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BUILDING PROJECT EVALUATION BASED ON PERIOD AND EXPENDITURES RELATIONSHIP

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Master's Thesis

Supervisor

Asst. Prof. Dr. Mohsen SEYEDİ

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The thesis titled BUILDING PROJECT EVALUATION BASED ON PERIOD AND EXPENDITURES RELATIONSHIP prepared by BAYDAA ALAZAWI and submitted on 19/04/2023 has been **accepted unanimously** for the degree of Master of Science in Civil Engineering.

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ABSTRACT

BUILDING PROJECT EVALUATION BASED ON PERIOD AND EXPENDITURES RELATIONSHIP

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Quality management systems (QMS) have been extensively employed in the manufacture sector. These are very big companies, and they can take megaprojects. Numerous reports are available regarding relationship between QMS and many industries such as food, manufacturing, service, etc. However, there are limited research on the building business. It is well known to everyone that three main scenarios considered for observing the achievement of the project implementation task; those are the required period, expenditure, and quality. The enterprise fineness system depends on the proper management of the required period and project expenditures. In analysing the period and expenditures, various parameters are considered such as project coordinators, team, client requirement, financial, internal process issues, learning, innovations, safety, and health perspective etc. Here implementation of the achievement model was discussed in detail. The building project achievement evaluation model was highly affected with required period and the expenditures of the project. Priority based evaluation is the important part of this topic since it helps to define the relationship between period and expenditures. Lower periods cause the higher expenditures as the total requirements are increased for completion of the project. Here we were discussed the ideal and practical graph between period and expenditures along with budget.

Keywords: Analytic hierarchy Process, Client, Expenditures, Flexibility, Priority, Perspectives.

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ABBREVIATIONS

QMS	:	Quality Management Systems
NN	:	Neural Network.
LCA	:	Life Cycle Assessment
ASHRAE	:	American Society of Heating Refrigerating and Air-Conditioning Engineers
CV	:	Costs Variance
LPC	:	Linear Predictive Coding
AHP	:	Approach With Analytical Hierarchy Process
TP	:	True Positive
TN	:	True Negative
FP	:	False Positive
FN	:	False Negative
CPI	:	Cost Performance Index
BS	:	Balanced Scorecard

1. INTRODUCTION

1.1 OVERVIEW

Quality management systems (QMS) have been extensively employed in the manufacture sector. These are very big companies, and they can take megaprojects. Numerous reports are available regarding relationship between QMS and many industries such as food, manufacturing, service, etc. However, there are limited research on the building business. This is due to the fact that these researchers are more concerned with the project's quality and expense[1], compared to quality management system. Building is an important sectors of many markets and donates significantly to the whole national outcome of most countries. In civil engineering, planner ideas and designer detailed plans are comes into authenticity. The work quality is depending upon the collective efforts of all parties. The goal of the manufacturing teams is to finish the project in scheduled period, without disputes, without wasted period, accident, zero reworking and with complete compliance [2]. In the developing countries, generally building projects are completed with less satisfactory achievement. Required period, expenditures and excellence of the project are three sides of a project achievement triangle. The project is one period unique process with specific objective which is source of innovation and development. Building is an important division of various economies, contributing significantly to most countries' total national outcome. It is the stage of civil engineering where the planner's thoughts and the designer's specific designs are translated into physical world. The effectiveness of this task is determined by how well the parties involved in the project coordinate their efforts. The building teams' goal is to achieve the project in the range of the given expenditures budget, within the due date, without wasted period accidents, no disputes, zero reworking, and overall compliance [3]. The basic goal of a project is to perform the intended task accurately, on budget, and within the given quality.

