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Sudan University of Science and Technology

College of Graduate Studies

FACTORS INFLUENCING CONSTRUCTION PROJECTS PERFORMANCE IN SUDAN

العوامل المؤثرة في أداء مشاريـع التشييــد في الســـــودان

A thesis submitted in partial of fulfillment of the requirement for the Master of Science Degree in Civil Engineering (Construction Management)

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بســم الله الرحمن الرحيم

قال تعالى:

{إِنَّما أَمْرُهُ إِذا أَرادَ شَيْئًا أَنْ يَقُولَ لَهُ كُنْ فَيَكُونُ {82} فَسُبْحانَ الَّذِي بِيَدِهِ مَلَكُوتُ كُلِّ شيء وَإِلَيْهِ تُرْجَعُونَ 83}}

صدق الله العظيـــــــم

سورة يـــــس

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Abstract

Construction industry has complexity in its nature because it contains large number of parties as clients, contractors, consultants, stakeholders and others. Construction projects suffer from many problems and complex issues in performance such as cost, time and safety. The aim of this thesis is to identify and evaluate the main factors affecting the performance of construction projects .Literature review about performance was reviewed to identify the factors affecting the performance of construction projects.

A questionnaire survey was conducted and 34 factors were identified, categorized into 7 groups, evaluated and ranked from consultants and contractors perspectives. Questionnaires were distributed as follows: 20 to consultants and 40 to contractors. The results were analyzed, discussed to obtain the most performance indicators. The relative importance index method (RII) was used here to determine consultants and contractors perceptions of the relative importance of the performance indicators in construction projects.

The most important factors agreed by contractors were: Leadership skills for project manager was the most important performance factor, Availability of personals with high experience and qualification, Availability of resources as planned through project duration, Learning from best practice and experience of others, Quality of equipment and raw materials in project, Average delay in payment from owner to contractor and Sequencing of work according to schedule. All these factors were represented the top significant factors affecting the performance of the construction projects according to the contractor's views.

The most important factors agreed by consultants were: the Conformance to specification, Availability of personals with high experience and qualification, Sequencing of work according to schedule, Liquidity of organization, learning from best practice and experience of others, Quality of equipment and raw materials in project. This factors were

represented the top significant affecting the performance of the construction projects according to the consultants views.

Recommendations were formulated to improve performance of construction projects. It was concluded that consultants and contractors agree that actual cost of executed projects was more than the estimated cost because of changing which can be happening especially in economic conditions and situation. The project sometimes delays by late payment from the owner and Contractors usually suffer from this problem, it also concluded that most of contractors do not care with applying health and safety factors during construction of projects and also there is shortage in formal safety training. In addition, consultants do not have sufficient control or continuous supervision for safety application. All of that will lead to occurrence of accidents and problems in construction projects.

The study recommended developing human resources in the construction industry through proper and continuous training programs about construction projects performance. It is necessary for construction organizations to evaluate the liquidity before implementation of any construction project because of difficult economic situation. All of that will assist organizations to perform projects successfully and strongly.

الملخص

يعتبر قطاع الانشاءات ذو طابع معقد لأنه يتعامل مع العديد من الأطراف كالمالك، المقاول، الاستشاري، المساهمين وغيرهم. لذلك تعاني المشاريع الإنشائية من العديد من المشاكل والقضايا المعقدة من حيث الأداء ولن الهدف من هذه الدراسة هو تحديد وتحليل العوامل المؤثرة على الأداء في المشاريع الإنشائية.

تمت مراجعه الدراسات السابقة لتحديد العوامل المؤثرة على الأداء في المشاريع الإنشائية، كما تم عمل استبيان وقد شمل الاستبيان 34 من العوامل المؤثرة على الأداء في المشاريع الإنشائية، تم تصنيفها إلى 7 مجموعات وهي (التكلفة، الوقت، الإنتاجية، الجودة، ارضاء المالك، الأمن والسلامة والتعليم والتدريب)، كما تم التحليل والتقييم للاستبيان من وجهه نظر كل من المقاول والاستشاري. تم توزيع الاستبيان على النحو التالي: 20 لفئه الاستشاري و 40 لفئه المقاول. وقد تم تحليل النتائج ومناقشة العوامل والمؤشرات التي لتحديد تصورات الاستشاريين والمقاولين حول مي (RII) تؤثر على الأداء في مشاريع التشييد. استخدم في هذه الدراسة أسلوب اهميه تلك العوامل المؤثرة على الأداء في المشاريع الإنشائية.

أهم العوامل التي تم التركيز عليها من قبل المقاول كانت: المهارات القيادية لمدير المشروع هو العامل الذي شكل أكبر أهمية بالنسبة للمقاول، توفر شخصيات ذات خبرة وتأهيل عالية، توفر الموارد كما هو مخطط لها خلال مدة المشروع، والتعلم من تجارب الآخرين، جودة المعدات والمواد الخام في المشروع، متوسط التأخير في الدفع من المالك إلى المقاول وتسلسل العمل وفقا للجدول الزمني. كانت كل هذه العوامل تمثل عوامل هامة تؤثر على الأداء في المشاريع وفقا لآراء المقاول.

أهم العوامل التي تم التركيز عليها من قبل الاستشاري كانت: مطابقة الاعمال للمواصفات، توفر شخصيات ذات خبرة وتأهيل عالية، تسلسل العمل وفقا لجدول زمني، السيولة لدي المؤسسة، نوعية المعدات والمواد الخام في المشروع. كانت كل هذه العوامل تمثل عوامل هامة تؤثر على أداء في المشاريع وفقا لآراء الاستشاري. من خلال الدراسة تبين أن الاستشاريين والمقاولين يتفقون على أن التكلفة الفعلية للمشاريع المنفذة كانت أكثر من التكلفة المقدرة بسبب تغيير التي يمكن أن يحدث في الأوضاع الاقتصادية. التأخر في السداد من قبل المالك يعتبر من المشاكل التي يعاني منها المقاول اثناء تنفيذ المشاريع، كما ايضا استنتج أن معظم المقاولين لا يهتمون بتطبيق عوامل الصحة والسلامة خلال بناء المشاريع وأيضا هناك نقص في التدريب على السلامة. وبالإضافة إلى ذلك تبين أن الاستشاريين ليس لديهم رقابة كافية أو الإشراف المستمر لتطبيق مبدأ وعامل الأمن والسلامة. كل ذلك سيؤدي إلى الحوادث والمشاكل في مشاريع التشييد.

بناء على هذه الدراسة ينصح مؤسسات قطاع التشييد بوضع رسالة واضحة لتحديد وتنفيذ وتقييم الأداء. كما يجب تطوير الموارد البشرية من خلال برامج تدريبيه مناسبه ومستمرة متعلقة بي اداء مشاريع التشييد. على المؤسسة ايضا تقييم الوضع المالي لديها قبل البدء في تنفيذ اي مشروع وذلك بسبب تغير الأوضاع المالية. كل ذلك سيساعد على تنفيذ وانجاز المشاريع بنجاح وفعالية.

أوصت هذه الدراسة بالاهتمام بتنمية الموارد البشرية في صناعة البناء والتشييد من خلال برامج التدريب المناسبة والمستمرة حول أداء مشاريع التشييد. فمن الضروري لمؤسسات التشييد تقييم السيولة قبل تنفيذ أي مشروع بسبب تغير الوضع الاقتصادي. وكل ذلك سيساعد على أداء المشاريع بنجاح وبقوة

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Chapter 1

Introduction

1.1- preamble:

The future of the society is what is building today, and the goals along with other means and resources will allow the nations to determine the future of their country. Construction is a vital sector contributing significantly to the economics of all countries.

Construction industry plays a major role in development and achievement the goals of society, it's considered as one of the largest industries and contributes to about 10% of the gross national product (GNP) in industrialized countries (Navon, 2005). Generally construction works are increasing rapidly to meet the growing needs of the population and to keep up with global development. To progress in terms of construction, project construction must be studied carefully and prepared well in order to get the best results, and to help in moving in the right direction to establish the future goals.

"*The difference between failure and success is the difference between doing something almost right and doing something right*" (Benjamin Franklin).

So failure does not only mean doing things wrong, but even doing things almost right, this idea will lead to recognize the best way to implement project management in construction projects and to open newera in thinking that will give value to construction industry. These led to study how project are managed, and what are the major elements and problems affecting the construction industry , in order to help managers to plan and implement construction projects in a proper way that will lead to better results and less risks, and to achieve success with good quality.

Construction project development involves numerous parties, various processes, different phases and stages of work and a great deal of input from both the public and private sectors, with the major aim being to bring the project to a successful conclusion. The level of success in carrying out construction project development activities will depend heavily on the quality of the managerial, financial, technical and organizational performance of the respective parties, while taking into consideration the associated risk management, the business environment, and economic and political stability. Construction is becoming more complex, a more sophisticated approach is necessary to deal with initiating, planning, financing, designing, approving, implementing and completing a project. (Takim, R and Akintoye 2004)

Construction industry in the projects has complexity in its nature because it contains large number of parties as clients, contractors, consultants, stakeholders, shareholders and regulators , this parties can affecting the performance of the project through many related topics and factors such as time, cost, quality, client satisfaction, productivity and safety . There are many realistic reasons such, amendment of drawings and amendment of the design. In addition, there are other different reasons affecting construction projects performance such as poor management and leadership, inappropriate participants, poor relations and coordination, absence of motivation, control, monitor or decision making systems, inadequate infrastructure, political problems, cultural problems and economic conditions.

The development in the construction industry is increasing in size, technologicalcomplexity, interdependencies and variations in demand from the client. The scope of construction industry is very wide, including residential construction, building construction of commercial, irrigation, roads, tunnels, transportation, facility building, and heavy engineering construction refer to infrastructure construction and industrial construction

that need specialist expertise and contributes substantially to the economic growth of country.Success criteria which relate to construction project often changes from project to project depending on participants, scope of services, project size, and sophistication of the owner related to the design of facilities, technological implications, and a variety of other factors.

A research done by Stephen M. Rowlinson (1998) specified that project participants, project procedures, human aspects and environment may affect project performance. These factors may be associated with the different parties who involved in construction project, and each of them will play their individual roles contributing to the success of a project. The team of construction project is normally formed by the client, design professionals which consist of architect, civil and structural engineer, and etc, construction professionals which formed by main contractors and sub-contractors, supplier, surveyor and etc. It is widely believed that the performance of projects consist of the performance of all stages with each other to result in the final performance according to time, cost and quality and others factors .

1.2 - Performance Indicators for Construction Projects:

A performance indicator or key performance indicator (KPI) is a type of performance measurement KPIs evaluate the success of an organization or of a particular activity in which it engages. The performance can be measured by key indicators for evaluation. The purpose ofKey performance indicators (KPIs) is that clients want their projects delivered: ontime, on budget, free from defects, efficiently, right first time, safely, by profitablecompanies. So, Regular clients expect continuous improvement from theirconstruction team to achieve year-on-year: reductions in project costs and time. Inaddition, the Key Performance Indicators (KPIs) can be used for benchmarkingpurposes, and will be a key

component of any organization move towards achievingbest practice. Clients, for instance, assess the suitability of potential suppliers orcontractors for a project, by asking them to provide information about how theyresponse to a range of indicators. Some information will also be available through theindustry's benchmarking initiatives, so clients observe how potential supplierscompare with the rest of industry in a number of different areas.

Construction supplychain companies will be able to benchmark their performance to enable them toidentify strengths and weaknesses, and assess their ability to improve over time. TheKPIs framework consists of seven main groups: time, cost, quality, client satisfaction, client changes, business Performance, health and safety (DETR, 2000).

1.3 - Aim of the Research:

This research aims to study and assess factors influencing on construction projects, and highlight the needs and identify the problems and the barriers that exists in construction projects to improve the quality of the work and avoid problems.

