time to affect a risk response, symptoms and warning signs, and the risk rating.

D- Performing Quantitative Risk Analysis :

The process of numerically analyzing the effect of identified risks on overall project objectives. The company used tools and techniques are as follows:

1- Data Gathering and Representation Techniques :

- Interviewing:Interviewing techniques draw on experience and historical data to quantify the probability and impact of risks on project objectives.
- Probability distributions**:** Continuous probability distributions**.**

2- Quantitative Risk Analysis and Modeling Techniques:Commonly used techniques include both event-oriented and project-oriented analysis approaches including:

- Sensitivity analysis:Sensitivity analysis helps to determine which risks have the most potential impact on the project.
- Expectedmonetary value analysis:Expected monetary value (EMV) analysis is a statistical concept that calculates the average outcome when the future includes scenarios that may or may not happen (i.e., analysis under uncertainty).
- Modeling and simulation:A project simulation uses a model that translates the specified detailed uncertainties of the project into their potential impact on project objectives.

E-Risk ResponsesPlan :

The process of developing options and actions to enhance opportunities and to reduce threats to project objectives.The tools and techniques used are:

1- Strategies for Negative Risks or Threats: Three of the following strategies typically deal with threats or risks that may have negative impacts on project

objectives if they occur. The fourth strategy, accept, can be used for negative risks or threats as well as positive risks or opportunities. *(PMBOK GUIDE 2008*).

2- Strategies for Positive Risks or Opportunities: Three of the four responses are suggested to deal with risks with potentially positive impacts on project objectives. The fourth strategy, accept, can be used for negative risks or threats as well as positive risks or opportunities.

3- Contingent Response Strategies: Some responses are designed for use only if certain events occur. For some risks, it is appropriate for the project team to make a response plan that will only be executed under certain predefined conditions, if it is believed that there will be sufficient warning to implement the plan.

F- Monitoring and ControllingRisks :

The process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project.The company used tools and techniques are as follows:

1- Risk Reassessment: Monitor and Control Risks often results in identification of new risks, reassessment of current risks, and the closing of risks that are outdated. Project risk reassessments should be regularly scheduled.

2- Risk Audits: Risk audits examine and document the effectiveness of risk responses in dealing with identified risks and their root causes, as well as the effectiveness of the risk management process.

3- Variance and Trend Analysis: Many control processes employ variance analysis to compare the planned results to the actual results. For the purposes of monitoring and controlling risk events, trends in the project's execution should be reviewed using performance information.

4- Reserve Analysis: Throughout execution of the project some risks may occur, with positive or negative impacts on budget or schedule contingency reserves .Reserve analysis compares the amount of the contingency reserves remaining to

the amount of risk remaining at any time in the project in order to determine if the remaining reserve is adequate.*(Levy, 2010) (Bannett, 2003) (Pmbpkguide , 2008)*

2.2.8 PROJECT PROCUREMENT MANAGEMENT :

Table (2-8) tools and techniques of procurement management

Knowledge area	Activities	Tools and Techniques
PROCUREMENT MANAGEMENT	Plan Procurements	.1 Make-or-buy analysis .2 Expert judgment .3 Contract types
	Conduct Procurements	.1 Bidder conferences .2 Proposal evaluation techniques .3 Independent estimates .4 Advertising .5 Internet search .7 Procurement negotiations
	Administer Procurements	.1 Procurement performance reviews .2 Inspections and audits .3 Performance reporting .4 Payment systems

	.5 Claims administration
	.6 Records management System
Close Procurements	.1 Procurement audits
	.2 Negotiated settlements
	.3 Records management System

Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team. The organization can be either the buyer or seller of the products, services, or results of a project. Project Procurement Management includes the contract management and change control processes required to develop and administer contracts or purchase orders issued by authorized project team members.Project Procurement Management also includes administering any contract issued by an outside organization (the buyer) that is acquiring the project from the performing organization (the seller), and administering contractual obligations placed on the project team by the contract. the Project Procurement Management processes which include the following (*Pmbok guide, 2008):*

A- Procurementsplanning :

The process of documenting project purchasing decisions, specifying the approach, and identifying potential sellers.The tools and techniques used are:

1- Make-or-Buy Analysis: A make-or-buy analysis is a general management technique used to determine whether particular work can best be accomplished by the project team or must be purchased from outside sources. Sometimes a capabilitymay exist within the project organization, but may be committed to

working on other projects, in which case the project may need to source such effort from outside the organization in order to meet its schedule commitments.

3- Contract Types: The risk shared between the buyer and seller is determined by the contract type. Although the firm-fixed-price type of contractual arrangement is typically the preferred type which is encouraged and often demanded by most organizations, there are times when another contract form may be in the best interests of the project. *(Pmbok guide, 2008).*

B- ConductingProcurements :

The process of obtaining seller responses, selecting a seller, and awarding a contract.The tools and techniques used are:

1- Bidder Conferences: Bidder conferences (sometimes called contractor conferences, vendor conferences, and pre-bid conferences) are meetings between the buyer and all prospective sellers prior to submittal of a bid or proposal. They are used to ensure that all prospective sellers have a clear and common understanding of the procurement (both technical and contractual requirements), and that no bidders receive preferential treatment *(Bennett,2010).*

2- Proposal Evaluation Techniques: On complex procurements, where source selection will be made based on seller responses to previously defined weighted criteria, a formal evaluation review process will be defined by the buyer's procurement policies.

3- Independent Estimates: For many procurement items, the procuring organization may elect to either prepare its own independent estimate, or have an estimate of costs prepared by an outside professional estimator, to serve as a benchmark on proposed responses.

5- Advertising: Existing lists of potential sellers can often be expanded by placing advertisements in general circulation publications such as selected newspapers or in specialty trade publications.

6- Internet Search: The internet has a major influence on most project procurements and supply chain acquisitions in organizations. While many

commodities, components, and off-the-shelf-items can be quickly located and secured at a fixed-price on the internet, the high-risk, highly complex, procurement effort that must be closely monitored cannot be obtained by this means.

7- Procurement Negotiations: Negotiations clarify the structure, requirements and other terms of the purchases so that mutual agreement can be reached prior to signing the contract.

C- AdministeringProcurements :

The process of managing procurement relationships, monitoring contract performance, and making changes and corrections as needed. *(Pmbok guide, 2008)*. The tools and techniques used are:

1- Procurement Performance Reviews: A procurement performance review is a structured review of the seller's progress to deliver project scope and quality, within cost and on schedule, as compared to the contract. It can include a review of sellerprepared documentation and buyer inspections, as well as quality audits conducted during seller's execution of the work *(Levy,2010).*

2- Inspections and Audits: Inspections and audits required by the buyer and supported by the seller as specified in the procurement contract can be conducted during execution of the project to verify compliance in the seller's work processes or deliverables.

3- Performance Reporting: Performance reporting provides management with information about how effectively the seller is achieving the contractual objectives.

4- Payment Systems: Payments to the seller are typically processed by the accounts payable system of the buyer after certification of satisfactory work by an authorized person on the project team. All payments should be made and documented in strict accordance with the terms of the contract.

5- Claims Administration: Contested changes and potential constructive changes are those requested changes where the buyer and seller cannot reach an agreement on compensation for the change, or cannot agree that a change has occurred.

6- Records Management System: A records management system is used by the project manager to manage contract and procurement documentation and records. It consists of a specific set of processes, related control functions, and automation tools that are consolidated and combined as part of the project management information system.

D- ClosingProcurements :

The process of completing each project procurement. *(Pmbok guide, 2008)*. The company used tools and techniques are as follows:

1- Procurement Audits: A procurement audit is a structured review of the procurement process originating from the Plan Procurements process through Administer Procurements. The objective of a procurement audit is to identify successes and failures that warrant recognition in the preparation or administration of other procurement contracts on the project, or on other projects within the performing organization.

2- Negotiated Settlements: In all procurement relationships the final equitable settlement of all outstanding issues, claims, and disputes by negotiation is a primary goal. Whenever settlement cannot be achieved through direct negotiation, some form of alternative dispute resolution (ADR) including mediation or arbitration may be explored. When all else fails, litigation in the courts is the least desirable option*(PMBOK GUIDE 2008*).

2.2.9 PROJECT INTEGRATION MANAGEMENT :

Table (2-9) tools and techniques of integration management

Knowledge area	Activities	Tools and Techniques
	Develop Project	.1 Expert judgment

	Charter	
	Develop Project Management Plan	.1 Expert judgment
	Direct and Manage Project Execution	.1 Expert judgment .2 Project management information system
INTEGRATION MANAGEMENT	Monitor and Control Project Work	.1 Expert judgment
	Perform Integrated Change Control	.1 Expert judgment .2 Change controlmeetings
	Close Project or Phase	.1 Expert judgment

Project Integration Management includes the processes and activities needed to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups. In the project management context, integration includes characteristics of unification, consolidation, articulation, and integrative actions that are crucial to project completion, successfully managing stakeholder expectations, and meeting requirements. which are as follows:*(Pmbok guide, 2008)*

A- Developing Project Charter :

The process of developing a document that formally authorizes a project or a phase and documenting initial requirements that satisfy the stakeholder's needs and expectations.

B- Developing Project Management Plan :

The process of documenting the actions necessary to define, prepare, integrate, and coordinate all subsidiary plans. *(Pmbok guide, 2008):*

C- Directing and Managing Project Execution :

The process of performing the work defined in the project management plan to achieve the project's objectives.The tools and Techniques used are:

1- Project Management Information System: The project management information system, part of the enterprise environmental factors, provides access to an automated tool, such as a scheduling software tool, a configuration management system, an information collection and distribution system, or web interfaces to other online automated systems used during the Direct and Manage Project Execution effort.

D- Monitoring and Controlling Project Work :

The process of tracking, reviewing, and regulating the progress to meet the performance objectives defined in the project management plan. (*Pmbok guide, 2008)*

E- Performing Integrated Change Control :

The process of reviewing all change requests, approving changes, and managing changes to the deliverables, organizational process assets, project documents, and the project management plan. *(Pmbok guide, 2008).* The tools and technique used:

1- Change Control Meetings: A change control board is responsible for meeting and reviewing the change requests and approving or rejecting those change requests. The roles and responsibilities of these boards are clearly defined and are agreed upon by appropriate stakeholders.*(PMBOK GUIDE 2008*).

F- Closing Project or Phase :

The process of finalizing all activities across all of the Project Management Process Groups to formally complete the project or phase.

2.3 TheMeasurement of Performance :

The measurement of performance of product development projects, even in mature organizations, is a complex task due to the subjectivity of the concept, to the difficulty of appraising intangible deliverables, and to the different meanings that performance has for different parties. Furthermore, projects may have different duration, assigned budget and scope. Therefore it is necessary to define a common ground for assessing the performance of projects from different perspectives.

2.3.1 Performance and the Triple Constraint in theProjects :

Different authors define the performance of projects in terms of indicators that can be basic or derived depending on the way in which they are measured. While basic indicators are measured directly and their units are typically the same units used in the measurement, derived indicators are usually calculated through the mathematical combination of different types of data and their units are compound or scaled *(Macedo and Rozenfeld, 2008; Echeveste, et al., 2005).* Levine (2002) mentions that the advantages of having a method to measure performance are the reduction of inaccuracies and subjectivity in the estimation of progress, and the increase of fidelity between the data and the real estate of the project. The latter helps to prevent creating a false sense of accomplishment and subsequent disillusionment, generating errors in time and cost forecasts, and making decisions based on inaccurate information.

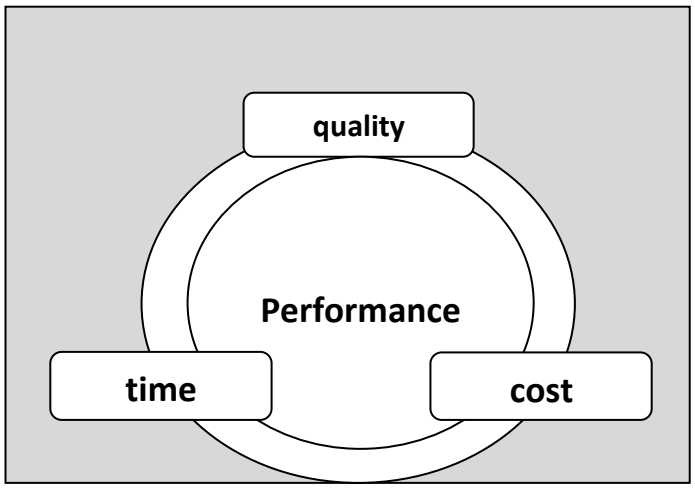

Figure 2-1 Direct interaction between quality, execution time and cost of projects

2.4Cost :

One of the most common variables mentioned in the product development literature used to monitor the performance of projects is cost (Borsato, et al., 2007; Echeveste, et al., 2005; de Toledo and Souza, 2005). Several authors indicate that while costs set the lower limit for prices, the customer perception of value sets the upper limit (Freixo and de Toledo, 2004). Armstrong and Kotler (2007) point out that a company must consider a number of internal and external factors when setting prices within these limits. Internal factors affecting pricing include the company's overall marketing strategy, products mix and the organization's objectives. External factors include the market conditions and nature of the demand, competitors' strategies and prices, and other environmental factors. More importantly, they define that pricing must be based on the value of the product as perceived by the customer.

2.4.1 Estimation of costs in product development projects:

Ben-Arieh and Qian (2003) depict the current market reality as one that fosters a reduced life cycle expectancy of products. This situation has increased the share of the development phase in the overall product life cycle. As a result, the development cost has become an important part of the total cost of products. In order to have a correct estimation of the product costs, the design and development cost have to be accurately measured. Freixo and de Toledo (2004) explain that the determination of product target costs can be carried out by surveying the clients, by comparing with similar products in the market, or by consulting the product development team and the decision makers in the organization. Price and therefore cost, are characteristics which target value should be defined during concept development or during early phases of the development of newproducts (Freixo and de Toledo, 2004). Jans, et al. (2008)

define development costs as the costs incurred in the creation of a new design. Ben-Arieh and Qian (2003) indicate that some of the activities that contribute to the cost structure during product development include, but are not limited to, design, engineering, production planning,production of prototypes, and testing. According to these authors, traditional costing techniques distort the cost information by only considering overheads.

2.4.2 Factors that affecting the costs of projects :

Several characteristics of a product are decided early in the development process. Target values, the central concept of the product, technology, final applications, shape, and design principles are among those characteristics. In addition, during the development of a new product other key parameters related to the structure of final products are defined, such as relations between components, precedence of assembly, materials, and processes (Freixo and de Toledo, 2004). The definition of characteristics in the early phases of product development projects does not incur in great costs but it commits a greater deal of costs by fixing dependencies with other parts and processes. Figure 2.3 depicts both the incurred and committed costs during the conceptual phases of the product development process.

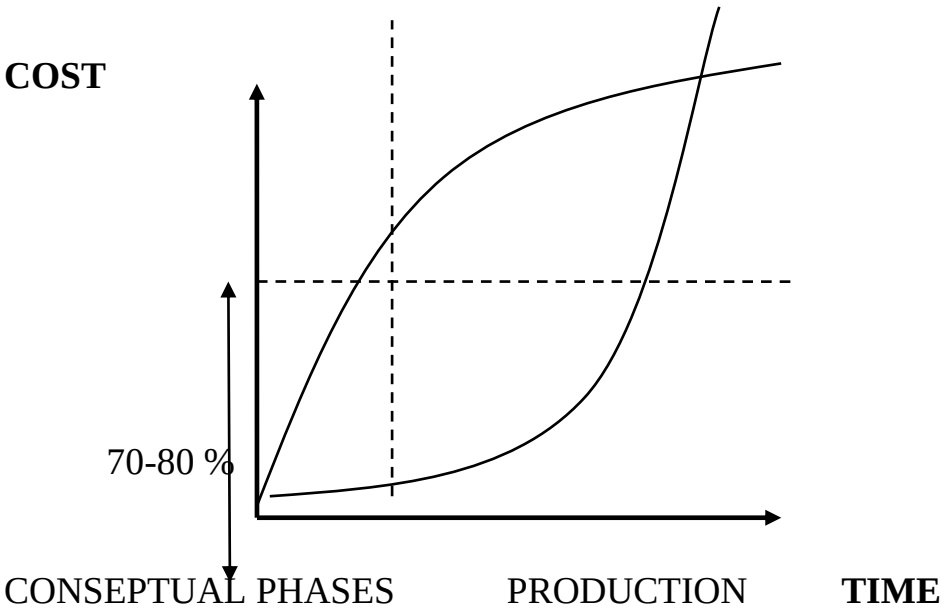

Figure 2-2 Commitment of the product cost curve (Freixo and de Toledo, 2000)

Graham (2000) states that the frequency of changes is much higher early in the product development process when customers are involved in the definition of characteristics.