Evaluation of a project, either in progress or at its conclusion, is known as a project evaluation. 1 Objectives such as development efficacy, efficiency, impact, and sustainability are evaluated to ascertain if the project was successful. 1 Its goals are to assess the project's adequacy and success in completing its stated goals, as well as the development's efficiency, impact, and sustainability. Donors and national partners will use the evaluation's findings to

guide their decision-making on the project. The ILO is responsible to its funders and partner organizations, in part, through evaluation. This section provides information on

a. Ideas and guidelines for assessing projects

b. Roles and responsibilities of the ILO in project evaluation

c. Taking Stock and Getting Ready for the Big Test

d. Evaluating projects and writing up the results

e. Maintaining and spreading the knowledge gained through evaluations

Many processes take place within a specific organization and model to complete a building project. These acts are sequentially linked to one another. For expenditures , period, and quality, any activity may have several options. The more complex the project, the more difficult it is to choose amongst these options. It's possible that a variety of period, expenditures , and quality possibilities will emerge. It's impossible to predict how much period and money will be spent on the project[4]. No point fits these three characteristics for projects that are intended to meet least period, least expenditures , and extreme quality. As the project's expenditures falls, the project's duration may lengthen or the quality may deteriorate. While the project length shortens, it is necessary to rise the expenditures to avoid a reduction in quality. It is difficult to discover a satisfactory resolution to all those standards, which include the shortest period, lowest expenditures , and highest quality. As a result, depending on the project's qualities, the project manager's focus may be drawn to one of these traits. It's challenging to make correct decisions when there are hundreds of actions in a project and each activity has varied period, expenditures , and quality possibilities[5]. Manage projects based on their outcomes by planning, tracking, and analyzing their progress. Project cycle management, and more specifically monitoring and evaluation, is based on the premise that individuals in charge of the project's resources and activities can use it to improve the project's short- and long-term development results. Managing for impact entails guiding project interventions toward long-term, sustainable effects via a logically connected chain of outcomes: inputs generate outputs that generate outcomes that add to impact (see Figure 1). The International Labor Organization (ILO) primarily pursues

technical cooperation projects and obtains funds from donors so that it may have a positive effect on policies, processes, rules, behavior, and, ultimately, individual lives.[6]

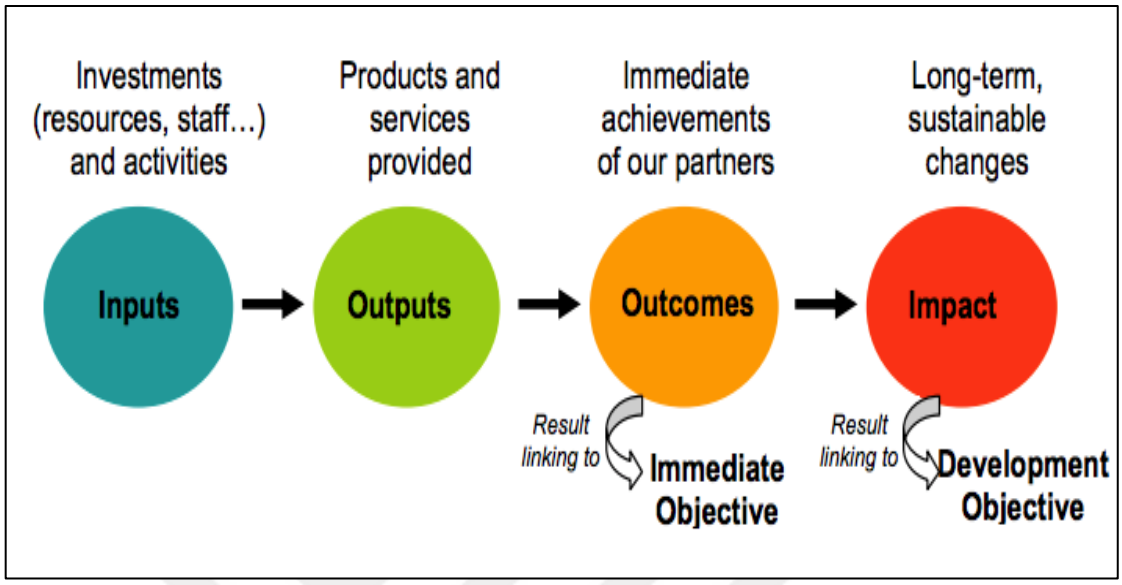

Figure 1.1: Effects-Oriented Project Management: The Project's Causal Chain of Outcomes.