1.4- Research Objectives:

- To identify the factors affecting the performance of construction projects. And identify the most significant factors affecting performance of construction projects.
- To measure consultants and contractors perceptions and views about the factors affecting the performance in construction projects.

- To formulate recommendations to improve performance of constructionProjects.

1.5 - Scope of research:

This research came due to the development in construction industry and productivity which is taking place in the world, in order to motivate and develop the management of the projects. This study stressed on many aspects on the subject of the indicators and factors that affecting construction projects in terms of problems and impediments that facing the construction industry process, and suggested solutions through this research, it is recommended for construction organizations to implement and evaluate their projects performance.

A structured methodology and technique should be identified to overcome the factors that affect the performance of project. By understanding the main objectives of the research and try to apply it clearly on the ground that will assist to perform projects successfully and strongly.

1.6 - Problem statement:

The development of construction industry make construction project became more difficult for the project objectives to be achieved, previous studies shown and proved that the failure of any project is mainly related to the problems and failure in performance. There are many reasons and factors which attribute to such this problem and appear through different directions,many projects which finished with poor performance because of many evidential reasons such as: obstacles by client, non-availability of

materials, roads closure, amendment of the design and drawing, additional works, waiting the decision, handing over, variation order, amendments in Bill of Quantity and delay of receiving drawings.This research will evaluate the factors affecting the performance of construction projects in order to assist owners, consultants and contractors to overcome performance problem and to improve performance of their construction projects.

1.7 - Methodology:

This research presents the indicators and factors affecting the performance of construction projects to achieve the required target, goals and objectives. This study will be used quantitative and questionnaire will perform to measure and study the attitude of consultants, and contractors towards the factors affecting the performance of construction projects, the questionnaires will sent to consultants and contractors. The respondents will ask to indicate, based on their local experience the level of importance of each one of the identified factors of performance.

1.8 - Research Structure:

This research consists of main five chapters as followings:

- **Chapter one**: Introduction: this chapter shows the aim and objectives of research,statement of the problem and justification of research.
- **Chapter two**: Literature review: this chapter shows a historical review fromprevious studied to identify the main factors affecting the performance of construction projects.
- **Chapter three**: Methodology: this chapter shows the main methodologies used inprevious studies and the methodology used in this research in order to achieve the required objectives.

- **Chapter four**: Results analysis: this chapter shows analysis, description anddiscussion of research results.
- **Chapter five**: Conclusions and recommendations.

Chapter 2

LITERATURE REVIEW

2.1 - Preface:

Construction can be considered as a vital sector contributing significantly to the economics of all countries. The construction industry must be dynamic to be able to respond to the changes that the world is constantly facing, as well as the social, economic, and technological challenges affecting all industries. The opportunities and problems in construction are different from those of the last century. The demands of clients, companies and employees differ from time to time, and thus the vision of the construction industry is always developing; to keep up, management must change too, which will be helpful in shaping the goals and requirements of the future .

Construction project development involves numerous parties, various processes, different phases and stages of work and a great deal of input from both the public and private sectors, with the major aim being to bring the project to a successful conclusion. The level of success in carrying out construction project development activities will depend heavily on the quality of the managerial, financial, technical and organizational performance of the respective parties, while taking into consideration the associated risk management, the business environment, and economic and political stability.Any construction organization must have a strategic plan and vision that lead the way to achieving its goals. The key to achieving that lays in successful management, by identifying needs and goals the company wants to achieve. To do that, project management must be planned on many levels,

such as implementing, organizing, delegating, decision making and performing. The survival and the progress of any company depend upon how well project management is implemented and how experienced the company is in this field (Walker, 2007).

2. 2 - History of construction project management:

The History of Project Management is the history of mega projects of the last 4,500 years that include the Pyramid, the Parthenon, the Colosseum, the Gothic Cathedrals of Europe, the TajMahal, and the Transcontinental Railway. These were not anomalies in history but projects delivered in a systematic way with very similar characteristics to today's projects. Typically, they had a project charter, a business justification, and a project sponsor. In close analysis they also followed a similar life-cycle of phases that we use today, incorporating the Project Management Process Groups (initiating, planning, executing, monitoring and controlling, and closing). In close examination they also intuitively followed all nine PMBOK knowledge areas (Integration, Scope, Time, Cost, Quality, Human Resources, Communications, Risk, and Procurement). Those complex works needed sophisticated and effective management. This shows that that the science of project management was known long ago and was practiced in different ways. It also shows that effective management and construction techniques can produce excellent and long-lasting results. However, in those eras, little attention was paid to those people who finished this work, or to how long it took from the standpoint of time, effort and budget.

In the late 19th century, because of the rising complexities of the construction business, management principles began to evolve more effectively. Big projects involved thousands of workers, huge quantities of

materials, machinery and equipment. It’s begun from that time to see project management implemented by engineers and architects themselves.

Later, techniques were applied to even more complicated projects (Anne, M. PM in Practice.Net. 2009). In the 1950, Taylor’s work was considered the basic element of modern project management, and included the work breakdown structure and resource allocation.

Work breakdown structure (WBS) is “A deliverable-oriented hierarchical decomposition of the work to be executedby the project team to accomplish the project objectives and create therequired deliverables.” This approach arranged tasks to produce the result of maximum output with minimum input. Many people criticized this approach, as it seemed to regard people as machines rather than human beings. AlthoughTaylor was considered as pragmatic in his field, he analyzed the various aspects of work patterns and behavior. His study confirmed that alternate work methods could result in a considerable increase in productivity and a reduction in labor and material costs. Others like Weber, who was from the same school of thought, was concerned with describing bureaucratic structure (PMBOK).

At the same time two other important methods were developed: the “Critical Path Method” (CPM) by DuPont Corporation and Remington Rand Corporation, and “Program Evaluation and Review Technique” (PERT) by B. A. Hamilton (U.S. Navy). This approach developed the principles of management which concentrated on the pyramid structure. This method emphasizes delegation, and encouraging delegating authority downwards from the head of the pyramid to the line of staff, but still with formalization and specialization. These approaches were considered as the classical approaches in management and were called “organizations without people”, as described by Bennis. The classical approaches were seen as rigid and inflexible because they concentrated on the internal characteristics of the organization rather than the external influences, and did not take into

consideration the social and environmental side of the work. As a result of these many studies the behavior school appeared between 1930s and the 1970s. Many psychologists devoted their studies to the behavior of supervisors and subordinates in an organization, describing the behavior of people in organizations, and considering the values and motivation can be helpful to achieve organization goals and objects,which can be reflected and appeared in the performance of any project through its implementation (Kerzner& John Willey, 2006).Still, the behavioral approach does not take into account environmental factors in a specific manner but treats them in general. Considering the organization as a closed system, there is still a big gap and many approaches between the classical and the behavioral approaches.

Later additional fields were developed, such as marketing approaches, industrial psychology and human relations, fields that went on to become the backbone of management. In 1967 the International Project Management Association (IPMA) was established in Europe as a federation of several national project management associations (Wiley, 1994).

The project management Institute (PMI), found in the U.S. in 1969, publishes the PMPOK Guide, (A guide to the Project Management Body of Knowledge) (PMBOK), which describes the most common project management practices and gives certification in PM field (Walker, Blakcwell , PM in construction,2007).

2.3 - Understanding Project & Management:

The definition of management is the basic knowledge in defining PM, management needs team working with the skills needed to achieve a certain goal; this is the core issue of successful management in all topics. In order to

understand project management, need to understand both project and management first. “A project is a temporary endeavor undertaken to create a unique product,service or result” (PMBOK). A project is temporary and that means it has a definite beginning and a definite end. In other words the time is limited but does not necessarily mean a short time; the duration of a project depends on project type. Unique means that each project is different, and each has some distinguishing features. Even if the project has repetitive elements it’s still unique because it has a different owner, design location and facilities. A project must be progressively developed, which means continuous and steady work and growth (John Willey, 2006).

2.4 - Construction Project:

A project is defined, whether it is in construction or not, by the following characteristics:

- A defined goal or objective.
- Specific tasks to be performed.
- A defined beginning and end.
- Resources being consumed.

The goal of construction project is to build something. What differentiate the construction industry from other industries is that its projects are large, built on-site, and generally unique. Time, money, labor, equipment, and, materials are all examples of the kinds of resources that are consumed by the project.Projects generally begin with a stated goal established by the owner and accomplished by the project team. As the team begins to design, estimate, and plan out the project, the members learn more about the project than was known when the goal was first established. This often leads to a redefinition of the stated project goals.

2.5 - Management of Construction Projects:

Construction projects can be considered as a largest industry in the world. Growth in this industry in fact is an indicator of the economic conditions of a country. This is because the construction industry consumes a wide employment circle of labor. It's on the other hand, most of construction projects exhibit cost overruns, time extensions, and conflicts among parties and dereliction in safety and quality sector.

Project management is designed to control the main important elements that provide practical information for achieving project objectives. (Kerzner, 2006) defined PM as "Project management is the planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives. Furthermore, project management utilizes the systems approach to management by having functional personnel (the vertical hierarchy assigned to a specific project (The horizontal hierarchy)".

Figure 2.1 shows that project management is designed to control the key elements that provide practical information for achieving project objectives in an efficient way; it means using the company resources on a certain activity within time, cost and performance constraints. A fourth key is good customer relations.

Figure 2.1: Overview of project management

This figure shows that project management is designed to control the key elements that provide practical information for achieving project objectives

(Kerzner, 2006) highlighted the main keys in project management is time and cost with an accepted level of performance. There are many definitions to project management , but the Project Management Body of Knowledge defined PM as “the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder’s needs and expectations from a project” .Each definition will vary according to the goals and needs of the organization.

Construction project management has the same main objects as project management which are cost, time and performance, but in construction PM its cost, time and quality, which did not change fundamentally but may be took a wider range in referring to people and the importance of working through others, also in construction project management client satisfaction is one important key to project success as well as the objectives and goals of the company itself. (Walker- 2007)

2.6 - Construction Management and Performance:

Construction projects require skilled management, as they are complicated and face many challenges and constraints, such as cost, time regulations, materials and environmental rules or customs. In construction

projects several activities happen and take place at the same time, but still are connected and integrated. Therefore we need thorough and effective communications and cooperation to manage and control these activities. (Walker- 2007).

There is a strong relation between project management and project performance. Management in construction industry is considered as one of the most important factors affecting performance of works. (Brown and Adams ,2000) studied a new approach to the measurement of the effect of Building Project Management (BPM) on time, cost and quality outputs using 15 `cases' derived from UK data. The evaluation undertaken demonstrates that BPM as it is presently implemented in the UK fails to perform as expected in relation to the three predominant performance evaluation criteria; time, cost and quality. (Thomas, 2002) stated that documenting and archiving performance data could be useful for future reference, such as for settling disputes on claims, and in maintenance and repair works.(Ugwu and Haupt ,2007) stated that an adequate understanding and knowledge of performance are desirable for archiving managerial goals such as improvement of institutional transformations, and efficient decision making in design, specification and construction, at various project-level interfaces, using appropriate decision-support tools.

(Cheung, 2004) studied the project performance related to project managers. It is remarked that development of construction Project Performance Monitoring System (PPMS) can assist project managers in exercising construction project performance indicators and can help senior project management, project directors, project managers, etc., in monitoring and assessing project performance. Using project management in organization helped in many ways, such as reducing costs, improving timing and focusing on results and quality, all through good cooperation across the organization.