2.5 Quality :

Quality is the way of measuring the state of being free of flaws and deviations. When the right parameters are measured and the products of a project satisfy the customer's needs and expectations, the project is focused on quality (Angel, 2010). Quality evaluations should therefore measure functional performance oriented towards the satisfaction of customer requirements by estimating the deviation between the desired and planned characteristics and the actual ones (Echeveste, et al., 2005). In the case of projects, the customer is not always a person or an entity external to the organization, in many cases customer are other parts of the same organization.

2.5.1 Translation of customer requirements into characteristics :

Echeveste, et al. (2005) indicate that product development projects experience adjustments that fit the outcomes of the project to physical, technological, and scope constrains. However they can also lead to considerable deviations from the scope and demands of the project. Cooper (2001, pp 23) indicates that the most common source of failure in new products is the disconnection between the customer needs and the project outcomes, which may be caused by poor marketing or by misunderstanding the customer needs. Not understanding the priority of the customer needs also contributes to the failure of products and projects. Therefore a constant focus on the customer is fundamental throughout the development process. It is common that product development projects lack market orientation or adequate market assessment.

2.5.2 Rework and the cost of poor quality :

Graham (2000) defines productivity as the creation of work products, and quality as the amount of work products that will not require further reworking. He explains that complex systems often result in rework cycles that represent half of the total work to be performed. Product development projects, by nature, are part of complex systems and therefore rework is not uncommon. The cost of poor quality encompasses the effort and use of resources to carry out corrections derived from the lack of quality in execution. Cooper (2001) affirms that the amount of rework that a project will experience is largely decided in the early stages, therefore a sharp and early definition of the business case and the outcomes of a project are fundamental to reduce the occurrence of rework.

2.6 Project Lead-time :

Lead-time is one of the most mentioned metrics of performance in product development literature (Echeveste, et al., 2005; de Toledo and Souza, 2005; Borsato, et al., 2007; Jonsson, 2008). The time invested in a product development project from the conception of a product to its launch is known as time-to-market. According to Jonsson (2008) time-to-market has a large impact on the innovation capacity of a firm since a short product development time can provide a time advantage in the market with respect to a competitor's products. Conversely, a large product development timemay result in delays, and the launch of a product that is no longer attractive to the market.Cooper (2001) considers short lead-time as an interim goal and profitability as the ultimate goal of a firm. Instead of defining time to market as a metric of the execution and performance of projects, he suggests the use of time to profit instead.

2.6.1 Conditions that help to reduce lead-time :

In addition to meeting customer requirements through the characteristics, quality and cost of outputs, the time in which the customer can have access to the product is also important for the success or failure of a product. Therefore the deliverables of the project must be scheduled to meet the launch date of the product. According to studies, poor timing of introduction is responsible of 8% of project

failures (Cooper, 2001). Poor timing may imply moving too slowly and missing an opportunity window, or moving forward too fast without defining clearly the customer requirements, plan and products. Rosenthal and Tatikonda (1992) suggest that management needs to be more precise in the definition of quality, cost and customer satisfaction parameters during the early phases of product development projects in order to reduce the project lead-time without compromising the quality and functionality of the final product. Booker, et al. (2001) indicate that rework represents an opportunity for reducing leadtime by 30%. Furthermore, they indicate that two thirds of technical modifications can be avoided if communication is improved.

2.7 Standardization of the performance measurement :

Projects may have different duration, budget and scope. Therefore it is necessary to define a way of breaking down the complexity and variation of projects into elements that are common to all projects. The latter allows for the analysis of different projects under similar parameters and metrics. Tollgate models are a means of homogenizing the management of product development projects by separating a project into phases that characterize the evolution of a project from the identification of the needs that drive the project to the delivery of project outcomes. Some of the indicators can be measured directly while others cannot. Furthermore, some of the indicators can be measured in real time, while the project is in progress, and others can be measured only when the project is completed. These differences create a need for defining a common ground for projects in order to measure performance according to the same criteria and at similar time intervals.

2.8 Toll gate models :

A tollgate model, as defined by Cooper (2001), is a stage-gate process to manage, accelerate and improve the product development endeavors. The definition of the succession of stages and gates is a road map to streamline the entire product development process. To enhance the effectiveness of their own

tollgate model, different firms integrate best practices, lessons learned, and success factors that arespecific to their market and context. The definition of a tollgate model is not a one offevent, the evolution towards more sophisticated models is characteristic of leadingfirms according to Cooper.

2.8.1 Earned Value Analysis to evaluate performance :

The Project Management Institute (PMI, 2004) defines project performance in terms of deviations with respect to planned values and ratios. From the PMI perspective, the measurement of performance is the quantification of the variances that will occur during the development of a project and the comparison of planned and actual values.The earned value analysis (EVA) is a common tool used in projects to measure the magnitude of the progress and variance from the baseline defined in the project plan. As explained by Bergquist and Carlsson (2005), EV management has the advantage of being simple to aggregate and presents information in a short and simple way, presenting both technical and economic progress together.

2.9 Framework of indicators to measure performance :

From the literature presented in this chapter, 8 indicators were selected to measure performance of product development projects. The purpose of selecting different indicators is to appraise the performance of projects from different perspectives. Figure 2.5 presents the indicators suggested in the literature review. Rework greatly affects the cost, duration and quality of projects. Although this research does not focus on rework, two indicators that are associated to rework and project performance were selected

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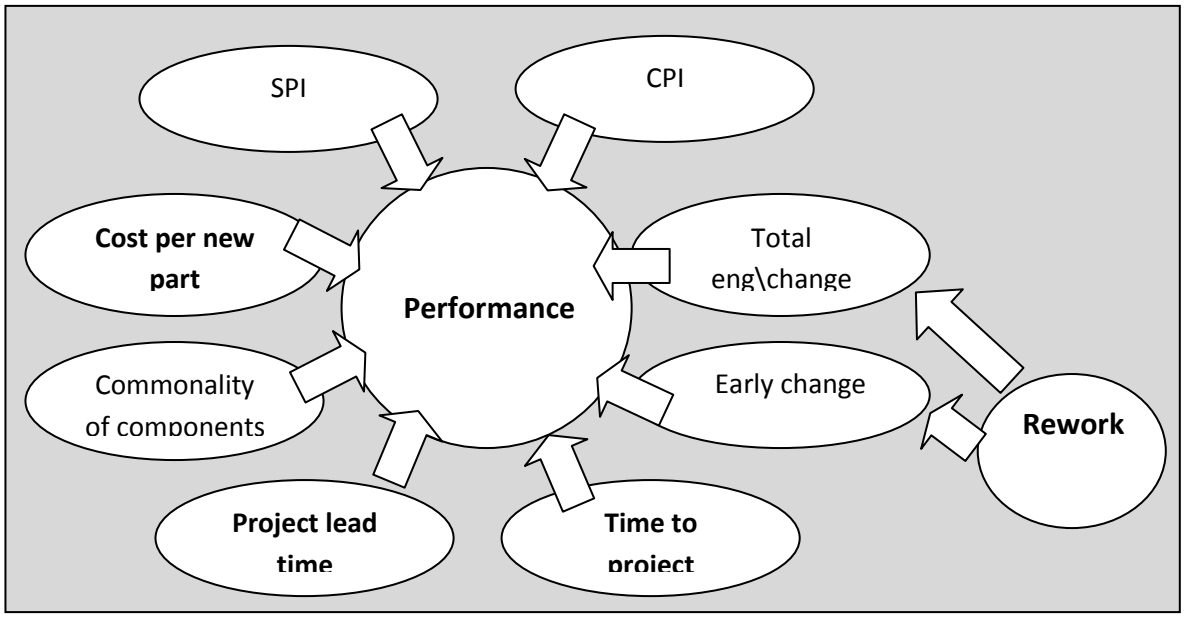

Figure 2-3 Theoretical framework indicators

The project's prime costs represent the direct materials and direct labor invested in the completion of projects. According to product development and project management literature, prior to the start of a project, the prime cost can be estimated by adding together the costs of the activities needed to complete the project (Maylor, 2005; Filomena, et al., 2005; Ben-Arieh and Qian, 2003). Once the project is in progress, the prime cost can be registered and monitored using accounting records and timesheets, and direct materials can be monitored from invoices (Maylor, 2005). The *cost performance index* appraises the performance of projects and portfolio using theproject's budget, costs and earned value. In a similar fashion, the *schedule performance index* is proposed as a performance indicator to estimate time deviationsfrom the plan based on the achievements of the project (PMI, 2004).

Projects that are different in scope and nature most likely require different amounts ofresources to be completed in a timely fashion with high quality results. Therefore thecomparison of two projects with different scopes may not be significant. If the project' prime cost is divided over the products of the project, or new part numbers in the case of product development projects, then a more detailed measurement of performance can be obtained. Projects do not represent

an economic gain for a firm, but new parts do. Therefore, *cost per new part* was selected as a performance indicator.

2.10 Previous studies :

Worldwide, many researchers have been conducted in the field of construction management. After a review of the relevant construction project performance literature, it has been found that different researchers adopted different performance definitions and frameworks based on their own understanding of project management tools and techniques and research objectives. Here below are summaries of these researches :

2.10.1 Implementation of Project Management Techniques to Baleela new airport project (AymanBabikerKhider 2011).

In this study many techniques that used in project management but he study the techniques that used in execution and scheduling.

2.10.2 Project Management for Construction Project (Hidaya said najmi 2011).

Study in execution phase time management, cost management, quality management, risk management, change management, software management, and implementation tools how effect in this phase.

2.10.3 Slootman study (2007).

Slootman (2007) discussed the influences of execution planning on project performance for construction and mine firms, for reasons of cost overrun, and schedule delays, these cost overruns were the result of a mismanagement of risks that occur due to the size and complexity of the project. In his results, he focused on the workforce planning principles as the best practice to provide the higher labor productivity, and better predictability including in sixth (6) which are (1) Tools and techniques and equipment , (2) Human resources, (3) Engineering and

Design, (4) Procedures, (5) materials, and (6) Environment. The early involvement of contractor ensures better communication which eventually leads to higher constructability of the product designs. The recommendations of this study were focused on the early involvement of the contractor and involvement of the owner through the entire process, and to continue of FIWPs, and to increase the level of detail one more step.

2.10.4 Tools and Techniques of Project Management (CIMA P5 2007).

Benefit WBS – Gantt Chart – Critical bath analysis (CPA) – Network analysis – (PERT) project Evaluation and Review techniques – Histogram.

2.10.5 Tat study (2009).

Tat (2009) discussed the factors affecting on the preparation of better construction schedule for construction work, he showed that there were thirty five factors where these factors were divided into four main categories which were project specific factors, project management, working condition and external environment relate factors. Tat recommended that to investigate another kind of specific project, such as, highway projects, and to evaluate the effectiveness of the construction work schedule on the particular project in the construction industry.

2.10.6 Gomaa study (2010).

Gomaa (2010) studied the different tools and techniques and procedures adopted by the Sudanese construction firms for the control of construction time and cost and moreover explores the main causes of project cost overruns, the obtained results confirmed that all construction projects suffer from time overruns ranging between (40-60%) of the per scheduled time, awareness of engineers with the basics and principles of financial accounting, unavailability system for cost control, and focusing on the well preparing of written and balanced contracts to ensure proper and timely projects progress. Gomaa recommended with the project

planning, good bid preparation, format contracts, good project management, accounted work for engineers, apply the statistical applications, and construct units for monitoring and evaluation.

2.10.7 Site implementation and assessment of lean construction techniques (D.salem, J. Solomon, A. genaidy and M. luegring).

The author found that the lean manufacturing tools can be modified for use in construction projects and successfully implemented.

2.10.8 Application of lean manufacturing principles to construction (O. Salim, E. Zimmer).

Whiles in some ways it is unsurprising in the extent of its criticism of construction, the clear definition of issues makes it a useful strategic document. Pinpointing how the construction sector can start to make better use of knowledge in its management practices.

2.11 Summary :

In this chapter, a comprehensive literature review was discussed with a wide spread of participants perspective in the field of construction management,from the core function of management scope, time, cost, and quality. facilitating function management human resources, communication, risk, and procurement. And integration between this function.The researchers were discussed to understand their problems, findings, and recommendation, in order to summarize the type of these researches to construct a theoretical model which would evaluate the project performance with a wide view. The hypotheses which suggested from the literature used to construct the theoretical model, figure (2-4)

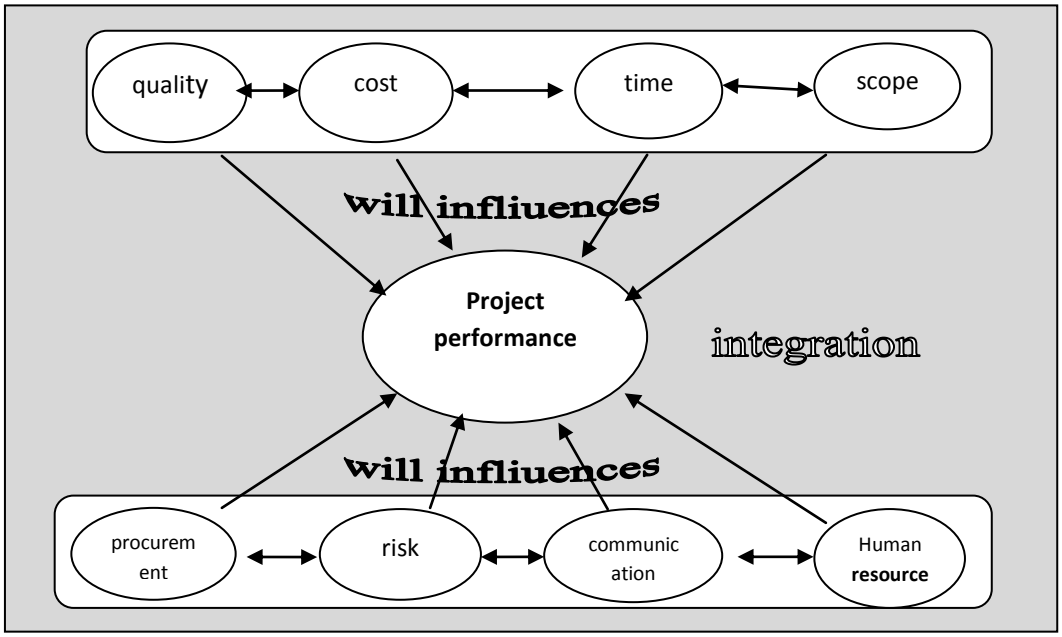

figure (2-4) The theoretical model explainaffect of 9 criteria to performance

CHAPTER THREE

DATA COLLECTION AND TABULATION

3.1 Introduction :

For conducting empirical research, there are two methods of data collection: Qualitative and quantitative. These two methods have their strength and weaknesses. The qualitative method permits researchers to study selected issues in depth and detail. Approaching fieldwork without being constrained by predetermined categories of analysis contributes to the depth, openness, and detail of qualitative inquiry. The quantitative method, on the other hand, requires the use of standardized instruments so that the varying perspectives and experiences of people can fit a limited number of predetermined response categories, to which numbers are assigned. The advantage of a quantitative method is that it is possible to measure the reactions of a great many people to a limited set of questions, thus facilitating comparison and statistical aggregation of the data. This give a broad, generalizable set of findings presented succinctly and parsimoniously. By contrast, a qualitative method typically produces a wealth of detail information about a much smaller number of people and cases.

3.2 Research design :

In order to answer the research questions and test hypotheses the researcher structured the study in two parts, theoretical and experimental. The sequence of the research components was considered to be complying the scientific methodology.

3.3 Research population :

The population of this research comprises all the registered construction firms in Sudan. The registration of companies adopted by the Organizing Council For Engineering Works Contractors in Sudan. Had been the main reference where a systematic random samples were taken. The questionnaire was piloted by professional members in the industry and all their remarks were included.

3.4 Research sample :

Construction firms in Khartoum state were selected for investigation due to the state's position as the center of construction firms in Sudan, as well as for reasons of practicability and convenience perceived by the researcher.

3.5 Data collection :

Data collection is considered as the crucial stage in gathering all required information, from the fundamental in achieving main objectives of the study. Basically, the main data were collected from literature review. All factors obtained from previous study wer listed. The main data was as a platform for the formulation of questionnaire. the second data is the finalize questionnaire as the main data to be used for the analysis for the study. The second data are collected from questionnaire survey delegated to project managers and participant from firms that involve in stages of construction project.

3.5.1 Data analysis :

For testing the theoretical model hypothesized in this study, the measurement instrument should be reliable an valid. Thus, they should be evaluated for reliability and validity. In evaluating measurement instrument, reliability analysis, item analysis, and factor analysis should be conducted in order to understand whether measurement instrument was reliable and valid. The SPSS IBM 19 program was used in evaluation.