Medium-term outcomes are the results of a project's activities. Outcomes are measurable results that may be traced back to the actions taken inside a project. Partners' accomplishments are often what are being showcased here. They make sense in light of the results we want to see. The project's outcomes are the tangible results that directly contribute to achieving the project's stated goals. "Impact" refers to a development intervention's direct and indirect, planned and unintended, long-term effects. 2 Impact is "the outcome that relates to the development objective as indicated in the project document"[7]. It takes years and rarely happens in one endeavor. It's crucial to predict outcomes and plan accordingly. Projects must provide outcomes and impact development. Since so many variables affect development, broad, long-term changes are hard to attribute to one program. Project results should achieve the desired effect.

Since WWII, prefabricated buildings have flourished and found widespread application around the globe [8]. It's common to refer such such structures as "prefabricated buildings" in many parts of the world. From country to country and region to region, the word "prefabricated buildings" is referred to in slightly different ways. There are subtle differences in the meanings of terms like "prefabricated," "pre-assembled," "modularized," "off-site manufacturing," and so on from one region to another. The term "off-site manufacturing" is

used here to refer to this practice. Modular homes in the US are called "prefab" homes in Japan and "prefabricated" homes in mainland China. prefabrication" in Hong Kong and Singapore, "off-site production" in European countries, and not "Prefabricated" in Japan and mainland China means "prefabricated housing" and includes parts like reinforcing structures that are constructed offsite and affixed to columns [9]. (Column cages). Describes factory-built components that are shipped to building sites for final assembly. We examined the ecological impacts of prefab and cast-in-place building technologies using a process model.. Results. These findings demonstrate that prefabricated buildings produce fewer GHG emissions during construction than conventional cast-in-place structures. were cheaper than the conventional cast-in-place construction method [10]. Analogous comparison studies of construction's resource use have also been conducted. Materials and energy use in building were also compared in a similar study. Comparisons with conventional structures revealed. Less wood and water are used in prefabricated buildings, and they are less harmful to the environment and people's health. Health and the environment are less likely to be negatively affected. A case study determined that common concrete frame and block buildings have a volumetric energy content of 66%. Savings on HVAC energy costs can be realized through proper insulation optimization in prefabricated buildings. Reduced heating and cooling energy use is possible. Longevity is also increased by this. Through the implementation of an established recycling program. Concrete trash from building demolition can be recycled efficiently and with minimal expense or environmental damage if a well-developed recycling system is put into place. In this way, we are able to lower the cost of recycling while also lessening our influence on the environment. Metal and concrete recovery rates are In comparison to other non-metallic materials, metals and concrete have a higher recovery rate. Most landfills accept only recyclable metals and plastics, thus nonmetallic materials that cannot be recycled are sent there [11]. Carbon footprint and energy footprint analysis of these two types of buildings. The analysis of the carbon footprint and energy footprint of these two building types shows that prefabricated buildings can reduce carbon emissions and energy consumption emissions and energy consumption. Using algorithms, it is now probable to select the wanted outcomes out of a lot of options. It is possible to plan the project's progress by identifying the important factor of the projects. A lot of research has gone into determining the best location for the building resources to be used. However, there are few research on the period-expenditures-quality improvement issue in the previous

research. A chain of improvement models have been built utilising a range of methodologies, including integer programming, meta-heuristic algorithms, linear programming, dynamic programming, and heuristic as a result of recent study in the literature[12]. These models maybe categorized into different categories depending on their optimization goals:

a. Models which reduce project period and/or increase resource use, and

b. Models which reduce the period and/or expenditures for building projects.