2.7 - Construction Projects and Performance:

Project success is almost the ultimate goal for every project. Success of construction projects depends mainly on success of performance. Many previous researches had been studied

performance of construction projects. (Reichelt and Lyneis, 1999) remarked three important structures underlying the dynamic of a project performance which are: the work accomplishment structure, feedback effects on productivity and work quality and effects from upstream phases to downstream phases.(Thomas,2002) identified the main performance criteria of construction projects as financial stability, progress of work, standard of quality, health and safety, resources, relationship with clients, relationship with consultants, management capabilities, claim and contractual disputes, relationship with subcontractors, reputation and amount of subcontracting. (Cheung, 2004) stated that construction time is increasingly important because it often serves as a crucial benchmarking for assessing the performance of a project and the efficiency of the project organization. For each of the project goals, one or more Project Performance Indicators (PPI) is needed.

(Cheung et al, 2004) identified project performance categories such as people, cost, time, quality, safety and health, environment, client satisfaction, and communication. It is obtained by Navon (2005) that a control system is an important element to identify factors affecting construction project effort.

(Ugwu and Haupt ,2007) remarked that both early contractor involvement (ECI) and early supplier involvement (ESI) would minimize constructability-related performance problems including costs associated with delays, claims, wastages and rework, etc. Control system is an important element to identify factors affecting construction project effort. For each of the project goals, one or more Project Performance Indicators (PPI) is needed.Generally performance of construction projects plays a main role in the success process of the projects.

2.8 - Measurement of Project Performance:

The purpose of performance measurement is to help organizations understand how decision-making processes or practices led to success or failure in the past and how that understanding can lead to future improvements. (Karim and Marosszeky, 1999) stated that performance measurement systems have been one of the primary tools used by the manufacturing sector for business process re-engineering in order to monitor the outcomes and effectiveness of implementation. Evaluation of framework to measure the efficiency of building project management (BPM) by using conventional economic analysis tools such as time, cost and quality (Adams, 2000).

The performance measurement is a complex issue that normally incorporates at least three different disciplines: economics, management and accounting. Measurement of performance has garnered significant interest recently among both academics and practitioners, and also remarked that the choice of a suitable measurement technique depends on a number of factors, including the purpose of the measurement; the level of detail required; the time available for the measurement; the existence of available data; and the cost of measurement (Tangen, 2004). Performance measurement is needed not only to control current projects but also to update the historic database. Such updates enable better planning of future projects in terms of costs, schedules, labor allocation, etc.

Stated that measuring the performance of any construction project is a very complex process because modern construction projects are generally multidisciplinary in nature and they involve participation of designers, contractors, subcontractors, specialists, construction managers, and consultants. With the increasing size of the project, number of participants in the project also increases.

The objectives or goals of all participants need not be same even in a given project. Hence to measure performance of a project without specifying the participant and without specifying the criteria for judging the performance holds no meaning. Past researchers have employed different criteria such as compliance to schedule, cost and quality to judge the project performance.(Iyer and Jha ,2005)

(Cheung,2004) stated that New South Wales Public Works Department in Australia launched a Project Performance Evaluation (PPE) framework, which covers a wide range of performance parameters. PPE parameters are communication, time, cost, quality, safety, claims and issues resolution, environment, contract relations. The main purpose of PPE is to extend project performance measures to cover soft parameters also, such as communication and dispute resolution. In UK, a project performance measurement tool referred to as the Key Performance Indicators (KPIs) was developed by the KPI working group under the UK Construction Industry Best Practice Programme to include time, cost, quality, client satisfaction, change orders, business performance, health and safety. The three major steps in implementing KPIs are as follows: Decide what to measure, Collect data and calculate the KPIs. However, both the PPE and KPIs are valuable tools for measuring project performance over a period of time. Anyway, it is obtained from previous study that both methods PPE and KPIs can be used for measuring of performance as the indicators are similar in two methods.

Measurement of project performance can no longer be restricted to the traditional criteria, which consist of time, cost and quality. There are other measurement criteria such as project management and products (Pheng and Chuan, 2006).

2.9 - Benchmarking of projects Performance:

For continuous improvement to occur, it is necessary to have performance measures which check and monitor performance, to verify changes and the effect of improvement actions, to understand the variability of the processes, and in general, it is a necessary to have objective information available in order to make effective decisions.

(Tolosi,2000) defined benchmarking as a process which continuously measures the products, services and operational practices of a given organization to compare the organization's performance and operational practices with a selected sample group. In addition to create a basis for comparison, benchmarking is a good development tool because it enforces a self-critical approach, indicating the points of operation the company must improve.

However, benchmarking must be used with caution, and its design as a tool of analysis must be thoughtfully considered in order to achieve accurate and meaningful indicators.Benchmarking helps companies to define the best possible indicators for comparison and to obtain a picture of the company's entire operation. Therefore, benchmarking is a useful tool for evaluating a company.

(Augusto,2006) stated that the effective performance cannot be achieved withoutchallenges and obstacles. To meet these challenges and overcome these obstacles, anorganization must have a clear understanding of its performance in relation to itscompetitors. To accomplish this task, an organization must have an organizationalbenchmarking system which is occupied with analytical models designed to measuremultifaceted performance characteristics and parameters. The results presented how business organizations may locate their position against competition, reduce their weak points and determine which characteristics will improve their global performance. This gives the ability to identify the most critical improvement actions and adopt the best practices of the industry.

Benchmarking and performance measurement service for the evaluation and comparison of scheduling techniques. Presented how benchmarking approach can be applied to evaluate and improve the construction project management. A conceptual research framework was generally developed to perform a benchmarking study of the project management performance (PMP) from the contractor’s viewpoint. It was remarked that benchmarking approach can help construction firms to learn from the best practices of others and carry out continuous improvement (Cavalieri, 2007)

2.10 - Project Success and Project Performance:

Project success is the completion of a project within acceptable time, cost and quality and achieving client's satisfaction. Project success can be achieved through the good performance of indicators of the project. So, success refers to project success and performance refers to performance of indicators such as project managers.The success of any project is related to two important features, which are service quality in construction delivered by contractors and the

project owner's expectations. Managing the construction so that all the participants perceive equity of benefits can be crucial to project success. It is obtained that the complete lack of attention devoted to owner's satisfaction contributes to poor performance, also low efficiency and productivity can lead to poor performance. The success of construction projects depends up on technology, process, people, procurement, legal issues, and knowledge management which must be considered equally. The focus of most studies of project success is on dimensions of project success (how to measure it) and factors influencing project success.(Pheng and Chuan, 2006).

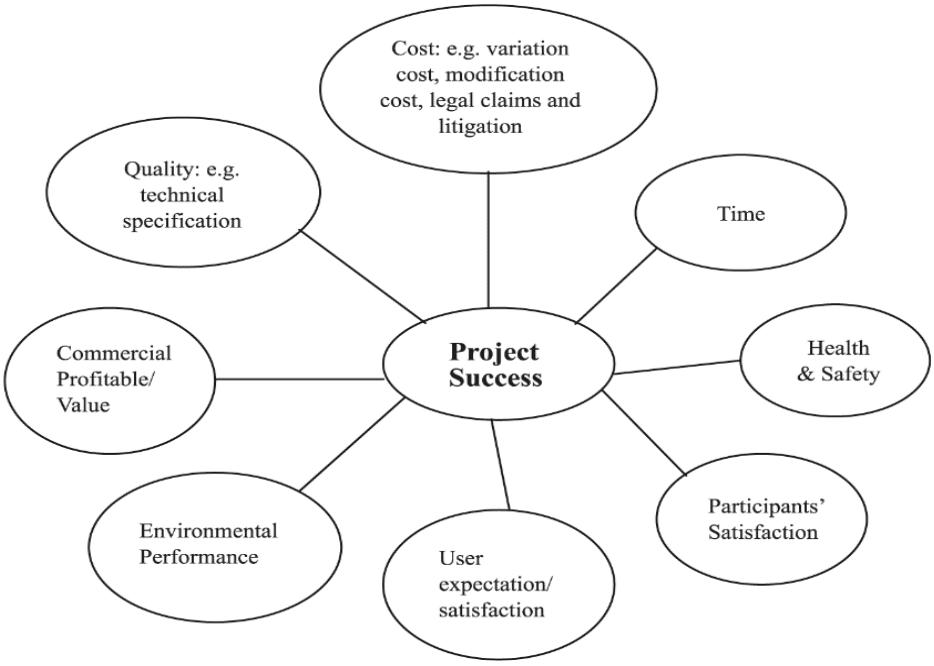


Fig 2.2: showing the consolidated framework for measuring project success

2.11 - Factors Affecting Performance of Managers:

Projects can be considered as a set of activities that must be completed in accordance to specific objectives which involve the utilization of a company's resources. In order to meet the objectives of modern projects, which are increasingly complex in nature, it is essential for project managers to be able to use a variety of managerial skills such as the following:

a. Management knowledge and skills: finance and accounting; sales and marketing; research and development; manufacturing and distributions; strategic planning; tactical planning; operational planning; organization structures; organizational behavior; personnel administration; managing work relationships .

b. Technical knowledge and skills: defined as an understanding of and proficiency in, a specific kind of activity, particularly one involving methods, processes, procedures, or techniques

c. Business knowledge and skill: on small projects, this can be a tough challenge because project managers are also managing the project control function.
d. Human knowledge and skills: the ability to work with and through other people.

Knowledge that would influence potential performance enables project managers to pay special attention to control performance more effectively. It's remarked that effective communication and fast information transfer between managers and participants help to accelerate the building construction process and performance.

2.12 - Factors Affecting Cost and Time Performance:

One of the most important problems in the construction industry is time and cost overruns. Time and cost overruns occur in every construction project and the magnitude of these delays and cost overruns varies considerably from project to project. So it is essential to define the actual causes of time and cost overruns in order to minimize and avoid the delays and increasing cost in any construction project.

Time overruns is defined as the extension of time beyond planned completion dates traceable to the contractors. Delays are incidents that impact a project's progress and postpone project activities; delay causing incidents may include weather delays, unavailability of resources, design delays, etc. In general, project delays occur as a result of project activities

that have both internal and external factors surrounded the project. Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation," "cost increase," or budget overrun. It’s the difference between the original cost estimate of project and actual construction cost on completion of works of a commercial sector construction project.

A number of unexpected problems and changes from original design arise during the construction phase, leading to problems in cost and time performance. It is found that poor site management, unforeseen ground conditions and low speed of decision making involving all project teams are the three most significant factors causing delays and problems of time performance. It is remarked that effective communication, fast information transfer between project participants, the better selection and training of managers, and detailed construction programs with advanced available software can help to accelerate the performance.(Chan, 2002)

2.13 - Factors Affecting Quality Performance:

This process is needed in this stage to make sure that what is produced by the team is exactly what had been agreed upon with the client or customer. Quality management is needed not only in this phase but throughout the project. At this point it is important to ensure that expectation of our work is what was planned from the beginning. The factors that affect process quality in the three phases (design, construction, and operation) of the life cycle of a building project are identified and ranked by degree of importance. The perceptions of long-time practitioners are obtained by means of a questionnaire survey. The findings indicate that management commitment to continuous quality improvement, management leadership in promoting high process quality; quality training of all personnel, efficient teamwork to promote quality issues at the corporate level, and effective cooperation between parties taking part in the project are generic factors that affect process quality.

Industry-specific factors that are perceived by practitioners to enhance the quality of the building process include drawings and specifications that are consistent, designers and contractors that are selected on merit, communication practices between the parties that are

effective, inspection of quality on the construction site that is diligent, a building operation manual that is thorough, and an adequate operation and maintenance budget that is planned as early as in the design phase.
(Arditi, D. and Gunaydin, H.,1998).