3.6 Research tool (questionnaire):

3.6.1 Introduction :

In this study, a research questionnaire was developed and used to obtain empirical data from construction firms in order to test the theoretical model

hypothesized in this study. In the questionnaire, there was on measurement instrument use to measure implementation tools and techniques in construction project, respectively. The instrument have some measurement scales (see appendix 1). Before testing the theoretical model, it was necessary to first evaluate the reliability and validity of the instrument; it is only on the basis of reliable and valid measurement scales that hypothesis testing can be conducted.

3.6.2 Questionnaire design :

The research tool adopted is the formed questionnaire where comprehensive questions were established covering all the topic of the research. The questions were established with respect to the research problems, questions and hypothesis.

3.6.3 Questionnaire modification :

In this research most of the literature reviewed was in English, thus the questionnaire was first developed in English. However, it was actually used for collecting information in Sudan. Therefore the English version had to be translated into Arabic. This translation might have biased the original design of the questionnaire. A number of factors terms, could not be precisely translated into Arabic terms. Various measures were taken into order minimize these potential problems. The English version was 72 items which was translated into Arabic by the supervisor and the researcher themselves. Some Arabic terms were translated into English by providing additional explanations with English term itself, so that respondents could better understand them. after translation, the Arabic version of the questionnaire was distributed to 5 persons who had a professional knowledge in the field of the construction management and work in deferent Sudanese construction firms. They were asked whether: (1)the items were stated in a shared vocabulary,

(2)the items were precise and unambiguous, (3) there were biased wordings, (4) they could answer these questions. They returned the questionnaires with their comment, and some alterations were made according to their suggestions. The Arabic version of the questionnaire was formally pre-tested on various people (i. e., consultant, researchers, practitioners, and project managers). The researcher interviewed these people and asked them to provide feedback on case of comprehension, clarity of the specific items, etc. their suggestion were then carefully evaluated by the researcher and the Arabic version of the questionnaire was further modified. After this step, the researcher was confident that the questionnaire could be used for the large scale survey. In appendix (2), the final Arabic version of the questionnaire consist of 70 items (questions) to measure implementation of tools and techniques in Sudanese construction firms. Appendix (1) lists the instrument that the researcher retranslated back into English from the final Arabic version. This instrument was used to measure effect ofimplementation tools and techniques on Sudanese construction firms.

3.7 Survey samples :

The type of samples and the number of firms were determined on the basis meeting the information requirements for the research. In this research, all of the investigated firms were from Khartoum state, where there are more than 100 large or medium- size construction firms. Thus the samples from Khartoum state were enough for this research purpose. Although the selected samples were limited to firms in the Khartoum region, therefore, the research results might be generalized to all firms in Sudan. However, strictly speaking, this generalization is limited. In this research, only Sudanese construction firms with annual turnover revenues of more than SDG 100 million were randomly selected for investigating their projects performance. The reason for this was that such relatively large firms could have more experiences of

implementing all project stages, have more qualified respondent to fill in questionnaires, and take the questionnaires seriously.

The organizing council for engineering works contractors provided the researcher with a firm list. In Khartoum state, there were more than 100 construction firms with annual turnover of more than SDG 100 million. The data were based on the year 2011, and a sample of 70 construction firms was randomly selected. The sample size was decided after considering the expected response rate, requirements for performing statistical analysis, and survey cost. After the 70 firms were randomly selected, they were contained groups according to their industrial sectors (roads, buildings, steel work, and complex). The questionnaires distributed to the target firms. Finally, 55 questionnaires were returned. The response rate was 78%, high for such research.

3.7.1 contacting relevant persons :

in year 2014, the researcher conducted data collection in Sudanese construction firms. He had asked the register of college of graduate studies department in the university to write an introduction latter for him. The measure content of that letter follows: Maha Hassan. is a student at the college graduate studies of the Sudan university in Khartoum. Currently, the researcher is doing research in the field of construction management. The major aim of the research is to study the effect of implementing project management tools and techniques in Sudanese construction performance. In this study , a project performance model will be developed, which can provide some suggestions and method for measuring the performance in Sudanese construction firms. In order to make the project performance model applicable and reliable, the researcher is going the investigate project performance issues

in Sudanese construction firms. On bases from this situation, it is appreciated that relevant Sudanese organizations could cooperate with him.

3.7.2 Description of the respondent firms :

3.7.2.1 Respondents :

The respondent ages ranged from 28 to 55 years old, and have an average age of 39.78. The respondent educational level is listed in table (3-1).

Table (3-1) The education levels of the respondents.

level of education	Percentage
Graduate	40.40%
Post graduate	59.60%

3.7.2.2. Respondents experience :

(3-2) Experience in company

Valid	51
Missing	2
Std. Deviation	1.153

(3-3) Experience in company

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 1 Year	1	1.9	2.0	2.0
		10	18.9	19.6	21.6
		18	34.0	35.3	56.9
	11-15	12	22.6	23.5	80.4
	16-20	8	15.1	15.7	96.1
	> 20 Year	2	3.8	3.9	100.0

	Total	**51**	**96.2**	**100.0**	
Missing	System	2	3.8		
Total		**53**	**100.0**		

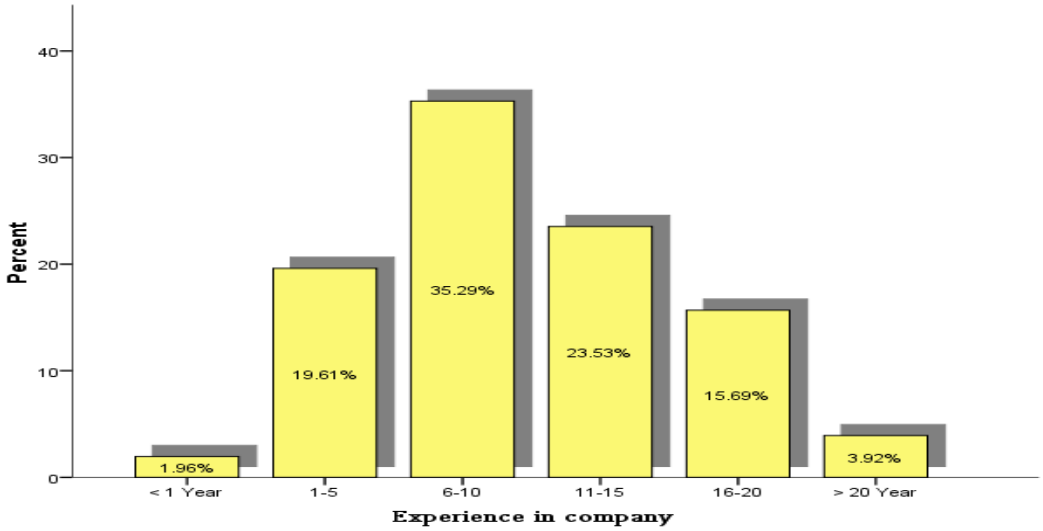

Figure (3-1) Experience in company

3.7.2.3 Respondent firms :

Out the 70 construction firms, 50 were large-sized, and 20 medium-sized. The current number of employees working in these sampled firms ranged from 25 engineers to 40. On average, each firms employed 200 employees. The annual turnover of the firms ranged from SDG 80 to 100 million. On average, annual turnover were SDG 70 million. Of the firms that responded, 17 were losing money, 20 were breaking even, and 10 were making a profit.

3.8 Summary :

The research strategies adopted in this study can be characterized as approaches of qualitative investigations (a literature review) and quantitative (a questionnaire survey). The research questionnaire was highly dependent on the concepts of theoretical constructs. Firstly, the English version questionnaire was 72 items which was translated into Arabic which was distributed to 5 persons who have professional knowledge in the field of

construction management and worked in different Sudanese construction firms. After the reliability analysis, item analysis, and validity analysis had been conducted, it was concluded that project performance instrument is reliable and valid. The reason for this is that the researcher used the analyzing methodology, but other researcher didn't used the analyzing methodology for testing and validating their instruments so, they were not reliability and validity, so the questionnaire of this study can be distributed for collecting data. The research samples were form Khartoum state firm, so the 70 firms were randomly selected, and the questionnaires distributed to the target firms. Finally, 55 questionnaires were returned. The response rate was 78%.

CHAPTER FOUR

ANALYSIS AND DISCUSSION

4.1 Introduction

The collected data have been tabulated processed and analyzed byusing SPSS program to generate the results which interpreted and used for further discussion regarding the theoretical part.

4.2 Data analysis :

The collected data had been analyzed in two scales as a follows :

Scale 1: Evaluation of Projects Performance in Company

4.2.1.Scope Management

Table (4-1) Statistics of scope management

		We have a section that defines the scopes the project before starting the project	We examine the expectations and requirements of the client before starting the project	We divide the tasks on the team before the start of the project
N	**Valid**	53	53	52
	Missing	0	0	1
Mean		3.43	3.42	3.60
Std. Deviation		1.217	1.134	1.225

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-2) scope management

	N	Mean	Std. Deviation	Attitude
We have a section that defines the scopes the project before starting the project	53	3.43	1.217	High Agree
We examine the expectations and requirements of the client before starting the project	53	3.42	1.134	High Agree
We divide the tasks on the team before the start of the project	52	3.60	1.225	High Agree
Scope Management	**53**	**3.4874**	**1.06008**	**High Agree**

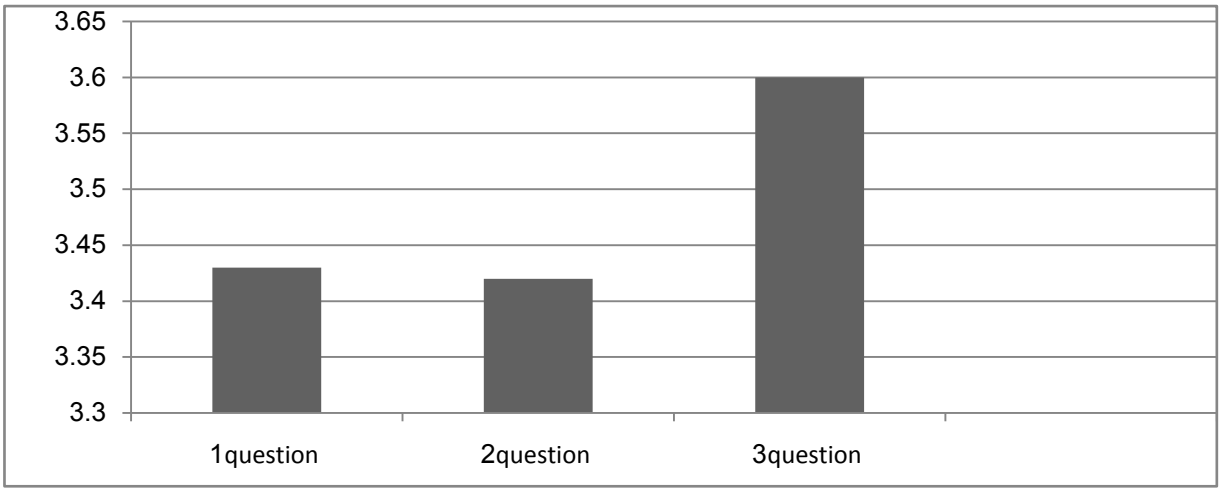

Figure (4-1) scope management

1. With respect to the topic "scope management" and the respondents answers, The analyses show the mean of 3.474, which is greater than the main average(3) which concludes that most firms defines the scopes of project, examine the expectations and requirements of the client before starting the project and divide the tasks on the team.

4.2.2. Time Management

Table (4-3) Statistics time management

		We set a timetable for the end of the project	We have sufficient knowledge to determine the time of each project activity	End of the project within the specified time has	Specifies penalties on failure to end the project on time
N	Valid	53	52	53	51
	Missing	0	1	0	2
Mean		3.79	3.46	2.91	3.43
Std. Deviation		1.246	1.212	1.445	1.473

Descriptive Statistics
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-4) time management

	N	Mean	Std. Deviation	Attitude
We set a timetable for the end of the project	53	3.79	1.246	High Agree
We have sufficient knowledge to determine the time of each project activity	52	3.46	1.212	High Agree
End of the project within the specified time has	53	2.91	1.445	Neutral
Specifies penalties on failure to end the project on time	51	3.43	1.473	High Agree
Time Management	**53**	**3.4088**	**1.11412**	**High Agree**

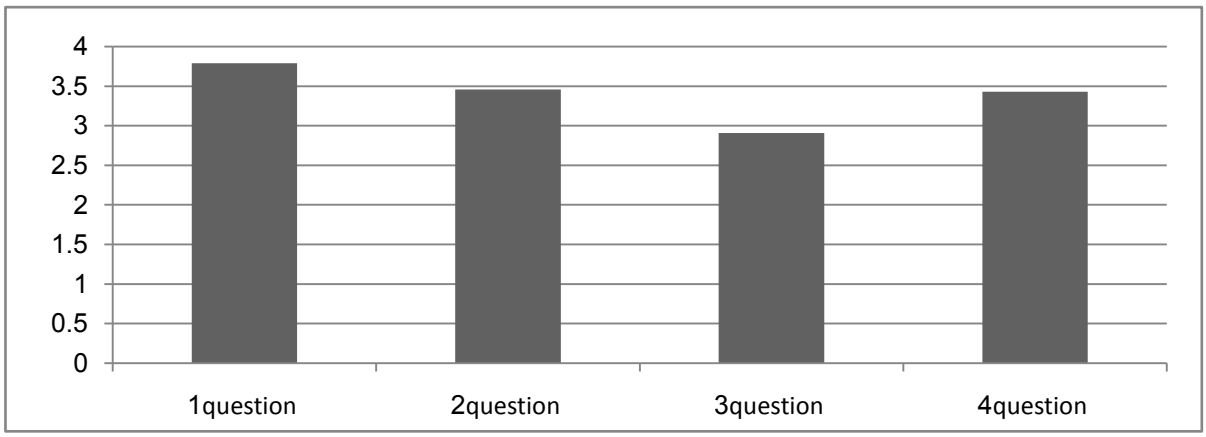

Figure (4-2) time management

1. With respect to the topic "TimeManagement" and the respondents answers, the analyses show the mean of 3.7, 3.4, 3.4, which is greater than the mean average(3) which concludes that most firmsrespondents set a time table, determine the time of each activity, and Specifies penalties on failure to end the project on time.
2. Regarding the Ending of the project within the specified time the analysis show the mean of 2.91, which is less than the mean average (3), which indicates the respondents didn't end of the project within the specified time.

4.2.3.Cost Management

Table (4-5) Statistics cost management

		We estimate the cost of an initial detailed project activities until his extradition	End of the project within the specified cost him	The company is studying the possibility of financial advances to customers before the tender	We have a plan to reduce wasted material
N	Valid	53	53	53	51
	Missing	0	0	0	2
Mean		3.40	3.08	3.40	3.35
Std. Deviation		1.132	1.284	1.149	1.092

Descriptive Statistics
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-6) cost management

	N	Mean	Std. Deviation	Attitude
We estimate the cost of an initial detailed project activities until his extradition	53	3.40	1.132	High Agree
End of the project within the specified cost him	53	3.08	1.284	Neutral
The company is studying the possibility of financial advances to customers before the tender	53	3.40	1.149	High Agree
We have a plan to reduce wasted material	51	3.35	1.092	Neutral
Cost Management	**53**	**3.3050**	**.86478**	**Neutral**

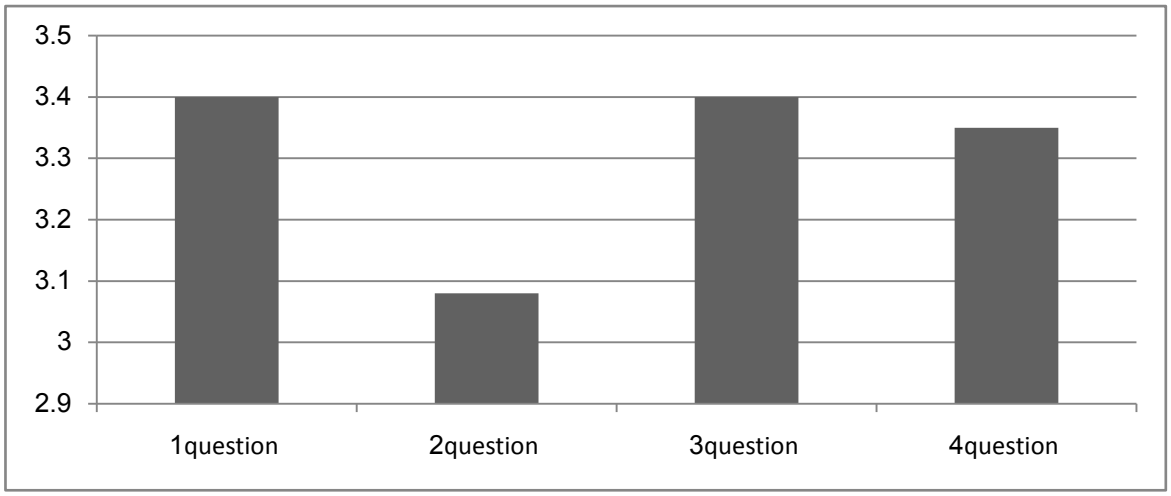

figure (4-3) cost management

1. With respect to the topic "CostManagement" and the respondents answers, the analyses show the mean of 3.4, 3.4, which is greater than the mean average(3) which concludes that most firmsrespondents had professional personnel to estimate the cost of project, and study the possibility of financial for customers.
2. the analysis show the mean of 3.08, 3.35, which is closed to the mean average (3), which indicates the respondents do not mostly end the project within the specified cost, and do not mostly do plan to reduce wasted materials, which lead to delay.