The effects and benefits of implementing quality management models in the building sector have been studied in certain research. According to some research, installing quality administration models can enhance connection issues, reduce errors and reworking, in addition to substance waste, as well as increasing subcontractor and supplier control. As a result, efficiency, effectiveness, and market portion have all risen, allowing suppliers to better acheive customer needs. Furthermore, a study is being conducted to develop a standard model of a quality administration scheme maintenance procedures, as it is been proved to be an important activity for all organizations, mainly the building sector. To define the reparation of quality administration, maintenance conceptions were initially associated with the concept of a quality administration matrix [13].Designing sustainable structures that meet all the operational needs of users by a distinctive challenge nowadays. Researchers, doctors and many suppliers are facing it and major threats because of the necessity to realize and address different variables approaches around us, like: universal weather change; consumption of mineral oil; increase organizational flexibility; growing community needs and expectations for comfort; increase knowing the relationship between home setting and healthiness and wellness they do not live, and therefore their efficiency. Administration of these features to gain robust structure and model resolutions that will be capable to facing future needs require and incorporated approach to sub-programs, clarified in (image 1.1).

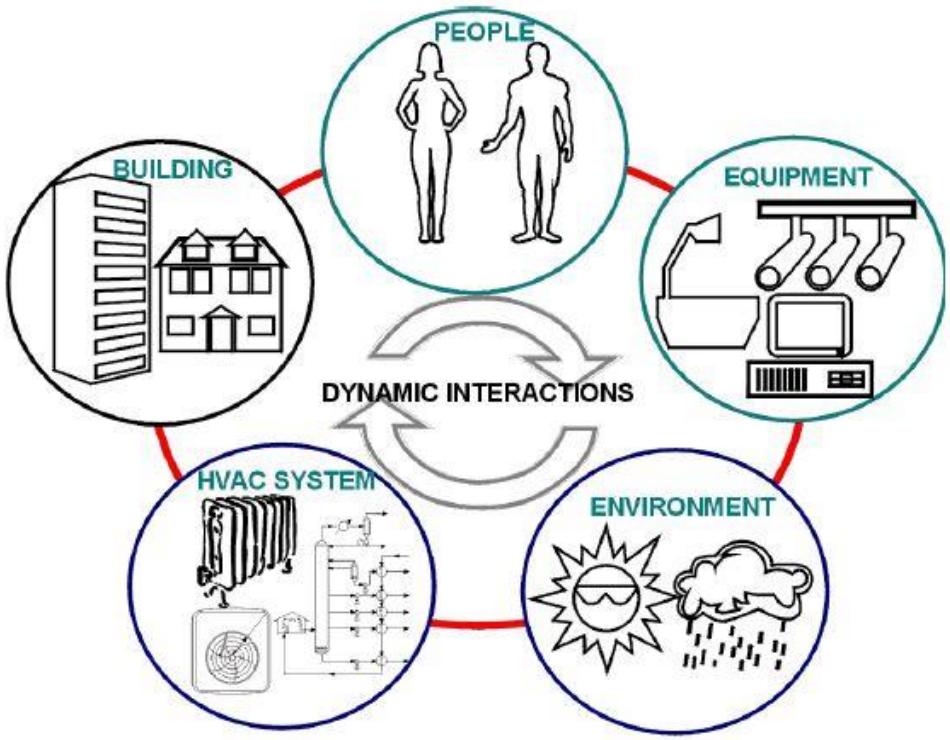

Figure 1.2: Powerful (Continuous Flexible) Interaction of Underground Systems [13].

As an action to the threats of sustainability, that are faced, the European committee has released a strong 20-20-20 plan (in line with 1999, by 2020 to reduce energy consumption by 20%, A 20% reduction in CO2, and a 20% reduction in renewable power. Same and pretty much stronger framework are improved through different countries from around the world. Even though strong, those plans and framework have to be considered as a initial step to more long-dated ambitions that seek prominence and aspirations as examined by [14]. Fulfilling these aspirations of desired stability needs the improvement of total power production buildings or locations. To achieve this certain models and equipment that allow enable consideration of collaborative fields like as transport and power networks on a large scale. Only then can the world be efficiency of power generation and use in a built setting should be realized.

Furthermore these high sustainability demands; future structures must also convey significant advances in the features of the indoor environment. There is a current trend of simply compliance with low environmental standards like heat, air characteristics, light and sound standards, future structures have to provide a good inner space a rejuvenating,

recovering or comfortable environment, based on the activity. That will end in reaching highly efficient structures[15].