2.14 - Factors Affecting Productivity Performance:

The term “productivity” expresses the relationship between outputs and inputs. Output and input differ from one industry to another. Also, the productivity definition varies when applied to different areas of the same industry. Labor is one of the basic requirements in the construction industry. Labor productivity usually relates manpower in terms of labor cost to the quantity of outputs produced. Achieving better productivity requires detailed studies of the actual labor cost. Various labors have different variables affecting their productivity levels. For every project, productivity, cost, quality, and time have been the main concern. Better productivity can be achieved if project management includes the skills of education and training, the work method, personal health, motivational factors, the type of tools, machines, required equipment and materials, personal skills, the workload to be executed, expected work quality, work location, the type of work to be done, and supervisory personnel (Borcherding and Liou, 1986).

Past studies and research show the number of factors affecting productivity such as:

- **Type of Project:** To accomplish substantial productivity, every member of a crew requires adequate space to perform task without being affected with/by the other crew members. When more labors are allotted to perform particular task, in a fixed amount of space, it is probable that interference may occur, thus decreasing productivity. Additionally, when multiple trades are assigned to work in the same area, the probability of interference rises and Productivity may be reduced. Interference among the various crews and laborers is due to mismanagement on construction sites. For example, a steel-fixture crew has to wait before fixing the reinforcement rods if the carpenter’s framework is incomplete. The types of activities and construction methods also influence labor productivity (Sanders and Thomas, 1991).

- **Safety:** Accidents have high impacts on labor productivity. Various accident types occur at the site, such as an accident causing death and resulting in a total work stoppage for a number of days. An accident that causes an injured person to be hospitalized results in a work decrease of the crew for which the injured employee worked. Small accidents resulting from nails and steel wires can stop work and, thus, decrease productivity (Sanders and Thomas, 1991). Even insufficient lighting shows decreased productivity because sufficient lighting is required to work efficiently and because insufficient lighting has negative effects. Employing a safety officer helps labors to recognize the required safety regulations and to follow them, which can reduce the number of accidents, thus increasing productivity.

- **Supervision:** Generally, projects come across some design, drawings and specification changes during construction. If drawings or specifications are with errors and unclear productivity is expected to decrease since laborers in the field are uncertain about what needs to be done. As a result, task may be delayed, or have to be completely stopped and postpone it until clear instruction. There is a 30% loss of productivity when work changes are being performed (Thomas et al., 1999). Work inspection by the supervisor is an essential process to proceed. For example, the contractor cannot cast concrete before an inspection of the formwork and steel work, thus affecting labor productivity (Zakeri et al., 1996). With non-completion of the required work according to the specifications and drawings, supervisors may ask for the rework of a specific task. Supervisors' absenteeism stops the work totally for activities that require their attendance, such as casting concrete and backfilling, further delaying inspection of the completed work which, in turn, leads to delays in starting new work.

- **Material/Tools:** Material management is one of the most important factors in construction industry. Productivity can be affected if required materials, tools, or construction equipment for the specific are not available at the correct location and time. Selection of the appropriate type and size of construction equipment often affects the required amount of time it is, therefore, essential for site managers to be familiar with the

characteristics of the major types of equipment most commonly used in construction. In order to increase job-site productivity, it is beneficial to select equipment with the proper characteristics and a size most suitable for the work conditions at a construction site. Laborers require a minimum number of tools and equipment to work effectively to complete the assigned task. If the improper tools or equipment is provided, productivity may be affected. The size of the construction site and the material storage location has a significant impact on productivity because laborers require extra time to move required materials from inappropriate storage locations, thus resulting in productivity loss (Sanders and Thomas, 1991).

- **Political Factors:** Law and order, stability of government, etc. are essential for high productivity in the construction industry. The government's taxation policies influence willingness to work and expansion of plants. (A. Kumar, as cited in Desai, 2004).

2.16 - The performance of construction projects in Sudan:

In the development of any country, the construction industry plays a main role in transforming the aspirations and the needs of its people into reality by implementing various physical structures. A construction project is commonly acknowledged as successful when it is completed on time, within budget, and in accordance with specifications and to stakeholder's satisfaction. The success of a construction project depends on its performance, Sudan construction industry is facing several problems and challenges this can be summarized in availability of poorness in the performance of construction projects. Performance is the way project managers, consultants, and contractors respond to the workload. Performance tools are able to monitor system variables and provide instantaneous or historical feedback on the way system has dealt with the workload. Performance management is the strategic use of performance standards, measures, progress reports, and ongoing quality improvement efforts to ensure that an agency achieves its desired results. Construction project life cycles occur in more phases (stages) of a product lifecycle. The phase structure allows the project to be segmented into logical subsets forease of management, planning, and control.

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 investments. The development in the construction industry is increasing in size, technological complexity, interdependencies and variations in demand from the client.

The scope of construction industry is very wide, including residential construction, building construction of commercial, irrigation, roads, tunnels, transportation, facility building, and heavy engineering construction refer to infrastructure construction and industrial construction that need specialist expertise and contributes substantially to the economic growth of country. The construction sector is important to the Sudan economy and it accounted for 3.2% of the country's GDP (Gross Domestic Product) in 2009 and grew by about 10% in 2010 in nominal terms, according to the Central Bank of Sudan. It is widely accepted that a project is successful when it is finished on time, within budget, in accordance with specifications and to stakeholders' satisfaction. Unfortunately, due to many reasons, high project performance and project success are not commonplace in the construction industry, especially in developing countries. Therefore, professionals and scholars have been motivated to take extensive efforts to meet this challenge. As a result, several studies have been undertaken on factors affecting delays, cost overrun, quality, safety, productivity and problems in specific types of projects.

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 construction project often changes from project to project depending on participants, scope of services, project size, and sophistication of the owner related to the design of facilities, technological implications, and a variety of other factors.

2.17- Summary:

The construction industry through the past years has suffered from criticism, as it always adopt the conservative way in work, and lack innovation, new ideas, and creative methods in implementing the construction projects are needed to be implemented in the new ways of technology. According to previous studies, it can be said that the performance measurement is a process include factors as Key Performance Indicators (KPIs) such as time, cost, quality, client satisfaction; productivity and safety in order to enable measurement of current organizational project performance and to achieve significant performance improvements of future projects.

It was obtained that there were many fields and topics which are related to performance such as, construction management, information technology, factors affecting performance of managers, measurement of project performance, key performance indicator and benchmarking.

The key performance indicators are used to evaluate performance of construction projects. These indicators can then be used for benchmarking purposes, and will be as a key component of any organization to move towards achieving best practice and to overcome performance problem in construction projects. Based on previous studies and literature review, the factors which will be studied in this research are:

1. Cost factor
2. Time factor
3. Quality factor
4. Productivity factor
5. Client satisfaction factor
6. Health and Safety factor
7. Innovation and learning factor

Chapter 3

RESEARCH METHODOLOGY

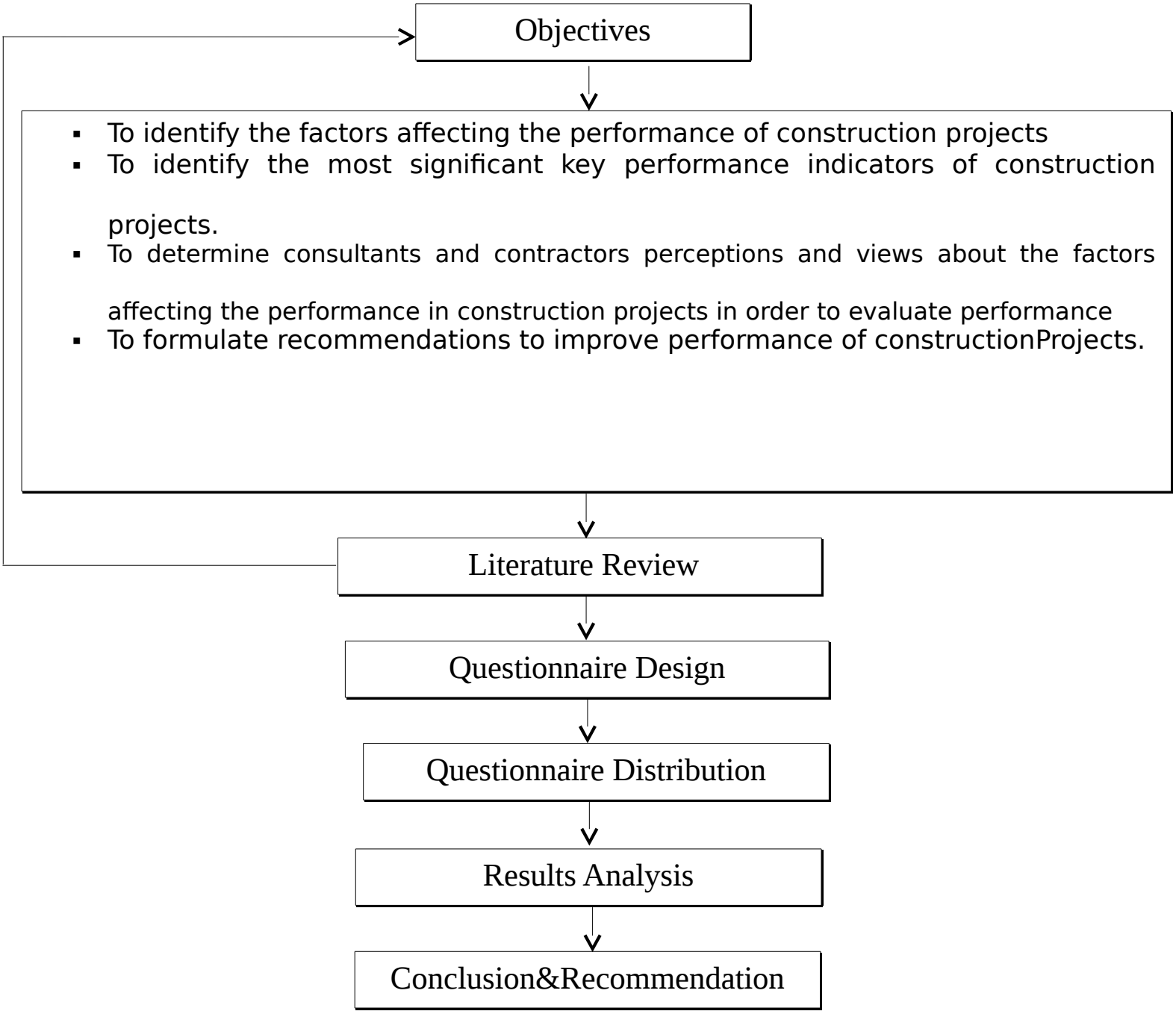
3.1- Introduction:

Generally, methodology can be considered more than simply the methods intend to use to collect data. It is often necessary to include a consideration of the concepts and theories which underlie the methods .Theoretical analysis of the methods and applied it to a field of study.

This research presents the main factors affecting the performance of construction projects. From literature review and past studies, it was obtained that there were different directions and methodologies used in order to achieve the required target, goals and objectives. Some of previous studies focused on factors affecting the performance of construction projects with in general view, other studies concentrated on one or two directions such as cost, time and quality performance, other studies focused on measurement of construction projects performance.

The differentiation of directions and goals of topic as shown previously, required different methodologies. The main methodologies obtained from literature review were: questionnaire survey and case studies. To summarize the methodology description of the research study, Figure 3.1 shows the diagram of the methodology used in this research.

Figure 3.1: shows the diagram of the methodology used in this research.



3.2 - Research strategy:

Selecting a research method is an important decision, the researchers needs to study the approaches to know which of them will satisfy the objectives of the study, and will fit with the information available and with the information needed. Two types of research strategies are used at studies, quantitative and qualitative research. Quantitative approach is used to gather factual data and to study relationships between facts and how such facts and relationships accord with theories and the findings of any research executed previously, but the qualitative approach seek to gain insights and to understand people's perception. In this research a quantitative approach is used to understand the perception of contractors and consultants towards factors influencing the performance of construction projects.