4.2.4.Quality Management

Table (4-7) Statistics quality management

		We provide quality manual within the tender documents	Keep up with technological advances of the mechanisms used in the project	Have submitted bids for the project on the technical specifications complete a comprehensive quality	Our department is interested in quality management in project
N	Valid	52	52	53	52
	Missing	1	1	0	1
Mean		3.15	3.58	3.377	3.27
Std. Deviation		1.258	1.210	1.2592	1.345

Descriptive Statistics
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-8) quality management

	N	Mean	Std. Deviation	Attitude
We provide quality manual within the tender documents	52	3.15	1.258	Neutral
Keep up with technological advances of the mechanisms used in the project	52	3.58	1.210	High Agree
Have submitted bids for the project on the technical specifications complete a comprehensive quality	53	3.377	1.2592	Neutral
Our department is interested in quality management in project	52	3.27	1.345	Neutral
Quality Management	**53**	**3.3428**	**1.00568**	**Neutral**

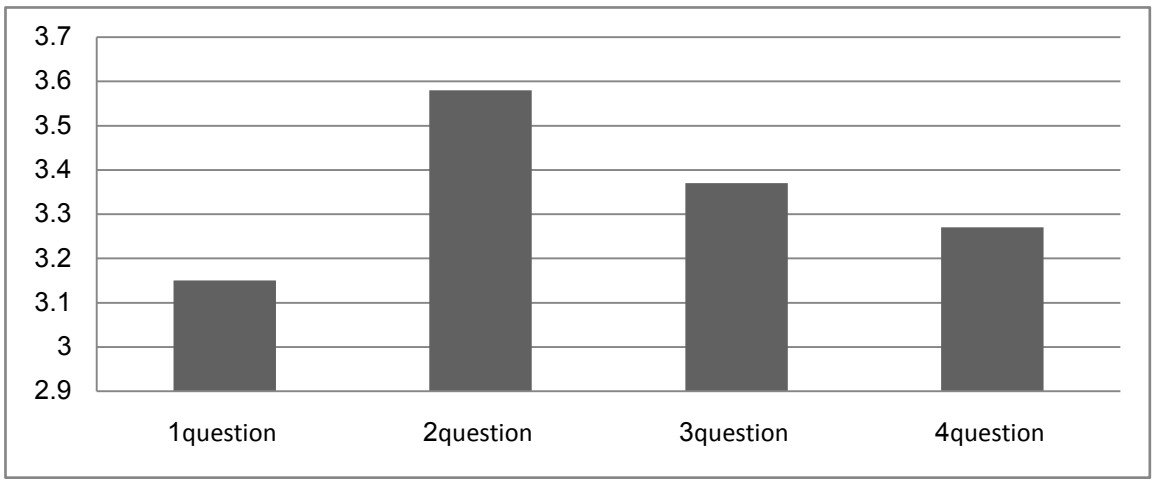

Figure (4-4) quality management

1. With respect to the topic "QualityManagement" and the respondents answers, the analyses show the mean of 3.58, which is greater than the mean average(3) which concludes that most of the firmsresponds that they had professional personnel to keep up the technological advances in the project.

2. the analysis show the mean of 3.1, 3.37, 3.2, which is near to the mean average (3), which indicates the respondents do not aware of quality manual benefit, the respondents do not mostly do the technical specifications submitted, and didn't have department for quality management in project, which may lead to project risk.

4.2.5. Human Resources Management

Table (4-9) Statistics human resources management

		The company's administrative organization arbitrator for each project activity	We have skilled workers to implement projects	Our policies are clear and easy ways to deal with the staff to perform the tasks	There administration dedicated to each project alone
N	Valid	53	53	53	53
	Missing	0	0	0	0
	Mean	3.51	3.64	3.25	2.92
	Std. Deviation	1.368	1.242	1.357	1.342

	We have a system of training and development for employees	We have a system of incentives for employees linked to their production	Of the company's employees and the absolute loyalty towards
N Valid	53	53	53
Missing	0	0	0
Mean	2.83	2.83	3.02
Std. Deviation	1.369	1.297	1.278

Descriptive Statistics
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-10) human resources management

	N	Mean	Std. Deviation	Attitude
The company's administrative organization arbitrator for each project activity	53	3.51	1.368	**High Agree**
We have skilled workers to implement projects	53	3.64	1.242	**High Agree**
Our policies are clear and easy ways to deal with the staff to perform the tasks	53	3.25	1.357	**Neutral**
There administration dedicated to each project alone	53	2.92	1.342	**Neutral**
We have a system of training and development for employees	53	2.83	1.369	**Neutral**
We have a system of incentives for employees linked to their production	53	2.83	1.297	**Neutral**
Of the company's employees and the absolute loyalty towards	53	3.02	1.278	**Neutral**
Human Resources Management	**53**	**3.1429**	**.99646**	**Neutral**

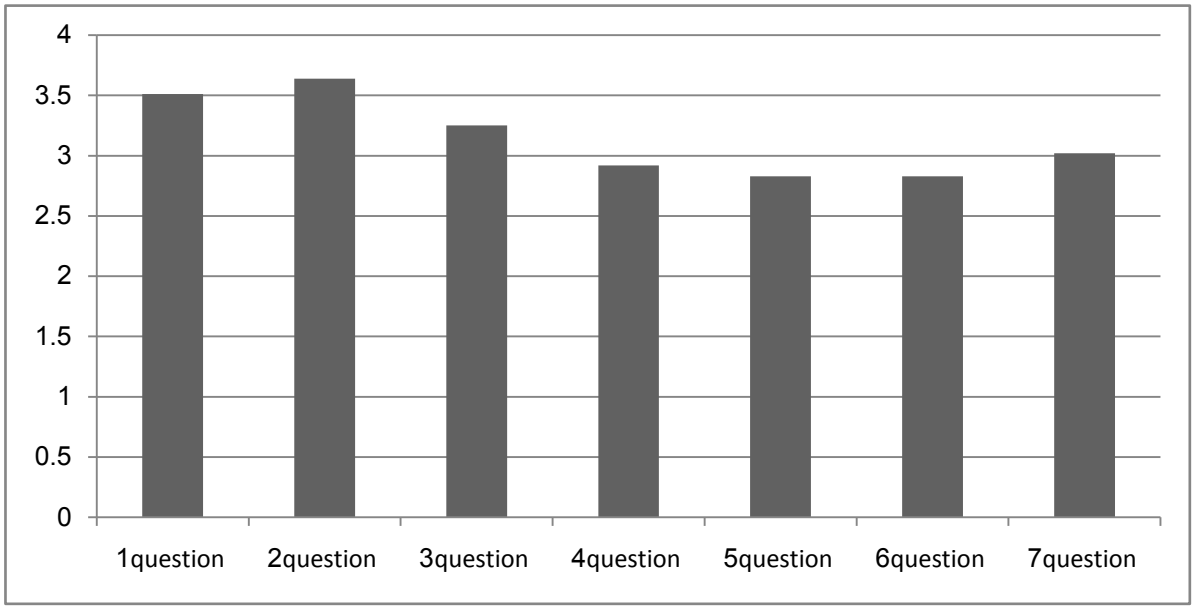

Figure (4-5) human resources management

1. With respect to the topic "Human ResourcesManagement" and the respondents answers, the analyses show the mean of 3.51, 3.64, which is greater than the mean average(3) which concludes that the most of the firmsrespondents that they had professional personnel administrative arbitrator for each project activity, and the respondent have skilled workers.

2. the analysis show the mean of 3.2, 2.92, 2.83, 2.83, 3.01, which is near to and less than the mean average (3), which indicates the respondents do not aware of policies to deal with staff, system of training, system of incentives, loyalty benefit,

4.2.6. Communication Management

Table (4-11) Statistics communication management

		There is a clear connection between members of the same project, and between them and the administration	We work planned for the site and motion paths and places of storage, security and services	The company's plan of communication between the parties to the contract (the owner and the contractor and consultant) before execution
N	Valid	53	53	53
	Missing	0	0	0
	Mean	3.45	3.34	3.58
	Std. Deviation	1.202	1.255	1.216

		We use modern media to communicate and connect (Cameras Site, the Internet and multimedia)	We hold weekly meetings to discuss the progress of the project performance
N	Valid	53	53
	Missing	0	0
	Mean	3.11	3.57
	Std. Deviation	1.219	1.294

Descriptive Statistics
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-12) communication management

	N	Mean	Std. Deviation	Attitude
There is a clear connection between members of the same project, and between them and the administration	53	3.45	1.202	**High Agree**
We work planned for the site and motion paths and places of storage, security and services	53	3.34	1.255	**Neutral**
The company's plan of communication between the parties to the contract (the owner and the contractor and consultant) before execution	53	3.58	1.216	**High Agree**
We use modern media to communicate and connect (Cameras Site, the Internet and multimedia)	53	3.11	1.219	**Neutral**
We hold weekly meetings to discuss the progress of the project performance	53	3.57	1.294	**High Agree**
Communication Management	**53**	**3.4113**	**.89478**	**High Agree**

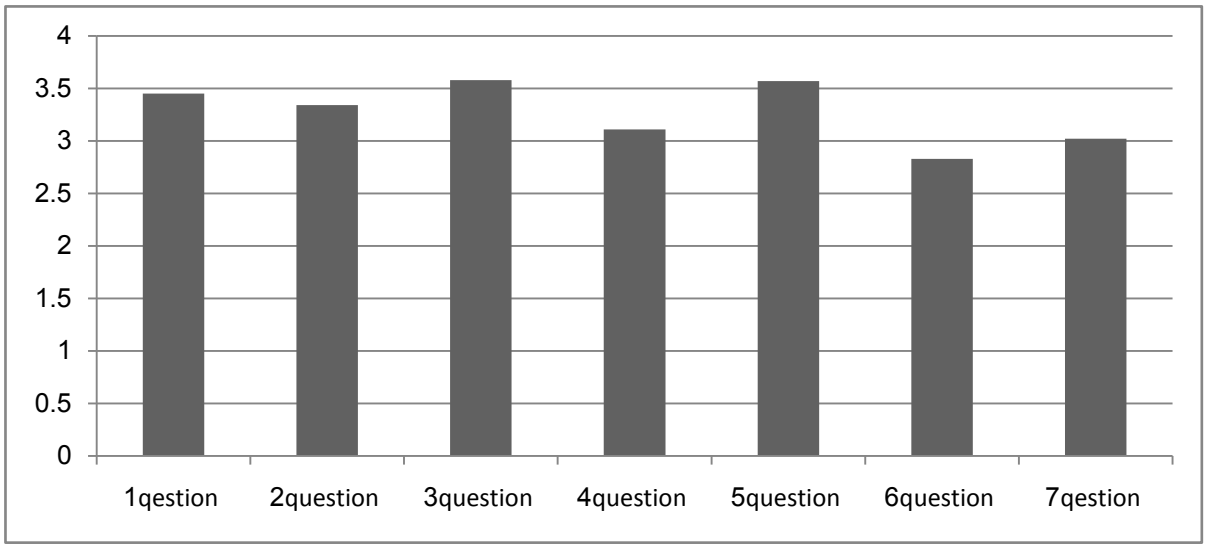

Figure (4-6) communication management

1. With respect to the topic "CommunicationManagement" and the respondents answers, the analyses show the mean of 3.45, 3.58, 3.57, which is greater than the mean average(3) which concludes that most of the firmsrespondents that they had clear connection between members, the respondents had plan of communication between the parties of contract, and discuss to the progress of project performance.

2. the analysis show the mean of 3.3, 3.1, which is near to the mean average (3), which indicates the respondents do not do plan for the site motion. And do not aware of modern media to communicate and connect benefit.

4.2.7. Risk Management

Table (4-13) Statistics of risk management

		We have plans to manage risks	We have weekly meetings to discuss the risks at the site	We have a dedicated budget for risk management project	We have qualified engineers identify the risks facing the project, which will
N	Valid	52	53	53	53
	Missing	1	0	0	0
	Mean	3.06	3.11	3.06	3.00
	Std. Deviation	1.274	1.325	1.292	1.240

Descriptive Statistics
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-14) risk management

	N	Mean	Std. Deviation	Attitude
We have plans to manage risks	52	3.06	1.274	**Neutral**
We have weekly meetings to discuss the risks at the site	53	3.11	1.325	**Neutral**
We have a dedicated budget for risk management project	53	3.06	1.292	**Neutral**
We have qualified engineers identify the risks facing the project, which will	53	3.00	1.240	**Neutral**
Risk Management	**53**	**3.0597**	**1.13409**	**Neutral**

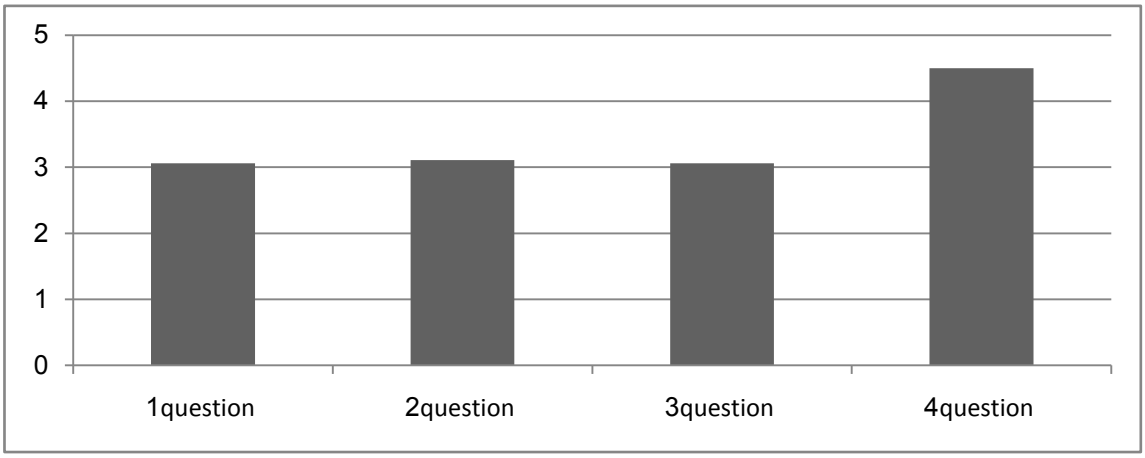

Figure (4-7) risk management

Regarding to the topic "RiskManagement" and the respondents answers, the analyses show the mean of 3.06, 3.11, 3.06, 3.00, which is near to the mean average (3), which indicates that this may conclude that there is no plans to manage risks, no weekly meetings, no dedicated budget for risk, and no qualified engineers identify the risks, so the performance of the project will be poor with respect to international firms.