At the moment, however, the focus - even on the most efficient areas - is still very much focused on mitigation the need for energy. Another recent, exciting procedure is to design the construction in a method which can be adapted to real external circumstances. Loonen (2010) provides a comprehensive summary concepts of shell structure adapted to the climate. An illustration of the latest building with the shell of a consistent structure is illustrated in (Image 1.2).

Figure 1.3: Virginia Tech Lumenhaus, Solar Decathlon 2009 hosted by U.S. Department of Energy, National Mall, Washington [15].

Because of low size of newly building enterprise (in Europe just in nearly 10% per annum of total construction substance), this is clear to achieve the goal of sustainable development, a significant work is required with regard to remodeling. of existing constructions. An important enterprise in this domain is ―cost efficient‖ that point to transform the frontage of existing ―Eventest constructions‖ into multiple, power-efficient elements[16].

Figure 1.4: Deutsche Bank Centers in Frankfurt am Basic in The Restructuring Process [16].

One structure of the hypothetical bodies is examined in Image 1.3. In a complete way, Deutsche Bank is now building an example of the world's most environmentally friendly constructions. As one of detailed steps, the bank substituted the front face of the current construction with a three-dimensional, high-security and improved windows. As each minute window maybe unlocked next period, the least amount of air is to be transmitted by mechanical ventilating system, because of the circulation of air. This enterprise demonstrates the probable development and power productivity that can be achieved in current buildings and how a “green building” can be useful in many different ways, even investing in existing buildings. Power use and CO2 release of a building named Green towers are probable to be decreased by 89 percent. So – each of the current and redesigned - future enterprises may

have major threats that appear to be more complex in current tools and methods. The conventional engineering design tools are not well suited to address the above threats because the proposed causes: they are usually self-disciplined, prone to problem solving and are very limited in range. They propose fixed boundary conditions (usually only maximum), and are usually depended on analytical procedures, that can be seen to a great extent to give a straightforward resolution to a much simple perspective (scheme) of real life).Theoretical and applied studies of prefabrication have mostly concentrated on the following points. Most studies on the practical and theoretical aspects of prefabricated structures have concentrated on one step of the construction process, looking at its economic and environmental effects. have been looked into, but not their full lifespan as prefabricated structures. are extremely uncommon. It's important to broaden the scope of prefab building studies to include their entire useful lifespan. It's important to broaden the scope of prefab building study to encompass the structure's whole lifespan. From the 1970s till the present day, Japan has been at the forefront of the global prefabrication movement. From 1970 to now, it has evolved into its fourth generation, including the entire building industry from concept through deconstruction. It has established a full manufacturing chain, beginning with building planning and ending with demolition. In addition, Japan's fundamental building and environmental data sets are finalized. [17]. Having such comprehensive baseline data on buildings and environments in Japan gives a solid foundation for investigations and research into the effects of prefabricated buildings. As a result, researchers in Japan now have a solid basis on which to examine the environmental effects of prefabricated structures over their entire life cycles, as the necessary basic data on buildings and the environment in the country is finally complete. Japan also ranks highly in both the global urbanization and building industrialization rates. As a result, it is vital for the growth of the construction industry in other nations to learn from Japan's experience with prefabricated buildings. Making prefabricated structures in Japan a topic of study is equally important for the growth of the construction sector in other nations. [18]. Depending on how it is calculated and what kind of information is being sought out, Life Cycle Assessment (LCA), a well-known approach to studying environmental impacts, is divided into two distinct categories. There are two main categories of life cycle assessment (LCA) that are distinguished by the methods used to calculate the results and the questions they set out to answer. Specifically, causal and attributive explanations. Attribution-type Research on the effects of the built environment