3.3 - Research Methodology:

The basic methodology which is considered to achieve the objectives of this research is which is (1- To identify the factors affecting the Performance of construction projects and identify the most significant key performance indicators of construction projects, 2- measure consultants and contractors perceptions and views about the factors affecting the performance in construction projects, 3/ formulate recommendations to improve Performance of construction projects).

Literature review about performance was reviewed and identified the factor affecting the performance of construction projects, these factors are grouped into seven groups based on literature review. These groups can give a comprehensive summary of the factors affecting the performance of construction projects. The factors, which are considered in the questionnaire, are summarized and collected according to previous studies.

A questionnaire survey approach is considered to study the impact of various attributes and factors affecting performance. In addition, the questionnaire can assist to study the attitude of consultants and contractors towards the factors that effect on performance in the construction.

The relative importance index method (RII) is used to determine the most significant key performance indicators of construction projects. The RII method has been adopted by many researchers (Kometa et al., 1994; Aibinu and Jagboro, 2002 and Cheung et al, 2004; Iyer and Jha, 2005; Ugwu and Haupt, 2007). The relative importance index is computed as:

$$RII = \frac{\sum W}{A \times N}$$

Where:

- W is the weight given to each factor by the respondents and ranges from 1 to 5
- A = the highest weight = 5
- N = the total number of respondents

Analyzed the practices concerning in order to know the main practical problems of project performance and then to formulate recommendations to improve performance of construction projects.

3.5 - Questionnaire Design:

The questionnaire included two parts that related to the factors influences the performance of construction projects , part one consist of

general information about the respondents, the second part consist of the factors and indicators that affecting the construction projects , were considered and were listed under seven groups based on the literature reviewed. The respondents were asked to indicate, based on their experience. The questionnairedivided for two copies (Arabic and English).

In this research, likertscales were used. Ordinal scale as shown in Table 3.1 is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the important (1, 2, 3, 4, 5) indicate that the interval between scales are not equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Likert scale we have the following table 3.5 (Cheung et al, 2004; Iyer and Jha, 2005; Ugwu and Haupt, 2007).

Table (3.1) Ordinal scale used for data measurement:

Item	Very high important	High important	Medium important	Low important	Very low important
Scale	5	4	3	2	1

3.6 - Questionnaire Distribution:

The target groups in this study are contractors and consultants. According to the Sudanese contractor union, there are 727 contractor organizations in Sudan. According to Organizing Council for Consultancy Firms there are 208 consultant organizations in Sudan.

The sample size can be calculated as following equation, in order to achieve 94% confidence level (Assaf et al 2001, Moore et al, 2003).

$$n= n'/ [1+ (n'/N)]$$

Where:

- N = total number of population
- n= sample size from finite population
- n' = sample size from infinite population = S^2/V^2; where S_2 is the variance of thepopulation elements and V is a standard error of sampling population. (Usually S= 0.5 and V = 0.06).

So, for 727 contractor organizations:

- n= n'/ [1+(n'/N)]
- n'= $S^2/V^2 = (0.5)_2/(0.06)_2 = 69.44$
- N = 727
- n= 69.44/ [1+(69.44 / 727)] = 63

This means that the questionnaire should be distributed to 63 contractor organizations in order to achieve 94% confidence level.

So, for 208 contractor organizations:

- n= n'/ [1+(n'/N)]
- n'= $S^2/V^2 = (0.5)_2/(0.06)_2 = 69.44$
- N = 208
- n= 69.44/ [1+(69.44 / 208)] = 52

This means that the questionnaire should be distributed to 52consultant organizations in order to achieve 94% confidence level.

Based on the information provided by those two bodies related to the construction industry in Sudan (Sudanese Contractors Union and Organizations Council Consultancy Firms), Number of contractors and consultants firms was provided are considered in all Sudanese states and there is no an accurate estimation for the number of firms working in Khartoum state only, where the study has been conducted. Therefore, size of samples will participate in this study will be chosen randomly, 40 (67%) for contractors and 20 (33%) for consultants.

Chapter 4

RESULTS AND ANALAYSIS

4.1. Introduction:

This chapter describes the results, analysis and discussion of questionnaire survey concerning the indicators that affecting the performance of construction project from contractors and consultants viewpoints. This chapter focuses on describing the respondent's characteristics in addition to the discussion of the factors that affecting the performance of the construction project.

4.2. Part One: General Information:

1. Type of Organization:

Table 4.1 shows the frequency and percent of each type of organization:

Type of Organization	Frequency	Percent%
Contractor	40	67%
Consultant	20	33%
Total	60	100%

Fig. 4.1. Percentages of received questionnaires

2. Typical of projects of organization:

Table 4.2 shows the percent of organizations projects types according to each type of target group:

Type of project	Frequency	Percent%
Residential	35	58.3%
Non Residential	20	33.3%
Roads	5	8.3%
Total	60	100%

Fig. 4.2. Show the Typical of projects of organization:

Figure 4.2 shows that the Residential represents the highest field of work according to who participated in the questionnaire, and 33.3% was recorded to the Nonresidential, the lowest percentage was for the Roads field work which is recorded8.3%.

4.3. Indicators Affecting the Performance of Construction Projects according to Contractors view:

The results of this part of study provide an indication of the relative importance index and rank of factors affecting the performance of construction projects. The following Table 4.5 show summary of factors ranking according to contractors view and show each type of target group.

Table (4.5) the relative importance index (RII) and rank of indicators affecting the performance of construction projects according to each category and according to Contractor view and opinion.

Cost Factor	***RII***	***Rank***
Liquidity of organization	0.81	10
Profit rate of project	0.74	19
Project design cost	0.68	25
Project labor cost	0.79	13
Material and equipment cost	0.77	15
Project overtime cost	0.58	34

Cost of rework	0.67	26
Regular project budget update	0.76	16
Motivation cost	0.60	32
Time Factor	***RII***	***Rank***
Planned time for project construction	0.62	31
Average delay in claim approval	0.78	14
Average delay in payment from owner to contractor	0.83	8
Time needed to rectify defects	0.65	28
Availability of resources as planned through project duration	0.89	3
Quality Factors	***RII***	***Rank***
Conformance to specification	0.86	5
Availability of personals with high experience and qualification	0.90	2
Quality of equipment and raw materials in project	0.85	6
Quality assessment system in organization	0.73	20
Quality training/meeting	0.64	29
Productivity Factors	***RII***	***Rank***
Sequencing of work according to schedule	0.82	9
Absenteeism rate through project	071	23
Management-labor relationship	0.76	17
Project complexity	0.75	18
Client Satisfaction Factors	***RII***	***Rank***
Speed and reliability of service to owner	0.84	7
Information coordination between owner and project parties	0.72	22
Leadership skills for project manager	0.91	1
Number of disputes between owner and project parties	0.80	11
Number of reworks	0.66	27
Health and Safety Factors	***RII***	***Rank***
Application of Health and safety factors in organization	0.69	24
Reportable accidents rate in project	0.59	33
Assurance rate of project	0.63	30
Training and Learning Factors	***RII***	***Rank***
Training the human resources in the skills demanded	0.80	12
Learning from best practice and experience of others	0.88	4
Review of failures and solve them	0.73	21

The most important factors agreed by the contractors as the main indicators and factors that affecting the performance of construction projects were (leadership skills for project manager ; Availability of personals with high experience and qualification ; Availability of resources as planned through project duration ; Learning from best practice and experience of others ; Conformance to specification ; Quality of equipment and raw materials in project ;

Speed and reliability of service to owner ; Average delay in payment from owner to contractor ; Sequencing of work according to schedule ; Liquidity of organization .
This can be explained and shown by Table 4.6:

4.3.1. Top significant factors affecting the performance of construction according to contractors view:

Table (4.6) the following factors are among the top significant factors affecting the performance of construction projects according to contractor view for all parties.

Top significant Indicators and factors	*RII*	*Rank*
Leadership skills for project manager	0.91	1
Availability of personals with high experience and qualification	0.90	2
Availability of resources as planned through project duration	0.89	3
Learning from best practice and experience of others	0.88	4
Conformance to specification	0.86	5
Quality of equipment and raw materials in project	0.85	6
Speed and reliability of service to owner	0.84	7
Average delay in payment from owner to contractor	0.83	8
Sequencing of work according to schedule	0.82	9
Liquidity of organization	0.81	10

According to contractors, it was obtained that the Leadership skills for project manager was the most important performance factor as it has the first rank among all factors with relative index (RII) = 0.91. This factor is considered as more important for contractors.

This is mainly because that if project manager has strong leadership skills, then the project performance can be monitored, controlled and managed with high quality.skills and quality of leadership affects strongly and directly on contractors performance through project.

Availability of personals with high experience and qualification has been ranked by the contractor respondents in the second position with (RII) = 0.90. This factor is playing main role

in construction process through executing the project. Availability of personals with high experience and qualification lead to better performance of quality, time, cost, productivity and safety of projects. Some of the lowest bidders may lack management skills and less attention is paid to contractor's plan, cost control, overall site management and resource allocation. This result shows that factor is very important because it affects strongly on quality performance of construction projects.

Availability of resources as planned through project duration has been ranked by the contractors respondents in the third position with (RII) = 0.89. This factor can be considered as an important for contractor and also the consultant, it affects directly on project performance specially the time zone. Availability of resources is related to closures.

If resources are not available as planned through project duration, the project will suffer from problem of time and cost performance. Availability of resources as planned through project duration is an important factor for consultant and contractors construction projects. This is because resource availability as planned schedule can improve time performance of projects.

The fourth position went to the factor of Learning from best practice and experience of others according to the contractor respondent which is achieved (RII) = 0.88. This factor can be helpful to improve and develop performance of current and future projects.

Learning from best practice and experience of others affects the performance of construction projects because it affects the innovation and learning required for construction.

According to contractors, it was obtained that the Conformance to specification is in the fifth rank with (RII) = 0.86. As it shown this factor rank late position, and this factor is can be considered more important for owners as it is significant and related to client satisfaction, but this doesn’t preclude that contractor should put this factor as one of the main indicator that can

achieve client satisfaction which is playing main role as one of the projects parties . Projects should execute according to required specifications. This factor is significant for owners because it is strongly related to client satisfaction.

The sixth position were for the Quality of equipment and raw materials in project with (RII) = 0.85. Contractors must implement their projects according to required and agreed quality because owners and consultants usually want materials used in supervised project according to specification and agreement. This factor affects the quality performance and the degree of owners and consultants satisfaction.

Speed and reliability of service to owner has been ranked by the contractor's respondents in the seventh position with (RII) equal 0.84. Speed and reliability of service from contractor to client representative affect the degree of satisfaction with respect to client. This factor affects strongly on project performance because it affects the client satisfaction degree.

Average delay in payment from owner to contractor has been ranked by the contractors respondents in the eight position with (RII) = 0.83. Delay in payment from owner to contractor lead to delay of contractors' performance and cause problem in time performance. This may also lead to disputes and claims between contractor and consultant of project. All of that will affect the overall performance of project that has been implemented.

Sequencing of work according to schedule has been ranked by the contractor's respondents in the ninth position with (RII) = 0.82. This factor is important for contractors because sequencing of work according to schedule assists contractors to implement project according to scheduled time for project completion.

Therefore, the contractors will not suffer from time and cost performance problems. Sequencing of work affects the productivity performance of contractors, Liquidity of organization has been ranked by the contractor's respondents in the tenth position with (RII) = 0.81. Cost performance of any construction project depends mainly on liquidity of organization.

Liquidity of organization is important for evaluation of contractors' cost performance. This might be due to different economic and political situation.