4.2.8. Procurement Management

Table (4-15) Statistics procurement management

		We use modern storage methods and materials suitable on-site	We have a plan to supply the various sites materials required for the implementation of	Our technical staff controls the process control of materials on-site customized to get the job done
N	Valid	53	53	53
	Missing	0	0	0
	Mean	3.13	3.36	3.11
	Std. Deviation	1.241	1.210	1.187

		We have an elaborate system for the management of material at the site	Always reserve minimum to store materials used on site
N	Valid	53	53
	Missing	0	0
	Mean	3.47	3.17
	Std. Deviation	1.339	1.490

Descriptive Statistics
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Disagree
From 1.80 to 2.59	Disagree
From 2.60 to 3.39	Neutral
From 3.40 to 4.19	High Agree
From 4.20 to 5.00	Very High Agree

Table (4-16) procurement management

	N	Mean	Std. Deviation	**Attitude**
We use modern storage methods and materials suitable on-site	53	3.13	1.241	**Neutral**
We have a plan to supply the various sites materials required for the implementation of	53	3.36	1.210	**Neutral**
Our technical staff controls the process control of materials on-site customized to get the job done	53	3.11	1.187	**Neutral**
We have an elaborate system for the management of material at the site	53	3.47	1.339	**High Agree**
Always reserve minimum to store materials used on site	53	3.17	1.490	**Neutral**
Procurement Management	**53**	**3.2491**	**1.03842**	**Neutral**

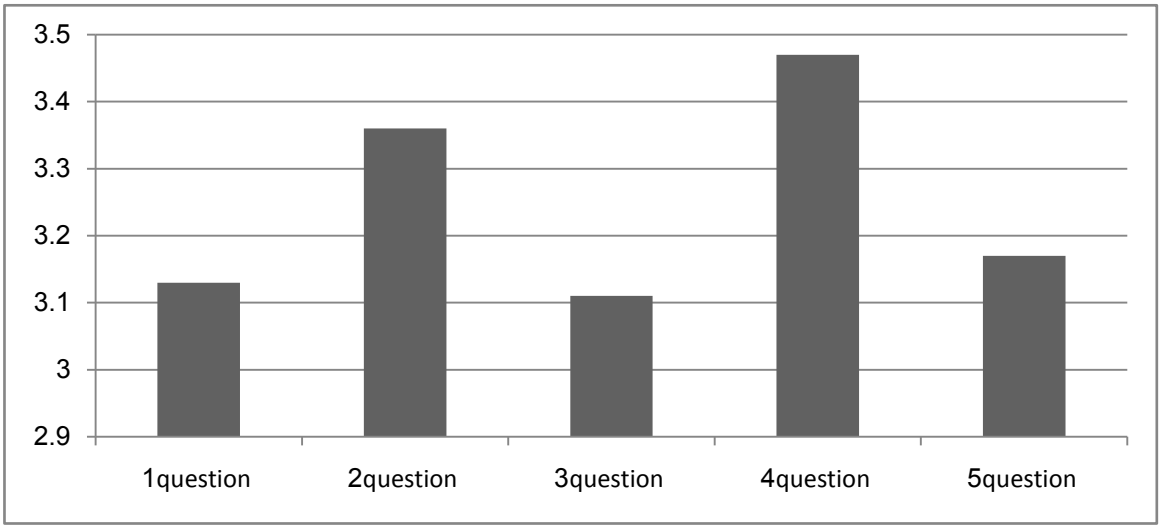

Figure (4-8) procurment managmenet

1. With respect to the topic "ProcurementManagement" and the respondents answers, the analyses show the mean of 3.47, which is

greater than the mean average(3) which concludes that most of the firmsrespondents had an elaborate system for the management of material at site, so they study is carefully.

2. the analysis show the mean of 3.13, 3.36, 3.11, 3.17, which is near to the mean average (3), which indicates the respondents do not use storage methods, do not have a plan to supply the various sites materials required, didn't have technical staff controls the process, and didn't always reserve minimum to store materials used on site, this issue may lead to many obstacles which may result to poor performance.

4.3 summary :

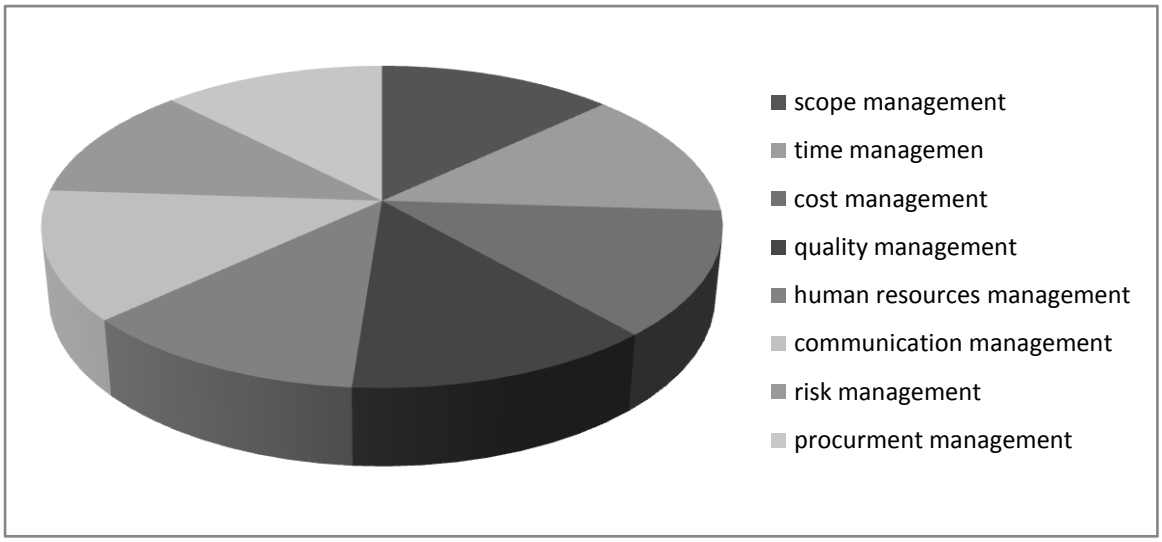

Figure (4-9) tools and techniques of project management

with respect to the "Tools and Techniques of project management" the respondents were answering, the analyses show the mean of 3.3008, which isnear to the mean average (3), which indicates that this may conclude that there is poor performance for the project because the construction firms has not enough knowledge to implement tools and techniques of project management.

4.4 Scale 2 : Application of tools and techniques through the nine knowledge area :

4.4.1 Project Scope Management:

1. When collecting customer requirement for the project our company uses the tools and techniques such as:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-17) collecting customer requirement

1.	N	Mean	Std. Deviation	Attitude
Interviews	53	1.60	.840	**Very Important**
Focus groups	53	2.58	.989	**Important**
Facilitated workshops	53	2.66	1.018	**Not Used**
Questionnaires and surveys	52	2.77	1.096	**Not Used**
Observations	52	2.79	1.143	**Not Used**
Group creativity techniques (brainstorming, Delphi technique, nominal technique)	52	2.92	1.169	**Not Used**
when collecting customer requirement for the project our company uses the tools and techniques such as	**53**	**2.5440**	**.85181**	**Important**
Valid N	52			

1. With respect to the question of "collecting customer requirements" the respondents were asked about Interviews and Focus groups, from their answers, the analyses show the mean of 1.60, which is less than the mean average, (3) and thatconcludes the most of the interviewed firms responded they use Interviews and Focus groups to collect customer requirement,so they adopt such tools and techniques.
2. the analysis show that the facilitated workshops, questionnaires and surveys, group creativity techniques have means of 2.66, 2.77, 2.79, 2.92, respectively which is near to the mean average (3), which

indicates that the respondents do not use these tools because they have no enough knowledge of important and benefit.

2. When Defining Scope for the project the tools and techniques uses are:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-18) Defining Scope

2.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Expert judgment	52	2.06	1.056	**Important**
Product analysis	52	2.50	1.163	**Important**
Alternatives identification	53	2.49	1.219	**Important**
When Defining Scope for the project the tools and techniques uses are :	**53**	**2.3459**	**1.04588**	**Important**
Valid N	52			

With respect to the question of "define scope" the respondents were asked about expert judgment, Product analysis, and Alternatives identification, from their answers, the analyses shows the mean of 2.06, 2.50, 2.49, respectively which is less than the mean average(3) and that concludes the most of the interviewed firms responded they use this tools to define scopeso they study is carefully and improve their performance.

3. When Creating WBS for the project the tools and techniques use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-19) Creating WBS

3.	N	Mean	Std. Deviation	Attitude
Decomposition	52	2.19	1.253	**Important**
Reference measurement	50	2.78	1.250	**Not Used**
Al-kouta system	48	2.79	1.071	**Not Used**
When Creating WBS for the project the tools and techniques use :	**53**	**2.5409**	**1.00687**	**Important**
Valid N (listwise)	47			

1. With respect to the question of "Creating WBS" the respondents were asked about decomposition, from their answers, the analyses show the main of 2.19, which is less than the mean average (3) and that concludes the most firms ofrespondents use this tools to creating WBSso they adopt such tools and techniques and improve their performance.
2. the analysis show that the Reference measurement, Al-kouta system, the mean of 2.78, 2.79, which is near to the mean average (3), which indicates the respondents do not use this tools because do not enough knowledge to important and benefit.

4. When Verifying Scope for the project use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-20) Verifying Scope

4.	N	Mean	Std. Deviation	Attitude
Inspection	52	2.13	1.010	**Important**
Control	53	2.21	1.063	**Important**
Orientation	52	2.29	1.194	**Important**

When Verifying Scope for the project use :	53	2.2075	1.01322	**Important**
Valid N	52			

With respect to the question of "Verifying scope" the respondents were asked about Inspection, Control, Orientation, from their answers, the analyses shows the mean of 2.13, 2.21, 2.29 respectively which is less than the mean average(3) and that concludes the most firmsrespondents use this tools to verifying scopeso they adopt such tools and techniques and improve their performance.

5. When Controlling Scope for the project use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table(4-21) Controlling Scope

5.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Variance analysis	52	2.48	1.057	**Important**
calculation analysis	53	2.42	1.008	**Important**
Structure analysis	52	2.60	1.071	**Not Used**
When Controlling Scope for the project use :	**53**	**2.4906**	**.91662**	**Important**
Valid N	52			

1. With respect to the question of "Controlling scope" the respondents were asked about variance analysis, calculation analysis, from their answers, the analyses show the mean of 2.48, 2.42, which is less than the mean average (3) which concludes the most of the interviewed firmsresponded they use this tools to controlling scopeso they adopt such tools and improve their performance.
2. the analysis show the reference measurement, structure analysis, the mean of 2.60, which is near than the mean average (3), which indicates the respondents do not use this tools because they have no enough knowledge to important and benefit.

4.4.2 Project Time Management:

1. In your company when Defining Activities the projects use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-22) Defining Activities

2.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Rolling wave planning,	52	1.63	.971	**Very Important**
Templates	52	1.88	.943	**Important**
General Computer Program	53	2.49	1.154	**Important**
In your company When Defining Activities the project use :	**53**	**2.0063**	**.85857**	**Important**
Valid N	52			

With respect to the question of "Defining activities" the respondents were asked about rolling wave planning, templates, general computer programfrom their answers, the analyses show the mean of 1.63, 1.88, 2.49 which is less than the mean average(3) and that concludes the most firmsrespondents use this tools to defining activitiesso they adopt such tools and improve their performance.

2. When Sequencing Activities the project tools and techniques use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-23) Sequencing Activities

2.	N	Mean	Std. Deviation	Attitude
Precedence diagramming method (PDM)	52	2.19	1.172	**Important**
Dependency determination,	52	2.54	1.111	**Important**
Applying leads and lags	53	2.42	1.151	**Important**
Schedule network templates	52	2.52	1.229	**Important**
When Sequencing Activities the project tools and techniques use :	**53**	**2.4104**	**1.01087**	**Important**
Valid N	52			

With respect to the question of "Sequencing activities" the respondents were asked about precedence diagramming method (PDM), dependency determination, Applying leads and lags, Schedule network templates, from their answers, the analyses shows the mean of 2.19, 2.54, 2.42, 2.52 respectively which is less than the mean average(3) and that concludes the most firmsrespondents use this tools to sequencing activitiesso they adopt such tools and improve their performance.

3. When Estimating Activity resource of the project our staff uses:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-24) Estimating Activity

3.	N	Mean	Std. Deviation	Attitude
Resources Alternatives analysis	51	2.20	1.040	**Important**
Published estimating data,	50	2.24	1.021	**Important**
Bottom-up estimating,	52	2.62	.953	**Not Used**
Project management software	52	2.25	1.046	**Important**

When Estimating Activity resource of the project our staff use :	**53**	**2.3223**	**.77729**	**Important**
Valid N	49			

1. With respect to the question of "Estimating activities" the respondents were asked about resources alternatives analysis, published estimating data, project management software, from their answers, the analyses shows the mean of 2.20, 2.24, 2.25 which is less than the mean average(3) which concludes that the most firmsrespondents use these tools to estimating activitiesso they adopt such tools and improve their performance.

2. the analysis show that the Bottom-up estimating, the mean of 2.62, which is near to the mean average (3), which indicates the respondents do not use these tools because they have no enough knowledge to important and benefit.

4. In order to Estimate Activity durations the staff will use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-25) Estimate project Cost

4.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Durations Analogous estimating	52	2.52	1.057	**Important**
Parametric estimating	52	2.65	1.153	**Not Used**
Bottom-up estimating	53	2.55	.889	**Important**
Project management estimating software	52	1.83	1.024	**Important**
Vendor bid analysis	49	2.27	1.319	**Important**
In order to Estimate project Cost which tools and techniques you use:	**53**	**2.3585**	**.86027**	**Important**
Valid N	49			

1. With respect to the question of "Estimate project cost" the respondents were asked about durations analogous estimating, bottom-

up estimating, project management estimating software, vendor bid analysisfrom their answers, the analyses show the mean of 2.52, 2.55, 1.83, 2.27 respectively, which is less than the mean average (3) which concludes the most firmsrespondents they use these tools to estimating project costso they adopt such tools and improve their performance.
2. the analysis show that the Parametric estimating, the mean of 2.65, which is near than the mean average (3), which indicates the respondents didn't use these tools because they have no enough knowledge to important and benefit.

5. For Developing project Schedule the tools and techniques use are:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-26) Developing project Schedule

5.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Critical path method	53	2.19	1.075	**Important**
Critical chain method	52	2.38	1.051	**Important**
Resource leveling	52	2.67	1.024	**Not Used**
Schedule compression	52	2.48	1.075	**Important**
For Developing project Schedule the tools and techniques use are :	**53**	**2.4245**	**.83721**	**Important**
Valid N	52			

1. With respect to the question of "Developing project schedule" the respondents were asked about critical path method, critical chain method, schedule compression, from their answers, the analyses show the mean of 219, 2.38, 2.48, which is less than the mean average(3) which concludes the most firmsrespondents they use these tools to developing project scheduleso they adopt such tools and improve their performance.
2. the analysis show that the resource leveling, the mean of 2.67, which is near to the mean average (3), which indicates the respondents do not

use these tools because they have no enough knowledge to important and benefit.

6. For Schedule control the tools and techniques use are:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-27) Schedule control

6.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Performance reviews	52	1.67	1.004	**Very Important**
Variance analysis	52	1.88	.758	**Important**
Schedule compression	53	2.43	1.135	**Important**
Scheduling tool	45	2.58	.941	**Important**
For Schedule control the tools and techniques use are :	**53**	**2.1336**	**.71019**	**Important**
Valid N	45			

With respect to the question of "Schedule control" the respondents were asked about performance reviews, variance analysis, schedule compression, scheduling toolfrom their answers, the analyses shows the mean of 1.67, 1.88, 2.43, 2.58 which is less than the mean average (3) which concludes the most firmsrespondents use these tools to schedule controlso they adopt such tools and improve their performance.

4.4.3 Project Cost Management:

1. In order to Estimate project Cost which tools and techniques you use

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important

From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-28) Estimate project Cost

1.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Analogous estimating	52	2.52	1.057	**Important**
Parametric estimating	52	2.65	1.153	**Not Used**
Bottom-up estimating	53	2.55	.889	**Important**
Project management estimating software	52	1.83	1.024	**Important**
Vendor bid analysis	49	2.27	1.319	**Important**
In order to Estimate project Cost which tools and techniques you use:	**53**	**2.3585**	**.86027**	**Important**
Valid N	49			

1. With respect to the question of "Estimate project cost" the respondents were asked about Analogous estimating, bottom-up estimating, project management estimating software, vendor bid analysisfrom their answers, the analyses show the mean of 219, 2.38, 2.48, which is less than the mean average(3) which concludes the most firmsrespondents they use these tools to estimate project costso they adopt such tools and improve their performance.

2. the analysis show the Parametric estimating, the mean of 2.65, which is near to the mean average (3), which indicates that the respondents do not use these tools because they have no enough knowledge to important and benefit.

2. When you determining Budget of the project which method you use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-29) Determining Budget

2.	N	Mean	Std. Deviation	Attitude
Cost aggregation	52	2.21	1.210	**Important**
Historical relationships	52	2.38	1.157	**Important**
estimation cost	53	2.21	1.199	**Important**
When you Determining Budget of the project which method you use :	**53**	**2.2642**	**1.06890**	**Important**
Valid N	52			

With respect to the question of "Determining budget of the project" the respondents were asked about cost aggregation, bottom-up estimating, historical relationships, estimation cost, from their answers, the analyses show the mean of 2.21, 2.38, 2.21, which is less than the mean average(3) which concludes the most firmsrespondents they use this tools to determining budget of the projectso they adopt such tools and improve their performance.