can benefit from LCA models. LCA mathematical models come in three flavors: attributed, attributed, and attributed. Input-output (I-O) models, process-based models, and hybrid models are the three main categories of mathematical models used in LCA. Economic input-output tables for a country or region provide the backbone of the I-O model. Consumption of resources and environmental effects can be measured across a wide It factors in the interdependence of the necessary construction industry subsectors. This paradigm, however, suffers from the problems of uniformity, stale data, and doubt. Quantifying and improving the results' correctness, process-based analytical models are becoming increasingly popular. However, this model necessitates precise data, making it difficult to obtain such information. The process of determining the model's applicability, however, might potentially lead to mistakes. Hybrid models integrate aspects of process and I-O models, and as a result, they are able to decrease the number of mistakes made by the organization. [19].Feature guarantee is an important and challenging issue that is examined in this research. The feature of the emulation results is depended, basically, on the visible accuracy of the scheme. Even though Robinson (1999) is not associated with the model structure, the result which is impossible to confirm the scheme alongside its effects, but just to rise the degree of assurance put on them, appears just true in our field. BESTEST's progressive lead. Is a basic international attempt in the field of building to rise assurance in imitation outcomes [American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) model Test procedure 140] It is noteworthy that it is still the norm not to report levels of confidence in the results of imitation. This is fascinating because it is popular that, such as, the actual use as well as prediction of low-power construction is highly based on uncertainty in the way of residents; as shown in Image 1.10.

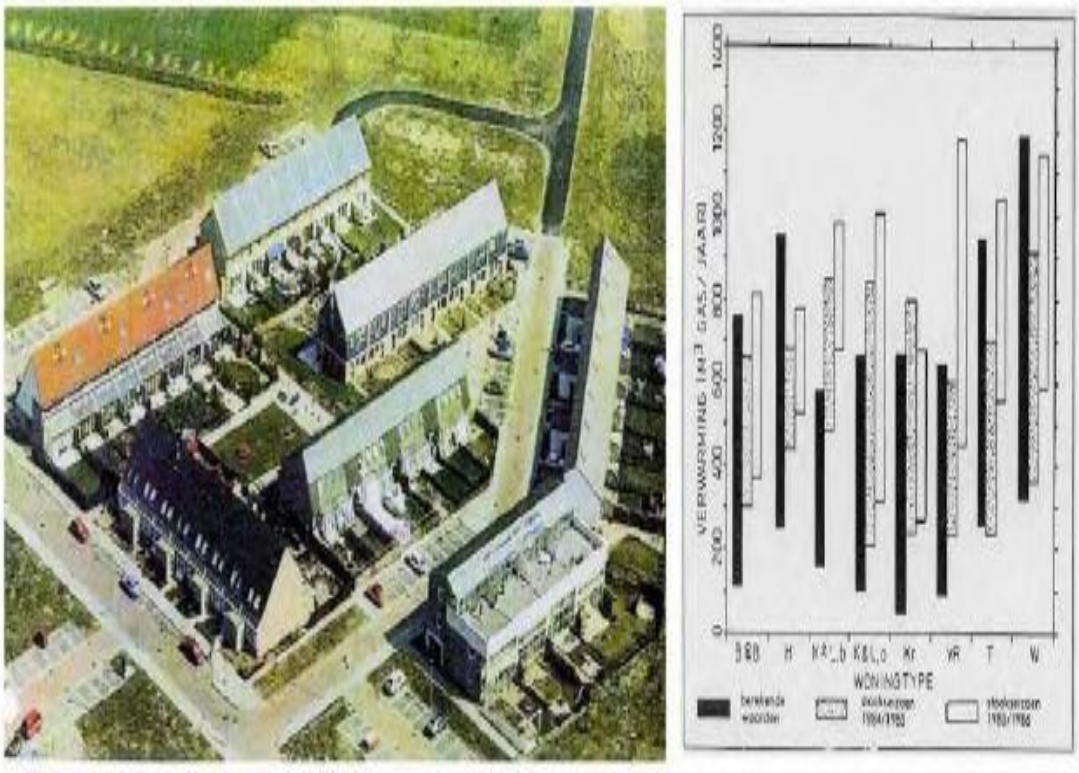

Figure 1.5: Variation in The Supposed Use of Gas at Room Temperature (Black Rods) In Eight Various Kinds of Dutch Minimum-Income Households Because of Uncertain Human Behavior with Regard to Heating, Nonprofits and Entry Levels, Compared to 1984 Estimates. -1986 Sea**.**

User-related features and uses are often not well received in simulating building achievement. Concerning of application, such as, modeling is efficient as it is used to assume achievement related to other scheme methods, more to assume the overall achievement of a single model for just one model solution. In building industry, maximum QMS previous research is not precisely meant to study the goals (period, expenditures , and feature) and as usual the study domain will contain various industries for differentiation aim. Additionally, few scholars have examined the link between QMS and governmental and business achievement as an alternative to project achievement. The ISO 9000 implementation can benefit societies by developing production achievement and feature Knowledge[20].