4.3.2. Discussion of the (RII) and ranking of factors for each group according to contractor view:

4.3.2.1. Group one: Cost factors:

Table (4.7) RII and rank of cost factors:

Cost Factor	*RII*	*Rank*
Liquidity of organization	0.81	10
Profit rate of project	0.74	19
Project design cost	0.68	25
Project labor cost	0.79	13
Material and equipment cost	0.77	15
Project overtime cost	0.58	34
Cost of rework	0.67	26
Regular project budget update	0.76	16
Motivation cost	0.60	32

Contractors view:

The top grad of relative importance index in group one were Liquidity of organization has been ranked by the contractor’s respondents in the tenth position with RII equal 0.81.

Cost performance of any construction project depends mainly on liquidity of organization, and its help for evaluation of contractors' cost performance. Profit rate of project has been ranked by the contractor respondents in the fifth position in group one with RII equal 0.74. Profit rate is considered an important indicator to evaluate cost performance of construction projects. Project design cost gained to sixth position with (RII) equal 0.68, and from this result it’s clear that this factor is not representing a big issue and responsibility for the contractor.

Project labor cost has been in group one ranked by the contractor respondents in the second position with RII equal 0.79. This factor affects the cost performance of project because labor cost is one of the main components of project cost. This can be attributed to different location, Regulations and laws. Material and equipment cost has been ranked by the contractors respondents in the third position in group one with RII equal 0.77. This factor is considered as one of project cost components. Therefore, material and equipment cost affects the contractors' profit rate and hence their cost performance. Project overtime cost recoded the lowest grad of (RII) and rank to the last position according to the contractor respondent.

4.3.2.2 Group Two: Time factors:

The relative importance index (RII) and rank of time factors are summarized in Table 4.8:

Time Factor	*RII*	*Rank*
Planned time for project construction	0.62	31
Average delay in claim approval	0.78	14
Average delay in payment from owner to contractor	0.83	8
Time needed to rectify defects	0.65	28
Availability of resources as planned through project duration	0.89	3

Contractor view:

Availability of resources as planned through project duration has been ranked by the contractor’s respondents in the first position with RII equal 0.89 in this group.

This factor affects directly and practically on contractors' performance through projects. If resources are not available for contractors as planned through project duration, the project will

suffer from problem of time and cost performance. Resource availability affect on processes performance of contractors. This also might be due to different location, political and economical situation.

This group also shows that average delay in payment from owner to contractor has been ranked by the contractor's respondents in the second position with RII equal 0.83. Delay in payment from owner to contractor lead to delay of contractors' performance and cause problem in time performance. This may also lead to disputes and claims between contractor and consultant of project. The factor of Average delay in claim approval has been ranked by the contractor respondent in the third position, this factor affecting the time performance and this delaying can cause disputes between all the project parties.

Planned time for project construction has been ranked by the contractors respondents in the last position with RII equal 0.62, this sign isn't good for contractor to ignore this factor and not representing a main part in their consideration. Planned time for project construction may not be suitable practically. Therefore, the performance of project will suffer from delay and disputes between contractor and consultant. Planned time for project construction is an important for contractors because this factor affects strongly on contractors performance for project time.

4.3.2.3 Group Three: Quality factors:

The relative importance index (RII) and rank of quality factors are summarized in Table 4.9:

Quality Factors	*RII*	*Rank*
Conformance to specification	0.86	5
Availability of personals with high experience and qualification	0.90	2
Quality of equipment and raw materials in project	0.85	6
Quality assessment system in organization	0.73	20
Quality training/meeting	0.64	29

Contractor view:

Availability of personals with high experience and qualification has been ranked by the contractor's respondents in the first position with RII equal 0.90.

This factor is the most important one for contractors because availability of personals with high experience and qualification assist contractors to implement their projects with a successful and suitable performance, this factor is very important to contractors because it affects strongly on quality performance of construction projects. The factor of Conformance to specification has been ranked by the contractor's respondents in the second position with RII equal 0.86. This factor is significant for contractors as it is related to consultants and client satisfaction.

Quality of equipment and raw materials in project has been ranked by the contractor's respondents in the third position with RII equal 0.85. Contractors must implement their projects according to required and agreed quality because owners and consultants usually want materials used in supervised project according to specification and agreement. Quality assessment system in organization has been ranked by the contractor's respondents in the fourth position with RII equal 0.73. Quality assessment system in organization is rarely achieved or implemented for contractors.

This factor is not important to contractors because of absence of quality assessment systemsconstruction projects. The last factor in this group were quality training/meeting has been ranked by the contractor respondents in the last position with RII equal 0.64.

4.3.2.4. Group four: Productivity factors:

The relative importance index (RII) and rank of productivity factors are summarized in Table 4.10:

Productivity Factors	***RII***	***Rank***
Sequencing of work according to schedule	0.82	9
Absenteeism rate through project	071	23
Management-labor relationship	0.76	17
Project complexity	0.75	18

Contractor view:

Sequencing of work according to schedule has been ranked by the contractor respondents in the first position with (RII) equal 0.82. This factor is important for contractor because sequencing of work according to schedule assists to deliver project according to scheduled time for project completion. Therefore, the contractors will not suffer from time and cost performance problems.

Management-labor relationship has been ranked by the contractor's respondents in the second position with (RII) equal 0.76. Management-labor relationship can assist for strong coordination and motivation between labor level and managerial level. This will lead to implement project with success productivity and suitable time performance of project. This result as management-labor relationship is significant for productivity performance of construction projects.

Project complexity has been ranked by the contractor's respondents in the third position with (RII) equal 0.75. Degree of project complexity is related with experiences required for implementation and skills needed to construct project. All of that affect on the degree of contractors performance. This might be because of different location and construction projects nature. Absenteeism rate through project has been ranked by the contractor's respondents in the fourth position which is the last one, with (RII) equal 0.71. Absenteeism through project will affect the productivity. The contractor will suffer from time performance problem. Absenteeism through project implementation is very important for contractors because it affects the productivity performance of contractors.

4.3.2.5. Group five: Client Satisfaction factors:

The relative importance index (RII) and rank of client satisfaction factors are summarized in Table 4.11:

Client Satisfaction Factors	***RII***	***Rank***
Speed and reliability of service to owner	0.84	7
Information coordination between owner and project parties	0.72	22
Leadership skills for project manager	0.91	1
Number of disputes between owner and project parties	0.80	11
Number of reworks	0.66	27

Contractor view:

Leadership skills for project manager have been ranked by the contractor's respondents in the first position in this group with (RII) equal 0.91 for contractors. This factor is the most important one for contractors because leadership skills for project manager affect and playing a big role in the construction contractors performance, this factor is an important for contractors because it is significant for effectiveness on project performance.

Speed and reliability of service to owner has been ranked by the contractor's respondents in the second position with (RII) equal 0.822.

Speed and reliability of service from contractor to client representative affect the degree of satisfaction with respect to client. This factor affects strongly on project performance because it affects the client satisfaction degree.

Number of disputes between owner and project parties has been ranked by the contractor's respondents in the third position with (RII) equal 0.80. Disputes between owner and contractor will affect the relationship between them and the degree of client satisfaction will be affected. All of that will lead to bad result which is affecting the performance of contractors.
Information coordination between owner and project parties has been ranked by the contractor's respondents in the fourth position with (RII) equal 0.809 for contractors.

Information coordination between owner and project parties will lead to success construction contractor's performance and strong relationship between project parties. This factor is an important for contractors because information coordination affects the client satisfaction and project performance. The last factor in this group were Number of reworks has been ranked by the contractor's respondents in the fifth position with (RII) equal 0.627. This factor has an effect on client satisfaction and contractors performance.

4.3.2.6. Group six: health and safety factors:

The relative importance index (RII) and rank of health and safety factors are summarized in Table 4.12:

Health and Safety Factors	***RII***	***Rank***
Application of Health and safety factors in organization	0.69	24
Reportable accidents rate in project	0.59	33
Assurance rate of project	0.63	30

Contractor view:

Application of health and safety factors in organization has been ranked by the contractor's respondents in the first position with RII equal 0.69. This factor is the most important one for contractors because application of health and safety factors in construction projects will improve construction contractors' performance in project, and it affects strongly on safety performance of projects.

Assurance rate of project has been ranked by the contractor's respondents in the second position with (RII) equal 0.63. This factor affects the safety and cost performance of construction contractor's projects. This factor affects the cost and safety performance of contractors.

Reportable accidents rate in project has been ranked by the contractor's respondents in the fourth position with (RII) equal 0.59. Reportable accidents rate affects the safety performance of construction projects. This will affect the overall of construction contractor's performance. The number of all accidents case affects the safety and health performance of construction projects.

4.3.2.7Group seven: Training and Learning Factors:

The relative importance index (RII) and rank of Training and learning factors are summarized in Table 4.13:

Training and Learning Factors	***RII***	***Rank***
Training the human resources in the skills demanded	0.80	12
Learning from best practice and experience of others	0.88	4
Review of failures and solve them	0.73	21

Contractor view:

Learning from best practice and experience of others has been ranked by the contractor's respondents in the first position with (RII) equal 0.88. Contractors considered this factor as the most important one because it can improve and develop construction contractors' performance of current and future projects. This factor is strongly related to contractors' party. Learning from best practice and experience of others affects the performance of contractors because it affects the innovation and learning required for construction.

Training the human resources in the skills demanded by the project has been ranked by the contractor's respondents in the second position with (RII) equal 0.80. Contractors should train their employees with different and improved skills in order to implement different and complex types of projects.

Review of failures and solve them has been ranked by the contractors respondents in the third position and the last one with (RII) equal 0.73. Review of failures and solve them will enhance contractors performance and will satisfy the owner, and also this factor will improve the contractors performance and will satisfy the owner of project.

4.4. Indicators Affecting the Performance of Construction Projects according to consultant view:

Table (4.14) the relative importance index (RII) and rank of indicators affecting the performance of construction projects according to each category and according to consultant view and opinion.

Cost Factor	***RII***	***Rank***
Liquidity of organization	0.863	4
Profit rate of project	0.796	11

Project design cost	0.700	25
Project labor cost	0.762	16
Material and equipment cost	0.791	12
Project overtime cost	0.614	32
Cost of rework	0.714	24
Regular project budget update	0.773	14
Motivation cost	0.582	33
Time Factor	***RII***	***Rank***
Planned time for project construction	0.624	31
Average delay in claim approval	0.722	22
Average delay in payment from owner to contractor	0.745	20
Time needed to rectify defects	0.751	18
Availability of resources as planned through project duration	0.838	7
Quality Factors	***RII***	***Rank***
Conformance to specification	0.893	1
Availability of personals with high experience and qualification	0.882	2
Quality of equipment and raw materials in project	0.814	8
Quality assessment system in organization	0.761	17
Quality training/meeting	0.684	27
Productivity Factors	***RII***	***Rank***
Sequencing of work according to schedule	0.874	3
Absenteeism rate through project	0.664	29
Management-labor relationship	0.693	26
Project complexity	0.723	23
Client Satisfaction Factors	***RII***	***Rank***
Speed and reliability of service to owner	0.771	15
Information coordination between owner and project parties	0.733	21
Leadership skills for project manager	0.841	6
Number of disputes between owner and project parties	0.782	13
Number of reworks	0.800	10
Health and Safety Factors	***RII***	***Rank***
Application of Health and safety factors in organization	0.674	28
Reportable accidents rate in project	0.631	30
Assurance rate of project	0.570	34
Training and Learning Factors	***RII***	***Rank***
Training the human resources in the skills demanded	0.752	19
Learning from best practice and experience of others	0.854	5
Review of failures and solve them	0.812	9

The most important factors agreed by the consultant as the main indicators and factors that affecting the performance of construction projects were (Conformance to specification ;

Availability of personals with high experience and qualification; Sequencing of work according to schedule;Liquidity of organization;Learning from best practice and experience of others;Leadership skills for project manager;Availability of resources as planned through project duration;Quality of equipment and raw materials in project).