3. When Controlling Costs of the project our staff use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-30) Controlling Costs

3.	N	Mean	Std. Deviation	Attitude
Earned value management	52	2.17	1.150	**Important**
To-complete performance index (TCPI)	51	2.33	1.125	**Important**
Performance reviews	53	2.06	1.064	**Important**
When Controlling Costs of the project our staff use :	**53**	**2.1761**	**.94869**	**Important**
Valid N	51			

With respect to the question of "Controlling cost of the project" the respondents were asked about Earned value management, To-complete

performance index (TCPI), Performance reviews, from their answers, the analyses show the mean of 2.17, 2.33, 2.06, which is less than the mean average(3) which concludes that the most firmsrespondents they use this tools to controlling cost of the projectso they study is carefully and improve their performance.

4.4.4 Project Quality Management

1. Which tools and techniques you use when plan for quality?

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-31) plan for quality

1.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Cost-benefit analysis	53	1.96	1.143	**Important**
Control charts	52	2.13	1.138	**Important**
Statistical sampling	52	2.37	1.085	**Important**
Flowcharting	52	2.27	1.239	**Important**
Which tools and techniques you use when plan for quality :	**53**	**2.1792**	**1.03122**	**Important**
Valid N	52			

With respect to the question of "plan for quality" the respondents were asked about Cost-benefit analysis, control charts, statistical sampling, flowcharting, from their answers, the analyses show the mean of 1.196, 2.13, 2.37, 2.27, respectively which is less than the mean average(3) which concludes the most firms ofrespondents use this tools to plan for quality of the projectso they adopt such tools and improve their performance.

2. When Performing Quality Assurance of the project our engineers use

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-32) Performing Quality Assurance

2.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Quality audits	52	2.29	1.035	**Important**
Process analysis	53	2.68	.976	**Important**
When Performing Quality Assurance of the project our engineers use	**53**	**2.4811**	**.89315**	**Important**
Valid N	52			

With respect to the question of "performing quality assurance" the respondents were asked about Quality audits, Process analysis, from their answers, the analyses shows the mean of, 2.29, 2.68, which is less than the mean average (3) which concludes the most firmsrespondents use this tools to performing quality assurance of the projectso they adopt such tools and improve their performance.

3. In your company when Performing Quality Control the project tools and techniques use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-33) Performing Quality Control

3.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Histogram	52	2.50	1.129	**Important**
Pareto chart	52	2.73	1.050	**Not Used**
Run chart	52	2.71	1.073	**Not Used**

Inspection	53	2.21	1.183	**Important**
In your company When Performing Quality Control the project tools and techniques use:	**53**	**2.5283**	**.86833**	**Important**
Valid N	52			

1. With respect to the question of " When Performing Quality Control " the respondents were asked about histogram, inspection, from their answers, the analyses show the mean of 2.50, 2.21, which is less than the mean average(3) which concludes the most firmsrespondents use this tools to Performing Quality Controlso they adopt such tools and improve their performance.
2. the analysis show that the pareto chart, run chart, the mean of 2.73, 2.71 which is near to the mean average (3), which indicates the respondents do not use this tools because they have no enough knowledge to important and benefit.

4.4.5.Project Human Resources Management:

1. If you manager asking you to develop human resources planning for the project you use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-34) Develop Human Resources Planning

1.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Organization charts and position descriptions	52	2.33	.810	**Important**
Networking	52	2.15	.894	**Important**

Organizational theory	53	2.42	1.064	**Important**
If you manager asking you to develop human resources planning for the project you use:	**53**	**2.2956**	**.83630**	**Important**
Valid N	52			

With respect to the question of " develop human resources planning" the respondents were asked about organization charts and position descriptions, networking, organizational theory, from their answers, the analyses show that the mean of 2.33, 2.15, 2.24 which is less than the mean average(3) which concludes the most firmsrespondents use this tools to develop human resources planning so they adopt such tools and improve their performance

2. In your company When Acquiring Project Team of the project use :

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-35) Acquiring Project Team

2.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Pre-assignment	53	2.13	1.038	**Important**
Negotiation	52	2.23	1.002	**Important**
Advertisement	52	2.33	.944	**Important**
In your company When Acquiring Project Team of the project use :	**53**	**2.2264**	**.81328**	**Important**
Valid N	52			

With respect to the question of " Acquiring Project Team " the respondents were asked aboutpre-assignment, pre-assignment, advertisement, from their answers, the analyses show the mean of 2.13,

2.23, 2.33 which is less than the mean average (3) and that concludes the most firms respondents use this tools to Acquiring Project Team so they adopt such tools and improve their performance

3. In your company When Developing Project Team of the project use

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-36) Developing Project Team

3.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Interpersonal skill	52	2.15	1.055	**Important**
Training	52	2.37	.950	**Important**
Team-building activities	52	2.46	.939	**Important**
Recognition and rewards	52	2.29	1.035	**Important**
In your company When Developing Project Team of the project use :	**53**	**2.3082**	**.84108**	**Important**
Valid N	51			

With respect to the question of " Developing Project Team " the respondents were asked aboutinterpersonal skill, pre-assignment, training, team-building activities, recognition and rewards, from their answers, the analyses show the mean of 2.15, 2.37, 2.46, 2.29, respectively which is less than the mean average (3) and that concludes the most firms respondents use this tools to Developing Project Team so they study is carefully and improve their performance

4. In your company When Managing Project Team of the project use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-37) Managing Project Team

4.	N	Mean	Std. Deviation	Attitude
Observation and conversation	53	2.34	1.055	**Important**
Project performance appraisals	52	2.46	1.093	**Important**
Conflict management	52	2.56	1.145	**Important**
Issue log	52	2.35	.947	**Important**
In your company When Managing Project Team of the project use :	**53**	**2.4198**	**.89975**	**Important**
Valid N	52			

With respect to the question of " Managing Project Team " the respondents were asked aboutobservation and conversation, project performance appraisals, conflict management, issue log, from their answers, the analyses show the mean of 2.34, 2.46, 2.56, 2.35, which is less than the mean average (3) and that concludes the most firms respondents use this tools to Managing Project Team so they study is carefully and improve their performance

4.4.6 Project Communication Management:

1. The stakeholders are those of affect on the project or affected by project, they can be identified by many methods which of the following you use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-38) stakeholders are those of affect on the project

1.	N	Mean	Std. Deviation	Attitude

Stakeholder analysis,	52	2.27	.992	**Important**
Expert judgment	52	2.33	.901	**Important**
variance analysis	19	2.37	.684	**Important**
Flowchart	52	2.10	.955	**Important**
The stakeholders are those of affect on the project or affected by project, they can be identified by many methods which of the following you use :	**53**	**2.2516**	**.77323**	**Important**
Valid N	18			

With respect to the question of " identified stakeholders" the respondents were asked aboutStakeholder analysis, expert judgment, variance analysis, flowchart, from their answers, the analyses show the mean of 2.27, 2.33, 2.37, 2.10, which is less than the mean average (3) which concludes the most firms respondents use this tools to identified stakeholders so they adopt such tools and improve their performance

2. In your company when Planning Communications in the project you use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-38) Planning Communications

2.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Communication Technology	53	2.02	.866	**Important**
Reports	53	1.96	.784	**Important**
Periodical Meetings	52	1.98	.874	**Important**

In your company When Planning Communications in the project you use :	**53**	**1.9874**	**.71301**	**Important**
Valid N	52			

With respect to the question of " Planning Communications " the respondents were asked aboutcommunication technology, reports, periodical meetings,from their answers, the analyses show the mean of 2.02, 1.96, 1.98, which is less than the mean average (3) and that concludes the most firms respondents use this tools to Planning Communications so they adopt such tools and improve their performance.

3. For any project the information may be share between stakeholders, thus you use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-39) project the information

3.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Communication methods	53	2.09	.925	**Important**
Information distribution tools	52	2.48	.852	**Important**
Information technology	52	2.42	.893	**Important**
For any project the information may be share between stakeholders, thus you use :	**53**	**2.3270**	**.74389**	**Important**
Valid N	52			

With respect to the question of " the information may be share between stakeholders " the respondents were asked aboutcommunication methods, information distribution tools, information technology,from their answers, the analyses show the mean of 2.02, 1.96, 1.98, which is less than the mean average (3) which concludes the most firms respondents use this tools to the information may be share between stakeholders so they adopt such tools and improve their performance

4. In your company when Managing Stakeholder Expectations in the project use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-40) Managing Stakeholder Expectations

4.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Interpersonal skills	53	2.11	.934	**Important**
Management skills	52	2.35	1.027	**Important**
Previous lists	52	2.63	1.010	**Not Used**
Beneficiaries Notebook	52	2.79	.997	**Not Used**
In your company When Managing Stakeholder Expectations in the project use :	**53**	**2.4623**	**.80473**	**Important**
Valid N	52			

1. With respect to the question of " Managing Stakeholder Expectations " the respondents were asked about interpersonal skills, management skills, from their answers, the analyses show the mean of 2.11, 2.35, which is less than the mean average(3) and that concludes the most

firms ofrespondents use this tools to managing stakeholder expectations so they adopt such tools and improve their performance.
2. the analysis show the previous lists, beneficiaries notebook, the mean of 2.63, 2.79 which is near to the mean average (3), which indicates the respondents do not use this tools because they have no enough knowledge to important and benefit.

5. In your company when reporting Performance in the project use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-41) Reporting Performance

5.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Variance analysis	51	2.35	1.092	**Important**
Forecasting methods	52	2.75	.926	**Not Used**
network analysis	52	2.63	.908	**Not Used**
References analysis	52	2.60	1.071	**Not Used**
In your company When Reporting Performance in the project use :	**52**	**2.5817**	**.80550**	**Important**
Valid N	51			

1. With respect to the question of " Reporting Performance " the respondents were asked about variance analysis, from their answers, the analyses shows the mean of 2.35, which is less than the mean average(3) and that concludes the most firms ofrespondents use this tools to Reporting Performance so they adopt such tools and improve their performance.
2. the analysis show the forecasting methods, network analysis, references analysis, the mean of 2.75, 2.63, 2,60 which is near to the

mean average (3), which indicates the respondents do not use this tools because they have no enough knowledge to important and benefit.

4.4.7Project Risk Management

1. When Identifying Risks of the project you staff use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-42) Identifying Risks

1.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Documentation reviews	53	2.09	.838	**Important**
Information gathering techniques	52	2.33	.785	**Important**
Checklist analysis	52	2.38	.889	**Important**
Assumptions analysis	52	2.40	.913	**Important**
When Identifying Risks of the project you staff use:	**53**	**2.2972**	**.70720**	**Important**
Valid N	52			

With respect to the question of " Identifying Risks " the respondents were asked about documentation reviews, information gathering techniques, checklist analysis, assumptions analysis, from their answers, the analyses show the mean of 2.09, 2.33, 2.38, 2.40 respectively which is less than the mean average(3) and that concludes the most of firmsrespondents use this tools to Identifying Risks so they adopt such tools and improve their performance.

2. When Performing Qualitative Risk Analysis of the project the staff uses:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-43) Performing Qualitative Risk

2.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Risk probability and impact assessment,	52	2.21	.936	**Important**
Probability and impact matrix,	52	2.71	.848	**Not Used**
Risk categorization	52	2.42	.936	**Important**
Expert judgment	52	2.19	.951	**Important**
When Performing Qualitative Risk Analysis of the project the staff use :	**53**	**2.3821**	**.72491**	**Important**
Valid N	51			

1. With respect to the question of "Performing Qualitative Risk " the respondents were asked about risk probability and impact assessment, risk categorization, expert judgment, from their answers, the analyses show the mean of 2.21, 2.42, 2.19 which is less than the mean average(3) which concludes the most of firmsrespondents use this tools to Performing Qualitative Riskso they study is carefully and improve their performance.
2. the analysis show that the Probability and impact matrix, the mean of 2.71, which is near to the mean average (3), which indicates the respondents do not use this tools because they have no enough knowledge to important and benefit.

3. When Performing Quantitative Risk Analysis of the project you engineers use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-44) Performing Quantitative Risk

3.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Data gathering and representation techniques,	52	2.37	1.030	**Important**
Quantitative risk analysis and modeling techniques	52	2.52	1.075	**Important**
Expert Judgment	52	2.19	1.085	**Important**
When Performing Quantitative Risk Analysis of the project you engineers use :	**53**	**2.3585**	**.94247**	**Important**
Valid N	51			

With respect to the question of "Performing Quantitative Risk " the respondents were asked about data gathering and representation techniques, quantitative risk analysis and modeling techniques, expert judgment, from their answers, the analyses show the mean of 2.37, 2.52, 2.19 which is less than the mean average(3) which concludes the most firmsrespondents use this tools to Performing Quantitative Risk so they adopt such tools and improve their performance.

4. When Planning Risk Responses the project uses:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-45) Planning Risk

4.	N	Mean	Std. Deviation	Attitude
Strategies for negative risks or threats (avoid, transfer, mitigate, or accept)	52	2.29	.957	**Important**
Strategies for positive risks or opportunities (exploit, share, enhance, or accept).,	51	2.29	.807	**Important**
Contingent response Strategies (Contingent Response Strategies)	49	2.47	.868	**Important**
Expert Judgment	50	2.00	.857	**Important**
When Planning Risk Responses the project use :	**53**	**2.2531**	**.73652**	**Important**
Valid N	46			

With respect to the question of "Planning Risk Responses " the respondents were asked about strategies for negative risks, strategies for positive risks, contingent response strategies, expert judgment, from their answers, the analyses show the mean of 2.29, 2.29, 2.47, 2.00 which is less than the mean average(3) which concludes the most firms ofrespondents use this tools to Planning Risk Responses so they adopt such tools and improve their performance.

5. When Monitoring and Control Risks of the project the staff uses:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-46) Control Risks

5.	N	Mean	Std. Deviation	Attitude
Risk reassessment	52	2.21	.957	**Important**
Risk audits	52	2.31	.853	**Important**
Variance and trend analysis	53	2.45	.822	**Important**
Reserve analysis	52	2.37	1.010	**Important**
When Monitoring and Control Risks of the project the staff use :	**53**	**2.3302**	**.73507**	**Important**
Valid N	52			

With respect to the question of "Monitoring and Control Risks " the respondents were asked about risk reassessment, risk audits, variance and trend analysis, reserve analysis, from their answers, the analyses show the mean of 2.21, 2.31, 2.45, 2.37, respectively which is less than the mean average (3) which concludes the most firmsrespondents use this tools to Monitoring and Control Risks so they adopt such tools and improve their performance.

4.4.8 Project procurement Management:

1. In your company when Planning Procurements we use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-47) Planning Procurements

1.	N	Mean	Std. Deviation	Attitude
Make-or-buy analysis	52	1.67	.810	**Very Important**
Contract types	52	1.88	.784	**Important**
Procurement sources	52	1.90	1.125	**Important**
In your company When Planning Procurements we use :	**53**	**1.8396**	**.88310**	**Important**
Valid N	51			

With respect to the question of "Planning Procurements " the respondents were asked about make-or-buy analysis, contract types, procurement sources, from their answers, the analyses show the mean of 1.67, 1.88, 1.90 which is less than the mean average (3) which concludes the most of firmsrespondents use this tools to Planning Procurements so they adopt such tools and improve their performance.

2. For procurement conducting, the purpose process may use which you company performs

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-48) procurement conducting

2.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Bidder conferences	52	2.21	1.126	**Important**
Proposal evaluation techniques,	53	2.11	.870	**Important**
Advertising	52	2.40	.891	**Important**
Internet search	52	2.37	1.010	**Important**
For procurement conducting, the purpose process may use which you company performs	**53**	**2.2689**	**.78116**	**Important**
Valid N	52			

With respect to the question of "procurement conducting " the respondents were asked about bidder conferences, proposal evaluation techniques, advertising, Internet search, from their answers, the analyses show the mean of 2.21, 2.11, 2.40, 2.37, which is less than the mean average(3) which concludes the most firms ofrespondents use this tools to procurement conducting so they adopt such tools and improve their performance.

3. For the procurement contract administration project manager use many tools which tool you perform to use:

Descriptive Statistics:

Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-49) procurement contract administration

3.	**N**	**Mean**	**Std. Deviation**	**Attitude**
Inspections and audits	53	1.85	.969	**Important**
Performance reporting	52	2.06	.938	**Important**
Payment systems	52	2.04	.969	**Important**
Claims administration	52	2.29	.977	**Important**
For the procurement contract administration project manager use many tools which tool you perform to use :	**53**	**2.0566**	**.86135**	**Important**
Valid N	52			

With respect to the question of "the procurement contract administration project manager " the respondents were asked about inspections and audits, performance reporting, payment systems, claims administration, from their answers, the analyses show the mean of 1.85, 2.06, 2.04, 2.29 which is less than the mean average (3) which concludes the most firms ofrespondents use this tools to the procurement contract administration project manager so they adopt such tools and improve their performance.