4.4.1. Top significant factors affecting the performance of construction according to consultant view:

Table (4.15) the following factors are among the top significant factors affecting the performance of construction projects according to consultant view for all parties.

Top significant Indicators and factors	*RII*	*Rank*
Conformance to specification	0.893	1
Availability of personals with high experience and qualification	0.882	2
Sequencing of work according to schedule	0.874	3
Liquidity of organization	0.863	4
Learning from best practice and experience of others	0.854	5
Leadership skills for project manager	0.841	6
Availability of resources as planned through project duration	0.838	7
Quality of equipment and raw materials in project	0.814	8
Review of failures and solve them	0.812	9
Number of reworks	0.800	10

According to consultant respondents, it was obtained that the Conformance to specification has been ranked by the consultant respondent in the first position with (RII) = 0.893. This factor is an important for owner's satisfaction and as long as the consultant is consider as the main assistant for owner during executing the project consultant should take care of this factor and put it as main factor. The owner usually seeks to implement project according to specification.

Availability of personals with high experience and qualification has been ranked by consultants in the second position with RII = 0.882. This factor is very important because availability of personals with high experience and qualification assist them to implement their project with a professional and successful performance and its affects strongly on quality

performance of construction projects. Sequencing of work according to schedule has been ranked by consultant respondents in the third position with RII = 0.874 .sequencing of work according to schedule assists to perform project according to scheduled time for project completion. Therefore, there is no delay or cost overruns. Sequencing of work affects the productivity performance of contractors.

Liquidity of organization has been ranked by the consultant respondent in the fourth Position with RII = 0.863. Consultants considered this factor important because cost performance of any project depends mainly on liquidity of organization and also very important for evaluation of project budget and cost performance. In the other side also there is some deferent opinions saying that this factor is more important for owners and contractors and it is moderately important for consultants. This might be due to different economical and political situation.
Learning from best practice and experience of others has been ranked by the consultants respondent in the fifth position with (RII) = 0.854. Learning from best practice and experience of others can improve and develop consultants and also contractor's performance. Learning from best practice and experience of others affects the performance of construction projects because it affects the training and learning required for construction. Leadership skills for project manager have been ranked by the consultant's respondent in the sixth Position with (RII) = 0.841.This factor is the important for all parties of the project because leadership skills for project manager affect the degree of project performance and client satisfaction.

Availability of resources as planned through project duration has been ranked by the Consultants respondent in the seventh position with RII = 0.838.This factor is related to closures and it affects directly on project performance such as time. If resources are not available as planned through project duration, the project will suffer from problem of time performance.

Quality of equipments and raw materials in project has been ranked by the consultants respondent in the eighth position with RII = 0.814. This factor is more important especially for consultant and also contractor; usually using materials in project with a good quality and according to specification .this factor affects the project performance and the degree of owners

Satisfaction which is one of the main responsibilities of contractors and consultants. Review of failures and solve them has also been ranked by the consultants respondents in the ninth position with RII equal 0.812. This factor will enhance project performance and will satisfy the owner of project.

Number of reworks has been ranked by the consultants respondent in the tenth position with RII = 080. This factor affect the relationship between all the parties of the project (contractor, consultant and owner) and, it affects specially the client satisfaction and overall project performance.

4.4.2. Discussion of the (RII) and ranking of factors for each group according to Consultant view:

4.4.2.1 Group one: Cost factors:

The relative importance index (RII) and rank of cost factors are summarized in Table 4.16:

Cost Factor	*RII*	*Rank*
Liquidity of organization	0.863	4
Profit rate of project	0.796	11
Project design cost	0.700	25
Project labor cost	0.762	16
Material and equipment cost	0.791	12
Project overtime cost	0.614	32
Cost of rework	0.714	24
Regular project budget update	0.773	14
Motivation cost	0.582	33

Consultant view:

Liquidity of organization has been ranked by the consultant's respondents in the first position with RII equal 0.863. Consultants considered this factor as the most important one because cost performance of any project depends mainly on liquidity of organization. This result of liquidity of organization is very important for evaluation project budget and cost performance.

In this group the factor of Profit rate of project has been ranked by the consultant's respondents in the second position with RII equal 0.796. Profit rate is an important indicator to evaluate cost Performance of construction projects; it can be one of the main components of project budget affecting the performance of cost, these factors affect directly on business performance of project and organization, Material and equipment cost has also been ranked by the consultant respondents in the second position with RII equal 0.791 . Regular project budget update obtained on the third position by the consultants responding with (RII) equal 0.773 and it's clear from its position that this factor affecting the cost performance.

Project labor cost has been ranked by the consultants' respondents in the fourth position with RII equal 0.761.This factor affects the cost performance of project because labor cost is one of the main components of project cost. This can be attributed to different location, regulations and laws. Motivation cost and project overtime cost recorded the lowest degree of RII in this group (cost factors) and placed in the last list, according to the consultants' respondents, because they consider those two factors are more important for the contractors.

4.4.2.2Group two: Time factors:

The relative importance index (RII) and rank of time factors are summarized in Table 4.17:

Time Factor	*RII*	*Rank*
Planned time for project construction	0.624	31
Average delay in claim approval	0.722	22
Average delay in payment from owner to contractor	0.745	20
Time needed to rectify defects	0.751	18
Availability of resources as planned through project duration	0.838	7

Consultant view:

Group two showing the time factors, and the Availability of resources as planned through project duration has been ranked by the consultant's respondents in the first position with RII equal 0.838. This factor affects directly and practically on project performance such as time. If resources are not available as planned through project duration, the project will suffer from problem of time performance which can subjected the project to the delays problems, it's an important factor for consultants because it affects the processes performance of construction projects.

Time needed to rectify defects has been ranked by the consultant's respondent the second position with RII equal 0.751. Time needed to rectify defects will affect the performance of basic schedule. Therefore, this will affect the time performance, which will lead to change and modify the schedule of work achievement. Average delay in payment from owner to contractor has been ranked by the consultant's respondents in the third position with RII equal 0.745.

Delay in payment from owner to contractor lead to delay of contractors' performance and cause problem in time performance. This may also lead to disputes and claims between contractor and consultant of project. All of that will affect the overall performance of project that has been implemented. Generally delay in payment from owner to contractor affects the time performance because it causes project delay.

The last factor in this group was planned time for project construction which is ranked by the consultant's respondents the lowest position with RII equal 0.624. Planned time for project

construction may not be suitable practically. Therefore, the performance of project will suffer from delay and disputes between contractor and consultant. Planned time for project construction is an important for contractors because this factor affects strongly on contractors performance for project time.

4.4.2.3.Group three: Quality factors:

The relative importance index (RII) and rank of quality factors are summarized In Table 4.18:

Quality Factors	***RII***	***Rank***
Conformance to specification	0.893	1
Availability of personals with high experience and qualification	0.882	2
Quality of equipment and raw materials in project	0.814	8
Quality assessment system in organization	0.761	17
Quality training/meeting	0.684	27

Consultant view:

Conformance to specification has been ranked by the consultant's respondents in the first position with RII equal 0.88.consultants should put this factor in there consideration because this factor is an important to client representative satisfaction because it is mainly related to owner satisfaction which the consultants are seeking for. The availability of personals with high experience and qualification has been ranked by the consultant's respondents in the second position with RII equal 0.882. This factor is the important for consultants because availability of personals with high experience and qualification assist consultants to supervise the project with a good professionalism and also this assist them to satisfy the owner with a successful performance of project. This factor affects strongly on project performance because it affects strongly the degree of owners satisfaction which is one of the main responsibilities of consultants.

Quality of equipments and raw materials in project has been ranked by the consultant's respondents in the third position with RII equal 0.814. Consultants usually want materials used in supervised project with a good quality and according to specification; also this factor affects the project performance and the degree of owner's satisfaction. The quality assessment system in organization has been ranked by the consultant's respondents in the fourth position with RII equal 0.763.

This result may be came out because of the absence of quality assessment which is might be due to different managerial properties. Quality training/meeting has been ranked by the consultant's respondents in the fifth position with RII equal 0.684. Quality training/meeting recorded the lowest rank in this group this factor affects strongly on quality performance of construction projects.

4.4.2.4.Group four: Productivity factors:

The relative importance index (RII) and rank of productivity factors are Summarized in Table 4.19:

Productivity Factors	***RII***	***Rank***
Sequencing of work according to schedule	0.874	3
Absenteeism rate through project	0.664	29
Management-labor relationship	0.693	26
Project complexity	0.723	23

Consultant view:

Sequencing of work according to schedule has been ranked by the consultant's respondents in the first position with RII equal 0.874. This factor is the most important one for

consultant because sequencing of work according to schedule assists consultant to deliver project to the owner according to scheduled time for project completion. This factor affects the productivity performance of construction projects. Project complexity has been ranked by the consultant's respondents in the second position with RII equal 0.723. Degree of project complexity is correlated with experiences required for supervision and skills needed to monitor and supervise performance of project. This might be because of different locations and projects types.

Management-labor relationship has been ranked by the consultant's respondents in the third position with RII equal 0.693. Management-labor relationship can assist for strong coordination and motivation between contractor level and consultant level.

This will lead to implement project with success supervision and so good performance of consultant, management-labor relationship is significant for productivity performance of construction projects. Absenteeism rate through project has been ranked by the consultant's respondents in the last position with RII equal 0.664. Absenteeism through project will affect the productivity and time performance of project.

4.4.2.5. Group five: Client Satisfaction factors:

The relative importance index (RII) and rank of client satisfaction factors are summarized in Table 4.20:

Client Satisfaction Factors	*RII*	*Rank*
Speed and reliability of service to owner	0.771	15
Information coordination between owner and project parties	0.733	21
Leadership skills for project manager	0.841	6
Number of disputes between owner and project parties	0.782	13
Number of reworks	0.800	10

Consultant view:

Leadership skills for project manager have been ranked by the consultant's respondents in the first position with RII equal 0.841. This factor is the most important one for consultants because leadership skills for project manager assist consultants to supervise the project with strong and suitable performance. This will convenient and satisfy the client of project. This factor is an important for effectiveness on project performance because client satisfaction depends up on it. Number of reworks has been ranked by the consultant's respondents in the second position with RII equal 0.800. This factor has an effect on client satisfaction and project performance.

Numbers of disputes between owner and project parties have been ranked by the consultant's respondents in the third position with RII equal 0.782. Disputes between owner and consultant will affect on relationship between them and the degree of client satisfaction will be affected. Al of that can affects the performance of project.

Speed and reliability of service to owner has been ranked by the consultant's respondents in the fourth position with RII equal 0.771. Speed and reliability of service from consultant to owner affect the degree of satisfaction with respect to client.

Information coordination between owner and project parties has been ranked by the consultant's respondents in the fifth position with RII equal 0.733. Information coordination between owner and project parties will lead to strong relationship between owner and consultant. This factor is an important for effectiveness on construction project performance. Number of reworks has been ranked by the consultant's respondents in the second position with RII equal 0.800. This factor has an effect on client satisfaction and project performance.

4.4.2.6. Group six: Health and safety factors:

The relative importance index (RII) and rank of health and safety factors are summarized in Table 4.21:

Health and Safety Factors	*RII*	*Rank*
Application of Health and safety factors in organization	0.674	28
Reportable accidents rate in project	0.631	30
Assurance rate of project	0.570	34

Consultant view:

Application of health and safety factors in organization has been ranked by the consultant's respondents in the first position with RII equal 0.674. This factor is the most important one for consultants because application of health and safety factors in construction projects will satisfy the labors of the project and protect them.

This factor is significant for consultants because it affects strongly the safety performance in projects. Reportable accidents rate in project has been ranked by the consultant's respondents in the second position with RII equal 0.631. Reportable accidents rate affects the safety performance of construction projects. Number of all accidents case affects the safety and health performance of construction projects.

The last factor in this group was the assurance rate of project which has been ranked by the consultant's respondents in the fourth position with RII equal 0.57. This factor affects the safety and cost performance of project. This factor affects the cost and safety performance of construction projects.

4.4.2.7. Group seven: Training and learning factors:

The relative importance index (RII) and rank of innovation and learning factors are summarized in Table 4.22:

Training and Learning Factors	*RII*	*Rank*
Training the human resources in the skills demanded	0.752	19
Learning from best practice and experience of others	0.854	5
Review of failures and solve them	0.812	9

Consultant view:

Learning from best practice and experience of others has been ranked by the consultant's respondents in the first position with RII equal 0.854. This factor can be considered important for consultants because it can improve and develop consultant's performance of current and future projects. Learning from best practice and experience of others affects the performance of consultants as it affects the training and learning required for supervision. This is related to clients' satisfaction.

Review of failures and solve them has been ranked by the consultants respondents in the second position with RII equal 0.812. This factor will enhance project performance and will satisfy the owner, review of failure and solve them can help to prevent and don't repeat any defect happening during the project executing, so contractor and consultant both of them are responsible from this part to achieve the client satisfaction.

The last factor in this group was training the human resources in the skills demanded by the project which has been ranked by the consultant's respondents in the last position with RII equal 0.752. Consultants should train employees with so that can be helpful to improve skills in order to design and supervise different and complex types of projects.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1. INTRODUCTION:

The construction industry is a development tool for achieving goals in modern society. The performance of the construction industry is affected by clients, contractors, consultants, and others. The main aim of this thesis is to identify the factors that affecting the performance of construction projects. This chapter include conclusion and recommendations that would help in solving the problems which appearing during executing the project and it affecting the performance of construction project.

The aim of this research was broken down into the following objectives:

- **5.1.1. To identify the factors affecting the performance of construction projects. And identify the most significant factors affecting performance of construction projects.**

According to contractors view Leadership skills for project manager was the most important performance factor as it has the first rank among all factors with RII = 0.910. Contractors focus on this factor because they consider that shortage of leadership skills will affect the monitoring and controlling process of the construction project, and also will affect strongly and directly on contractors performance through project. Project overtime cost considered the lowest factor according to the contractors view which has been recorded low value of RII = 0.58 rank in the position.

According to consultant respondents, it was obtained that the Conformance to specification has been ranked by the consultant respondent in the first position with (RII) = 0.893. Implementing the project without conformance to specification will subject both parties (consultant and contractor) to the danger, which can be under illegal work; this factor is an important for owner's satisfaction.

The lowest factor according to the consultant view were Assurance rate of project with RII = 0570 this factor affects the safety and cost performance of project, this result confirming that this factor is not representing as main important point for consultants.

The most important factors agreed by the consultants and contractors as the main factors affecting the performance of construction projects were: Conformance to specification; Availability of personals with high experience and qualification; Leadership skills for project manager; Learning from best practice and experience of others; Availability of resources as planned through project duration and Liquidity of organization. However, there are some factors which can be considered as more important for one party than for others.

The factors that recorded the lowest results and agreed by the consultants and contractors were: overtime cost; planned time for project construction; Quality training/meeting; Application of Health and safety factors in organization; Reportable accidents rate in project and Assurance rate of project. It is noted that all the factor of the sixth group (health and safety factors) recorded very low results for both respondents (consultants and contractors).

- **5.1.2. Tomeasure consultants and contractors perceptions and views about the factors affecting the performance in construction.**

A questionnaire survey approach was considered to study the impact of various attributes and factors affecting construction projects performance. The questionnaire assists to study the attitude of consultants and contractors towards performance in the construction industry. These questionnaires were distributed to expert engineers regarding to their years' experience. Thirty-four factors were considered in this study and were listed under seven groups as it mentioned in the literature review. These groups give a comprehensive summary about performance factors. The factors were summarized and collected according to previous studies.

The main groups considered in this thesis are cost, time, quality, productivity, client satisfaction, health and safety, training and learning. 60 questionnaires were distributed as follows: 20 to consultants and 40 to contractors. The respondent's experiences were a suitable indication to find out the perceptive of the relative importance of project performance indicators of the owner, consultant and contractor parties.

The results were analyzed, discussed to obtain the most performance indicators. The relative importance index method (RII) was used here to determine consultants and contractors perceptions.

5.1.3. To formulate recommendations to improve performance of construction projects:

The practices concerning such as time, cost, quality , productivity, health and safety ,training and client satisfaction factors were analyzed in order to know the main practical problems in projects performance and then to formulate recommendations to improve

performance of construction projects. Performance problem is costly and often result in disputes, claims and affect the development of the construction industry.

The construction organizations must have a clear mission and vision to formulate, implement and evaluate performance. The environment of construction organizations should be proper to implement projects with success performance. It is important for construction organizations to identify the weaknesses of performance in order to solve and overcome.

Time can be considered as an important factor affecting the performance of construction projects, there are several planning and scheduling methods which can facilitate time performance control for each activity through project implementation, these methods such as (Bar Chart method and Critical Path Method (CPM)).

Owners, consultants and contractors often meet weekly for discussion. Weekly meeting assist them for monitoring, updating and controlling the progress through project implementation. In addition, they can solve problems, evaluate current performance, and improve future work.

Most of consultants and contractors agree that actual cost of executed projects was more than the estimated cost because of changing which can be happening especially in economic conditions and situation. Shortage of construction materials and escalation of construction material prices. This escalation of material prices affect the liquidity and cost performance of projects, so because of this software program should be used in order to facilitate planning, monitoring and controlling cost.

Health and safety factors recorded low rank and also low rate of RII which is clarifying that this factor is not representing much of importance during construction of projects. In addition, consultants do not have sufficient control or continuous supervision for safety application. All of that will lead to occurrence of accidents and problems in construction projects, it’s necessary to have formal safety training in order to improve performance of construction projects.

5.2. Recommendation:

The following issues and points are recommendations related to obtained results:

5.2.2. Training programs:

It is recommended to develop human resources in the construction industry through proper and continuous training programs about construction projects performance. These programs can update their knowledge and can assist them to be more familiar with project management techniques and processes. In addition, it is preferred to develop and improve the managerial skills of engineers in order to improve performance of construction projects. All of that can be implemented by offering effective and efficient training courses in scheduling, time, cost, quality, safety, productivity, information systems and management of human resources. These courses will lead to success performance through construction projects such as availability of resources as planned through project duration, availability of personals with high experience and qualification, proper quality of equipment and raw materials used in project.

5.2.3 Recommendations for construction organizations:

It is necessary for construction organizations to evaluate liquidity before implementation of any construction project because of changing and variation in economic situation. That will assist organizations to perform projects successfully and strongly. In addition, construction organizations are recommended to evaluate project overtime through project construction in order to enhance and improve time and cost performance of projects. Also time needed to implement variation orders and to rectify defects should be estimated and scheduled without

affecting project time completion. Having regular meeting among project participants can also enhance performance.

5.2.4. Recommendations for consultants:

Consultants should be more interested with design cost by using multi criteria analysis and choosing the most economic criteria in order to improve their performance and to increase owner's satisfaction. In addition, consultants are recommended to facilitate and quicken orders delivered to contractors to obtain better time performance and to minimize disputes and claims. Consultants should reviewing and approving design documents, shop drawings, and the payments of contractor to avoid any delay or cost overruns at the project. Consultants are advised to hire a qualified technical staff to manage the project in a good way, so he would be able to overcome any technical or management problems that happen. It is also advised for consultant to have high qualification to give suitable instruction in a suitable time and to be able to answer any question stated by contractor to avoid time and cost overruns. Flexibility is required in evaluating contractor works. Compromising between the cost and high quality should be considered.

5.2.5. Recommendations for contractors:

Contractors should not increase the number of projects that can't be performed successfully. In addition, contractors should consider the economic and business environment risk in their cost estimation in order to overcome delay because of closures and materials shortage.A proper motivation and safety systems should be established for improvement productivity performance of construction projects. More applications of health and safety factors are necessary to overcome problems of safety performance. Monitoring the quality of activities continuously and to set the required quality system in the different activities of the project so as to avoid any mistakes that may lead to rework of

activities, and finally time and cost overruns. Contractors are recommended to be aware about construction materials, so they are advised to purchase the construction materials at the beginning of work. It is also better for them to have time schedule for material delivery process to the site in order to avoid shortage or lack of materials.

Contractors should be more interested with conformance to project specification to overcome disputes, time and cost performance problems. Quality materials should be more interested with contractors to improve cost, time and quality performance. This can be done by applying quality trainings and meetings which are necessary for performance improvement. It's necessary to have qualified technical staff with appropriate experience of the project in order to be able to follow the different technical and managerial aspects of the project. The staff will be more effective if it is consisted of enough numbers of engineers, technicians, and foremen, so the responsibilities would be shared between all of them. It's recommended for contractors to set up a computerized system to perform documentation process for all the activities in the site, so they would be able to detect performance in the work and to follow the time schedule continuously.

5.2.6. Recommendations for future study:

- Developing performance measurement framework and modeling system in order to measure performance of construction organizations and projects.
- Study and evaluate the most important factors as a case study of construction projects.

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Appendix

Questionnaire:

The aim of this questionnaire is to study the factors affecting the performance of construction projects. This questionnaire is required to be filled with exact relevant facts as much as possible. All data included in this questionnaire will be used only for academic research. After all questionnaires are collected and analyzed, interested participants of this study will be given feedback on the overall research results.

Part (1): General Information: Please add (√) as appropriate:

1) Type of Organization :

Owner	( )	Consultant	( )	Contractor

2) Type of projects of organization:

Residential	( )	Roads	( )	Nonresidential ( )

3) Number of projects executed in the last five years:

1 - 5	( )	5 - 10	( )	10 – 15 ( )

4) Number of experience years of the respondent is.....Year

Part (2): Factors Affecting the Performance of Construction Projects:

Below are numbers of factors affecting the performance of construction projects, related to your experience, please express your opinion on the importance of the following factors as key performance indicators of construction projects. (Please tick the appropriate box).

(1) *Cost factors*	***Very high important***	***High important***	***Medium important***	***Low important***	***Very low important***
Liquidity of organization					
Profit rate of project					
Project design cost					
Project labor cost					
Material and equipment cost					
Project overtime cost					
Cost of rework					
Regular project budget update					
Motivation cost					

(2) Time factors	***Very high important***	***High important***	***Medium important***	***Low important***	***Very low important***
Planned time for project construction					
Time needed to rectify defects					
Average delay in claim approval					
Average delay in payment from owner to contractor					
Availability of resources as planned through project duration					

3) Quality factors	***Very high important***	***High important***	***Medium important***	***Low important***	***Very low important***
Conformance to specification					
Availability of personals with high experience and qualification					
Quality of equipment’s and raw materials in project					
Quality assessment system in organization					
Quality training/meeting					

4)Productivity factors	***Very high important***	***High important***	***Medium important***	***Low important***	***Very low important***
Project complexity					
Management-labor relationship					
Absenteeism rate through project					
Sequencing of work according to schedule					

5)Client Satisfaction factors	***Very high important***	***High important***	***Medium important***	***Low important***	***Very low important***
Speed and reliability of service to owner					
Information coordination between owner and project parties					
Leadership skills for project manager					
Number of disputes between owner and project parties					
Number of reworks					

6) Training and learning factors	***Very high important***	***High important***	***Medium important***	***Low important***	***Very low important***
Learning from best practice and experience of others					
Training the human resources in the skills demanded by the project					
Review of failures and solve them					

7) Health and Safety factors	*Very high important*	*High important*	*Medium important*	*Low important*	*Very low important*
Application of Health and safety factors in organization					
Reportable accidents rate in project					
Assurance rate of project					