4. In your company when Closing Procurements of the project use:

Descriptive Statistics:
Likert Pentatonic Scale
Weighted Mean Level:

From 1.00 to 1.79	Very Important
From 1.80 to 2.59	Important
From 2.60 to 3.39	Not Used
From 3.40 to 4.19	Not Important
From 4.20 to 5.00	Not Important at All

Table (4-50) Closing Procurements

4.	N	Mean	Std. Deviation	Attitude
Procurement performance reviews	52	1.88	1.022	**Important**
Performance reporting	52	2.17	.985	**Important**
Claims administration	52	2.25	.968	**Important**
Consolidation	53	1.87	.833	**Important**
In your company When Closing Procurements of the project use :	**53**	**2.0425**	**.82877**	**Important**
Valid N	52			

With respect to the question of "Closing Procurements " the respondents were asked about procurement performance reviews, performance reporting, claims administration ,consolidation, from their answers, the analyses show the mean of 1.88, 2.17, 2.25, 1.87, respectively which is less than the mean average(3) which concludes the most firms ofrespondents use this tools to Closing Procurements so they study is carefully and improve their performance.

4.5 Summary

With respect to the tools and techniques in construction management the respondents were asked about the importance of implementing tools and techniques on project management, from their answers, the analysis show all mean of this tools is greater than the average, that they highly agree and believe on the importance of these tools, but on the other hand the study came very scarce. The consequence of this is reflected on the poor performance of the projects. The results concludes that the use of these tools and techniques must be of a sustainable scientific way in order to achieve project objectives successfully.

CHAPTER FIVE

RESULTS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction :

This chapter comprises of the summery of this thesis, research conclusions obtained from conducting this study, and the recommendations.

5.2 Brief summary :

The scope of construction industry is very wide, includes residential construction, building construction of commercial, irrigation, roads, tunnels, transportation and facility building. It is widely accepted when the project is completed on time, and budget with respect to specification and quality which may lead stakeholders satisfaction, in this case the project is said to be successful. The Sudanese construction sector is characterized by many small and large projects and high labor intensity. The construction industry is dynamic in nature due to the increasing uncertainties in technology, budgets, and development processes. Nowadays, building projects are becoming much more complex and difficult, so the construction project passes through several stages of its project life such as (Bid preparation, Project characteristics, and project management) and facing different problems in its performance. The project may suffer from delay. The lack of sufficient guidelines to assist the project always lead to have unsuccessful projects in the Sudan. Thus the

major objectives of this study are:

1- To identify the major project management activities and what tools and techniques can be used and that are commonly used by Sudanese Construction industry.

2- To determine the project management tools and techniques that strongly affect the Sudanese Construction activities.

3- To develop a theoretical model which can be used as an internal mechanism for the evaluation of project management tools and technique which may improve the local construction project performance.

To achieve the three research objectives, and the questions raised by the research which were proposed as follows:

1- What are the project management process activities?

2- What are the tools and techniques which can be used in different process activities?

3- How can tools and techniques influence the Sudanese construction performance?

The study started with an extinctive review of tools and techniques in nine knowledge in construction management literature from construction researchers.

The researcher established the theoretical part of the research by studying topics in the field such as: Which are considered to be the core function of management comprises of :

(1) scope management,

(2) time management,

(3) cost management,

(4) quality management.

Which are considered to be facilitating function managementof :

(1) human resources management,

(2) communication management,

(3) risk management,

(4) procurement management.

The integration between these functions lead to enterprise success, as well as .

The implementation of management knowledge in construction projects could affect positively the performance factors. The researcher studied The measurement of performance. The performance in all stages project in a comparative way to assess the final performance according to time, cost, and quality. The first and second questions and objectives were answered from literature review and in order to achieve the other research objectives and answer the other research questions, the following strategies for collecting data was adopted: A questionnaire survey, being of lower cost compared to other tools, was designed with to the research problems and hypotheses. A systematic random samples were selected. to 70 local firms which work in the field of construction projects. 55 questionnaires were returned, with a response rate of approximately 78%. The data obtained from the questionnaire survey was used mainly in testing the adopted model and to study the effect of different factors on project performance.

In order to empirically test the theoretical model. The measurement instrument measuring the effect of the different factors on the performance of the Sudanese construction firms were evaluated for reliability and validity.

The obtained data was analyzed and the results was interpreted regarding the theoretical part. The SPSS 19 IBM program was used for data analysis. The average index (mean) and frequencies were calculated to determine the influential factors which discussed according to respondent answers for each stge. In summary, the research questions were answered

through the responses of the questionnaire and consequently research objectives were achieved through conducting this study.

5.3 Conclusions :

A number of results have been obtained from this research. Thus, performance theory related to Sudanese construction firms has been developed.

1. Explanation of the nine criteria for project management and arranged according to importance of core function management and facilitating function management
2. Tools and techniques proved to be necessary for the application of the nine criteria for project management
3. The local construction projects performance is 64.2%, as per results, which indicate the necessary for improvement.
4. The importance of using tools and techniques of project management to increase the Sudanese construction performance
5. The organized application of tools and techniques in project management result in optimum performance for construction projects.

5.4 GeneralRecommendations :

1. Construction firms should train their staff in using tools and techniques relevant to scope management in order ensure project scope
2. Tools and techniques regarding time management are very essential, so they should be known and applicable to monitor and control project progress.
3. Cost management have many tool and techniques, which when applied correctly they could reduce the cost of the project, so it is too important to develop the project staff on such area.

4. It is too vital to train and develop the skills of staff in the route of quality management in order to control the quality plan and establish suitable corrective actions.
5. The human resources is the key factor in executing projects, the research encourage the construction firms to give more attention in training their participants to raise the effectiveness of the project performance .
6. The construction firms to should apply and develop tools and techniques of communication management to communicate all information in order to avoid improper planning which may lead to failure the projects.
7. It is very essential for construction firms to develop their engineers to depend on tools and techniques about risk management to identify, access and manage risks to avoid the poor performance.
8. Procurement management has many tools and techniques so, the construction firms should be developed the procedures in procurement process by applying tools and techniques which facilitate procurement management.
9. Integration management of project is the key factor in completing project so the researcher recommends the construction firms to the develop skills of the staff in using tools and techniques supporting to integration management to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups.

5.5 Forward and Future Studies :

To continue of establishing standards and legislation that support the practice of this profession, it is investigating the advisable to make research in the scope such as :

1. Investigating the study of critical factors affecting the application of tools and techniques of project management in Sudan.
2. Factors affecting the performance and control of projects in Sudan.
3. Generation of Models measuring the performance of projects.
4. The common shortcoming in using tools and techniques in construction projects in Sudan.

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APPENDICES

Appendix (1)

SudanUniversity of science and technology

College of graduate studies and science research

Civil engineering Dep.

Questionnaire about the The effect of implementing Project Management tools and techniques on the construction project performance in Sudan

Respondent profile (optional):

1- Name /company name…….. 2- Experience in company ……

3- Education level……..4. Occupation ……..

Scale 1 :

Evaluation projects performance in company :

1= very disagree, 2= disagree, 3= neutral, 4= high agree, 5= very high agree

	N	factors	1	2	3	4	5
Scope Management	1	We have a section that defines the scopes the project before starting the project					
	2	We examine the expectations and requirements of the client before starting the project					
	3	We divide the tasks on the team before the start of the project					
Time Management	1	We set a timetable for the end of the project					
	2	We have sufficient knowledge to determine the time of each project activity					
	3	End of the project within the specified time					
	4	Specifies penalties on failure to end the project on time					
	1	We estimate the cost of an initial detailed project activities until his extradition					

Cost Management	2	End of the project within the specified cost					
	3	The company is studying the possibility of financial advances to customers before the tender					
	4	We have a plan to reduce wasted material					
Quality Management	1	We provide quality manual within the tender documents					
	2	Keep up with technological advances of the mechanisms used in the project					
	3	Have submitted bids for the project on the technical specifications complete a comprehensive quality					
	4	Our department is interested in quality management in project					
Human Resources Management	1	The company's administrative organization arbitrator for each project activity					
	2	We have skilled workers to implement projects					
	3	Our policies are clear and easy ways to deal with the staff to perform the tasks					
	4	There administration dedicated to each project alone					
	5	We have a system of training and development for employees					
	6	We have a system of incentives for employees linked to their production					
	7	Of the company's employees and the absolute loyalty towards					
Communication Management	1	There is a clear connection between members of the same project, and between them and the administration					
	2	We work planned for the site and motion paths and places of storage, security and services					
	3	The company's plan of communication between the parties to the contract (the owner and the contractor and consultant) before execution					
	4	We use modern media to communicate and connect (Cameras Site, the Internet (and multimedia					
	5	We hold weekly meetings to discuss the progress of the project performance					
	1	We have plans to manage risks					
	2	We have weekly meetings to discuss the risks at the site					

Risk Management	3	We have a dedicated budget for risk management project					
	4	We have qualified engineers identify the risks facing the project, which will					
Procurement Management	1	We use modern storage methods and materials suitable on-site					
	2	We have a plan to supply the various sites materials required for the implementation of					
	3	Our technical staff controls the process control of materials on-site customized to get the job done					
	4	We have an elaborate system for the management of material at the site					
	5	Always reserve minimum to store materials used					

Scale 2 :

Nine knowledge area:

Put √ sign in the right box According tothe importance oftheir usein the companymentioned 1 very important 2 important 3 not used 4 not important 5 not important at

1- project scope management :

no	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- when collecting customer requirement for the project our company uses the tools and techniques such as :**					
	1 Interviews					
	.2 Facilitated workshops					
	.3 Questionnaires and surveys					
	.4 Focus groups					
	.5 group creativity techniques (brainstorming, Delphi technique, nominal technique)					
	.6 Observations					
2	**2- When Defining Scope for the project the tools and techniques uses are :**					
	.1Expert judgment					
	.2 Product analysis					
	.3 Alternatives identification					
3	**3- when Creating WBS for the project the tools and techniques use :**					
	.1 Decomposition					

	.2 Reference measurement					
	3 Al-kouta system					
4	**4- when Verifying Scope for the project use :**					
	.1 Inspection					
	.2 control					
	.3 orientation					
5	**5- When Controlling Scope for the project use :**					
	.1 Variance analysis					
	.2 calculation analysis					
	.3 Structure analysis					

2- Project time management:

no	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- In your company When Defining Activities the project use :**					
	.1 Rolling wave planning,					
	.2 Templates					
	.3 general computer program					
2	**2- When Sequencing Activities the project tools and techniques use :**					
	.1 Precedence diagramming method (PDM)					
	.2 Dependency determination,					
	.3 Applying leads and lags					
	4 Schedule network templates					
3	**3- When Estimating Activity resource of the project our staff use :**					
	.1 Resources Alternatives analysis,					
	.2 Published estimating data,					
	3 Bottom-up estimating,					
	..4 Project management software					
4	**4- in order to Estimate Activity durations the staff will use :**					
	.1 Durations Analogous estimating,					
	.2 Parametric estimating					
	.3 Three-point estimates (Most likely, Pessimistic, optimistic),					
	.4 Reserve analysis					
5	**5- For Developing project Schedule the tools and techniques use are :**					
	.1 Schedule network analysis					
	.2 Critical path method					
	.3 Critical chain method					
	.4 Resource leveling					
	.5 Schedule compression					

6	**6- For Schedule control the tools and techniques use are :**					
	.1 Performance reviews					
	2 Variance analysis					
	3 Schedule compression					
	4 Scheduling tool					

3- project cost management :

no	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- in order to Estimate project Cost which tools and techniques you use**					
	.1 Analogous estimating					
	.2 Parametric estimating					
	.3 Bottom-up estimating					
	.4 Reserve analysis					
	.5 Cost of quality					
	.6 Project management estimating software					
	.7 Vendor bid analysis					
2	**2- when you Determining Budget of the project which method you use :**					
	.1 Cost aggregation					
	.2 Historical relationships					
	.3 estimation cost					
3	**3- when Controlling Costs of the project our staff use :**					
	.1 Earned value management					
	.2 Forecasting					
	.3 To-complete performance index (TCPI)					
	4 Performance reviews					

4- project quality management :

no	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- which tools and techniques you use when plan for quality :**					
	.1 Cost-benefit analysis					
	.2 Cost of quality					
	.3 Control charts					
	.4 Statistical sampling					
	.5 Flowcharting					
2	**2- When Performing Quality Assurance of the project our engineers use**					
	1 Quality audits					
	2 Process analysis					

3	**3- in your company When Performing Quality Control the project tools and techniques use:**					
	.1 Histogram					
	2 Pareto chart					
	3 Run chart					
	4 Scatter diagram					
	5 Inspection					
	.6 Approved change requests Review					

5- project human resources management :

no	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- If you manager asking you to develop human resources planning for the project you use:**					
	.1 Organization charts and position descriptions					
	.2 Networking					
	.3 Organizational theory					
2	**2- in your company When Acquiring Project Team of the project use :**					
	.1 Pre-assignment					
	.2 Negotiation					
	.3 **Advertisement**					
	.4 Virtual teams					
3	**3- in your company When Developing Project Team of the project use :**					
	.1 Interpersonal skill					
	.2 Training					
	.3 Team-building activities					
	.4 Ground rules					
	.5 Co-location					
	.6 Recognition and rewards					
4	**4- in your company When Managing Project Team of the project use :**					
	.1 Observation and conversation					
	.2 Project performance appraisals					
	.3 Conflict management					
	.4 Issue log					

6- project communication management :

no	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- The stakeholders are those of affect on the project or affected by project, they can be identified by many methods which of the following you use :**					

	.1 Stakeholder analysis,					
	.2 Expert judgment					
	.3 variance analysis					
	.4 flowchart					
2	**2- in your company When Planning Communications in the project you use :**					
	1 Communication requirements analysis					
	2 Communication technology					
	3 Reports					
	4 Periodical Meetings					
3	**3- For any project the information may be share between stakeholders, thus you use :**					
	1 Communication methods					
	2 Information distribution tools					
	3 Information technology					
4	**4- In your company When Managing Stakeholder Expectations in the project use :**					
	.1 Interpersonal skills					
	.2 Management skills					
	.3 Previous lists					
	4. Beneficiaries Notebook					
5	**5- in your company When Reporting Performance in the project use :**					
	1 Variance analysis					
	.2 Forecasting methods					
	.3 network analysis					
	.4 References analysis					

7- project risk management :

No	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- When Identifying Risks of the project you staff use :**					
	.1 Documentation reviews					
	.2 Information gathering techniques					
	.3 Checklist analysis					
	.4 Assumptions analysis					
2	**2- When Performing Qualitative Risk Analysis of the project the staff use :**					
	.1 Risk probability and impact assessment,					
	.2 Probability and impact matrix,					
	.3 Risk data quality assessment,					
	.4 Risk categorization					
	5 Risk urgency assessment,					
	6 Expert judgment					

4	**4- When Performing Quantitative Risk Analysis of the project you engineers use :**					
	1 Data gathering and representation techniques,					
	.2 Quantitative risk analysis and modeling techniques					
	3. Expert judgment					
5	**5- When Planning Risk Responses the project use :**					
	.1Strategies for negative risks or threats (avoid, transfer, mitigate, or accept)					
	.2 Strategies for positive risks or opportunities (exploit, share, enhance, or accept).,					
	.3 Contingent response Strategies (Contingent Response Strategies)					
	4. Expert judgment					
6	**6- When Monitoring and Control Risks of the project the staff use :**					
	1 Risk reassessment					
	2 Risk audits					
	3 Variance and trend analysis					
	4 Reserve analysis					

8- project procurement management :

no	Activities and tools	V.i	i	n.u	n.i	n.i.a
1	**1- In your company When Planning Procurements we use :**					
	.1 Make-or-buy analysis					
	.2 Contract types					
	3. Procurement sources					
2	**2- For procurement conducting, the purpose process may use which you company performs**					
	1 Bidder conferences					
	2 Proposal evaluation techniques,					
	3 Independent estimates					
	4 Advertising					
	5 Internet search					
	6 Procurement negotiation					
3	**3- For the procurement contract administration project manager use many tools which tool you perform to use :**					
	.1 Procurement performance reviews					
	.2 Inspections and audits					
	.3 Performance reporting					

	.4 Payment systems					
	.5 Claims administration					
4	**4- In your company When Closing Procurements of the project use :**					
	.1 Procurement performance reviews					
	.2 Performance reporting					
	.3 Claims administration					
	4. Consolidation					

Appendix (2)

جامعة السودان للعلوم والتكنولوجيا

كلية الدراسات العليا– قسم الهندسة المدنية

لقد تم اختياركم ضمن الشركات التي نرى أهليتها الكافية للمشاركة في تعبئة استبيان لنيل درجة الماجستير آملين أن ينعكس دوركم إيجابا على صناعة التشييد في السودان الاستبيان بعنوان**تأثير تطبيق أدوات وتقنيات إدارة المشروعات على أداء مشروعات التشييد في السودان**

معلومات شخصية :

1- الاسم/ اسم الشركة (اختياري) ..... 2- سنوات الخبرة .....

3- المسمى الوظيفي ..... 4- المستوى التعليمي .....

المقياس (1) :

تقييم أداء المشاريع في الشركة : للاجابه على أي سؤال يجب ان تكون وفقا للمدرج أدناه :

1- غير موافق إطلاقاً 2- غير موافق 3- محايد 4- موافق 5- موافق بشدة

ر	المعيار	الرقم	العوامل	1	2	3	4	5
1	إدارة نطاق المشروع	1	لدينا قسم يقوم بتعريف نطاقات المشروع قبل البدء في المشروع					
		2	نقوم بدراسة توقعات ومتطلبات العميل قبل البدء في المشروع					
		3	نقوم بتقسيم المهام على فريق العمل قبل البدء في المشروع					
2	إدارة زمن المشروع	1	نقوم بتحديد جدول زمني لإنهاء المشروع					
		2	لدينا المعرفة الكافية لتحديد زمن كل نشاط بالمشروع					
		3	ينتهي المشروع ضمن الوقت المحدد له					
		4	تحدد عقوبات عند الفشل في انهاء المشروع في الوقت المحدد له					
3	إدارة تكلفة المشروع	1	نقوم بتقدير تكلفة مبدئية مفصلة لأنشطة المشروع حتى تسليمه					
		2	ينتهي المشروع ضمن التكلفة المحددة له					
		3	تدرس الشركة الإمكانية المالية للعملاء قبل التقدم بالعطاء					
		4	لدينا خطة لتقليل المواد المهدرة					
	إدارة الجودة	1	نقوم بتقديم دليل الجودة ضمن مستندات العطاء					
		2	نواكب التقدم التكنولوجي للآليات المستخدمة في المشروع					

4		3	تحتوي العطاءات المقدمة للمشروع على مواصفات فنية كاملة شاملة الجودة						
		4	لدينا قسم يهتم بإدارة الجودة في المشروع						
5	إدارة الموارد البشرية	1	للشركة تنظيم إداري محكم لكل أنشطة المشروع						
		2	لدينا عمال مهرة لتنفيذ المشاريع						
		3	لدينا سياسات واضحة وطرق سهلة للتعامل مع الموظفين لتنفيذ المهام						
		4	هناك إدارة مخصصة لكل مشروع على حده						
		5	لدينا نظام تدريب وتطوير للعاملين						
		6	لدينا نظام حوافز للموظفين مرتبط بإنتاجهم						
		7	للعاملين بالشركة ولاء مطلق نحوها						
6	إدارة الاتصالات	1	هناك نظام اتصال واضح بين أعضاء المشروع الواحد وبينهم وبين الإدارة						
		2	نقوم بعمل خط اتصال للموقع ولمسارات الحركة وأماكن التخزين والأمن والخدمات						

6		3	للشركة خطة اتصال بين أطراف المشروع (المالك والمقاول والاستشاري) قبل التنفيذ						
		4	نستخدم الوسائط الحديثة في التواصل والاتصال (كاميرات الموقع والانترنت والوسائط المتعددة)						
		5	نعقد اجتماعات أسبوعية لمناقشة سير الأداء بالمشروع						
7	إدارة المخاطر	1	لدينا خطط لإدارة المخاطر						
		2	لدينا اجتماعات أسبوعية لمناقشة المخاطر في الموقع						
		3	لدينا موازنة مخصصة لإدارة المخاطر بالمشروع						
		4	لدينا مهندسين مؤهلين بتحديد المخاطر التي سوف تواجه المشروع						
8	إدارة المشتريات	1	نستخدم طرق تخزين حديثة ومناسبة للمواد في الموقع						
		2	لدينا خطة لإمداد المواقع المختلفة بالمواد المطلوبة للتنفيذ						
		3	لدينا طاقم فني يتحكم في عملية تدفق المواد في الموقع حسب الطلب لانجاز العمل						
		4	لدينا نظام محكم لإدارة المواد في الموقع						
		5	نحتفظ دائما بالحد الأدنى لتخزين المواد المستخدمة بالموقع						

المقياس (2) :

تطبيق معايير المعرفة التسع :

✓ ضع أمام الأداة المناسبة حسب أهمية استخدامها في الشركة المذكورة :

1- إدارة نطاق المشروع (Project Scope management) :

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غير مهم إطلاقا
1	**للتعرف على احتياجات العميل تستخدم الشركة الأدوات والتقنيات التالية :**					
	1- عن طريق المقابلة الشخصية (Interviews)					
	2- التركيز على المجموعات ذات المعرفة بالمواصفات					
	3- عن طريق ورش العمل (Facilitated					

	workshops)					
	4- عن طريق الاستقصاء (questionnaire and survey)					
	5- من خلال الملاحظات (Observation)					
	6- خلق تقنيات المجموعة (brainstorming, Delphi technique, nominal technique)					
2	**عند تعريف نطاق المشروع الأدوات والتقنيات المستخدمة هي :**					
	1- رأي الخبراء المختصين (Expert judgment)					
	2- تحليل عناصر الإنتاج (Product analysis)					
	3- تحديد البدائل (Alternatives analysis)					
3	**عند التعامل مع مهام المشروع (هيكلة المهام WBS) نستخدم التقنيات التالية :**					
	1- تقسيم المهام لوحدات صغيرة يمكن إدارتها (Decomposition)					
	2- استخدام طرق القياس المرجعي					
	3- تستخدم نظام الكوته					
4	**عند تحقيق نطاق المشروع نستخدم أدوات وتقنيات مثل:**					
	1- التفتيش (inspection)					
	2- الرقابة (control)					
	3- التوجيه (Orientation)					
5	**عند التحكم في نطاق المشروع نستخدم ادوات مختلفة :**					
	1- تحليل التباين (Arithmetic analysis)					
	2- التحليل الحسابي (Calculate analysis)					
	3- التحليل الهيكلي (Structural analysis)					

2- إدارة وقت المشروع (Project Time management) :

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غير مهم إطلاقا
1	**عند تعريف نشاطات المشروع تستخدم الشركة التقنيات التالية :**					
	1- الخبرات الفنية بالشركة					
	2- برامج الحاسوب العامة (Compute program)					
	3- جداول خاصة بالشركة (Templates)					
2	**الأدوات والتقنيات المستخدمة عند عمل تسلسل نشاطات المشروع هي :**					
	1- طريقة مخطط الاسبقية (PDM)					
	2- تقرير التبعية (dependency determination)					
	3 تطبيق السابق واللاحق (leads and lags)					
	4- طباعة الجدول الشبكي (network templates)					
3	**عند تحديد الموارد الخاصة بكل نشاط يستخدم**					

	العاملون الطرق التالية :					
	1- حساب الموارد المتاحة حينها					
	2- استخدام بيانات المشاريع السابقة					
	3- طرق التقدير من أسفل الى اعلي (Bottom-up estimate)					
	4 برمجيات إدارة المشروع (project management software)					
4	**لحساب زمن الأنشطة نستخدم الطرق التالية :**					
	1- التقدير عن طريق التماثل (Duration analogous)					
	2- التقدير الإجمالي (Parametric estimating)					
	3- استخدام طريقة النقاط الثلاثة (متوسط ثلاث مدد متوقعه)					
	4- استخدام التحليل التحوطي (Reserve analysis)					
5	**عند تصميم وتطوير الجدول الزمني للمشروع نستخدم الطرق التالية :**					
	1- طريقة المسار الحرج (Critical bath analysis)					
	2- طريقة السلسلة الحرجة (PERT)					
	3- طريقة القضبان					
	4- طريقة المخطط القضيبي (Bar Chart)					
6	**للتحكم في الجدول الزمني للمشروع نستخدم :**					
	1- التقارير (Reports)					
	2- تحليل التباين بين المخطط والمنجز(E.V)					
	3- ضغط الجدول الزمني(Pistem Theory)					
	4- أدوات الجدولة (scheduling tool)					

3- إدارة تكلفة المشروع (Project Cost management) :

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غ مهم إطلاقا
1	**لتقدير تكلفة أنشطة المشروع الأدوات والتقنيات المستخدمة هي :**					
	1- التقدير التماثلي (Analogous estimating)					
	2- التقدير المتوسطي (parametric)					
	3- التقدير من الاسفل الى الاعلى (Bottom-up)					
	4- استخدام برامج الحاسوب الخاصة بالتكلفة المشروعات (for costSpecial program)					
	5- تحليل التكلفة					
2	**الطرق المستخدمة عند تحديد موازنة المشروع هي:**					
	1- هيكلة التكلفة (Cost aggregation)					
	2- تكاليف الأنشطة المماثلة (Analogous)					
	3- التكاليف التقديرية (estimation cost)					
3	**عند التحكم في تكلفة المشروع الموظفون يستخدمون**					
	1- إدارة القيم المكتسبة (EV)					

	2- مؤشر مكملة الأداء (TCPI)					
	3- تقارير الأداء (Performance Report)					

4- إدارة جودة المشروع (Project Quality management) :

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غير مهم إطلاقا
1	**أي من الأدوات والتقنيات التي تستخدمها عند عمل خطة الجودة :**					
	1 تحليل التكلفة والعائد (Cost-benefit)					
	2- مخططات التحكم (Control chart)					
	3- العينات الإحصائية (statistical sampling)					
	4- مخططات التدفق (Flowchart)					
2	**عند توكيد جودة الاداء بالمشروع نستخدم :**					
	.1 تدقيق الأنشطة والمهام (quality audits)					
	.2 تحليل متطلبات العمليات (process analysis)					
3	**أي الادوات التي يستخدمها المهندس عند التحكم في اداء الجودة للمشروع المنتج :**					
	1- المدرج الاحصائي (Histogram)					
	2- مخططات باريتو (Parito chart)					
	3- المخطط التشغيلي (Run chart)					
	4- التفتيش (inspection)					

5- ادارة الموارد البشرية للمشروع (Project Human resources management)

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غير مهم إطلاقا
1	**لو طلب من مديرك تطوير خطة الموارد البشرية للمشروع يستخدم :**					
	1- مخططات الهيكل التنظيمي (Organizational structure)					
	2- مخططات الهيكل الوظيفي (Functional structure)					
	3- تطبيق النظريات الإدارية (Organizational theory)					
2	**في الشركة عندما تحتاج لتعيين العاملين في المشروع تستخدم:**					
	1- تحديد امكانية الافراد لأداء المهام قبل بدء الانشطة (Pre-assignment)					
	2- عن طريق التفاوض (Negotiation)					
	3- عن طريق الاعلانات (Advertisement)					
3	**في شركتكم عند تطوير فريق العمل في المشروع نستخدم :**					
	1- تحديد المهارات الشخصية (Interpersonal skill)					
	2- تدريب العاملين حسب حوجة العمل (Training)					
	3- بناء فرق عمل متجانسة (Team building)					

	4- التحفيز والمكافاءات (motivation and reward)					
4	**عند ادارة فريق المشروع في الشركة نستخدم :**					
	1- مناقشة أعضاء فريق العمل في اداء المهام (Observation and conversation)					
	2- تقييم أداء العاملين بالمشروع (Project performance appraisals)					
	3- ادارة النزاعات بيت أعضاء فريق المشروع (Conflict management)					
	4- تشجيع المهارات الشخصية (Interpersonal skills)					

6- أدارة اتصال المشروع (Project Communication management)

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غير مهم إطلاقا
1	**يؤثر المستفيدون (Stakeholders) على المشروع ويؤثر المشروع عليهم، يمكن تحديدهم بواسطة عدة عوامل هي :**					
	1- تحليل متطلبات المستفيدين Stakeholders analysis					
	2- مخطط التدفق (Flowchart)					
	3- تحليل التباين (Variance analysis)					
	4- استخدام اراء الخبراء (Expert judgment)					
2	**عند عمل خطة اتصالات المشروع في الشركة تستخدم :**					
	1- استخدام تقنيات الاتصال الالكترونية					
	2- التقارير					
	3- الاجتماعات الدورية					
3	**في أي مشروع يتم تبادل المعلومات من قبل المستفيدون ويستخدم الموظفون الطرق التالية :**					
	1- عن طريق طرق الاتصالات المتاحة (communication methods)					
	2- عن طريق وسائل توزيع المعلومات مثل الرسائل (information distribution tools)					
	3- عن طريق تقنية المعلومات (information technology)					
4	**كيفية ادارة توقعات المستفيدين من المشروع نستخدم الادوات التالية :**					
	1- من خلال المهارات الادارية للعاملين (management skills)					
	2- من خلال المهارات الشخصية للعاملين					
	3- من خلال كشوفات سابقة (Previous lists)					
	4- دفتر ملاحظات المستفيدين					
5	**عند كتابة تقارير الاداء في المشروع يقوم العاملين باستخدام الوسائل التالية :**					
	1- تحليل التباين					

	2- طرق التنبوء					
	3- التحليل الشبكي					
	4- القياس المرجعي					

7- ادارة مخاطر المشروع (Project Risk management)

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غير مهم إطلاقا
1	**عند تحديد مخاطر المشروع الموظفون يستخدمون**					
	1- توقعات المخاطر السابقة					
	2- استخدام وسائل جمع المعلومات المتاحة					
	3- وتحليل المخاطر السابقة					
	4- تحليل الفرضيات الخاصة بالمخاطر					
2	**عند تحليل المخاطر بصورة كمية للمشروع نستخدم الوسائل التالية :**					
	1- تقييم وتأثير احتمالات المخاطر (Probability and impact assessment)					
	2- مصفوفة الاحتمالات والتأثير (Probability and impact matrix)					
	3- تصنيف المخاطر (risk categorization)					
	4- التعرف على المخاطر من خلال اراء الخبراء (Expert judgment)					
4	**عند تحليل المخاطر بصورة نوعية في المشروع نستخدم**					
	1- جمع بيانات المخاطر النوعية و عرضها					
	2- تحليل مخاطر النوعية و تقنيات النماذج					
	3- التعرف على المخاطر النوعية من خلال اراء الخبراء					
5	**لإدارة مخاطر المشروع هناك عدة وسائل تستخدم:**					
	1- استراتيجيات المخاطر السلبية او المهددات (avoid, transfer, mitigate, or accept)					
	2- استراتيجيات المخاطر الايجابية او الفرص (exploit, share, enhance, or accept).					
	3- استراتيجيات الرد العرضية (Contingent Response Strategies					
	4- رأي الخبراء (Expert judgment)					
6	**عند المراقبة والتحكم في المخاطر على المشروع نستخدم :**					
	1- اعادة تقييم المخاطر					
	2- التدقيق على المخاطر (audits)					
	3- تحديد نوعية المخاطر ووجهتها (Variance and trend analysis)					
	4- وضع ميزانية احتياطية كدرء للمخاطر (reserve analysis)					

8- ادارة مشتريات المشروع (Project Procurement management)

ر	النشاطات والأدوات	مهم جدا	مهم	غير مستخدم	غير مهم	غير مهم إطلاقا
1	**في شركتكم عند تخطيط المشتريات نستخدم :**					
	1- تحديد هل يتم الشراء او الايجار (Make- buy decision)					
	2- تحديد نوع العقود (type of contract)					
	3- تحديد مصادر الشراء (Procurement sources)					
2	**هناك عدة طرق تستخدمها الشركة عند اجراء عملية الشراء او التفاوض عليها :**					
	1- تقوم الشركة بجمع الموردون في اجتماع (Bidder conferences)					
	2- تقييم عروض الشراء (Proposal evaluation techniques)					
	3- يتم الشراء من خلال الاعلانات (Advertising)					
	4- عن طريق شبكة المعلومات (Internet search)					
3	**لإدارة عقود الشراء يمكن لمدير المشروع استخدام عده أدوات منها :**					
	1- الفحص والإشراف على التوريد (inspections and audits)					
	2- كتابة التقارير عن اداء الموردين (Performance reporting)					
	3- مراجعة نظام الدفعيات (Payment system)					
	4- ادارة المطالبات والنزاعات					
4	**عند ختام مشتروات المشروع في الشركة يستخدم:**					
	1- مراجعة جميع العقود					
	2- تقييم اداء الموردين (Performance reporting)					
	3- ادارة المطالبات (Claims administration)					
	4- توثيق العملية					

معلـوماتك سوف تعامل بسرية تامــه وتستخدم للأغراض الاكــادمية فقط .

"شكرا لتعاونكم معنا "

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