Many reports suggested that after implementing QMS, some organizations increased their productivity. However, limited researcher is available related to the link between enterprise achievement and QMS. Hence, it is necessity to know the importance of QMS in the enterprise achievement development, in this way the effectiveness and benefit of QMS can be described. Within the feature system, feature administration is procedures that the entire

as actions of the entire administration function that identify the feature politics, goals, and duties and put them into action through feature designing, feature monitoring, feature confirmation, and feature development.

1.2 ENTERPRISE CONTRIBUTION

The capacity to deal with parallelism and complex optimization problems will be the most prominent advantage of genetic algorithms over traditional optimization techniques. Different kinds of suitability task optimization, such as fixed or unfixed, longitudinal or changing, progressive or separate, will be addressed using genetic algorithms. The goal of this research is to develop a multi-functional, diversified development scheme that assist reducing building period and expenditures while maintaining high feature. A genetic algorithm will be used to solve a multi-functional development problem in this study. The informations for the issue will be acquired from a building enterprise and reviewed in Matlab code. This study will look into a topic that comprises of 15 primary activities. The problem will be performed in just 15 primary actions, without considering the sources of important activities, because the Matlab code is for experimental purposes. These data will also contain the action ID, the activity noun, the activities immediately preceding the primary activity, and reaching five different period-expenditures -feature values for each action. Subcontractors' tenders for a genuine building enterprise will be used to decide the period and expenditures principles of the five options. Now days, the administration of feature system has been highly focused. It is widely used in building line in case of a bigger enterprise. Lots of research had been carried out under the consideration of the feature as a dominant scenario in different fields. In recent years, throughout the world, many studies are going on the enterprise base on the relationship between period and expenditures . Not only in the field of software industries, but also in case of hardware industries.

Along with feature the expenditures and period are also studied with high priority which ultimately resulted in higher efficiency. Very few researches are available which considered three parameters simultaneously. In this paper, we were dealing with the relationship between expenditures , period and the feature. There are three major parameters which help to determine the achievement of the enterprise. The main sides of the achievement triangle are feature, expenditures and period. As it is well known to everyone that enterprise is nothing but an unique process. The balanced scorecard is one commonly used method for

evaluation of the achievement of the system. Many researchers has been introduced the BSC i.e. Balanced scorecard. Robert and Kaplan introduced the system which actually resulted in compressive set and supported to the outline of the strategic framework. Some researchers worked based on the market needs with regular updates. The present study focused on the priority based model. Perspectives are defined to judge the achievement of the process of enterprise completion. The results are plotted depended on the achievement result and the overall score for Perspectives of Client, Perspectives of Finance, Perspectives of Enterprise team, Perspectives of internal processes and Perspective for health and security. Also comparison between ideal period -expenditures graph and practical period-cot graph is done. The following part of the research is outlined as as: part II summarized the previous researches. Methodology and connected concepts are included into part III. part IV summarized the results. Conclusion and references are noted in part V and VI respectively.

1.3 OBJECTIVES

The overall goal of the analysis is to optimize the following three levels, The goal is to optimize the following three levels:

a. To evaluate the achievement of enterprise depended on period, expenditures

b. structural system and column grid

c. the spaces and interiors of the selected building zones

d. building elements such as walls and windows

1.4 OUTLINE OF THESIS

Chapter 1: It introduce the achievement of building enterprise based on period, expenditures , and feature.

Chapter 2: This chapter discuss the past research examining the outcomes of various feature administration methods on feature achievement, functional achievement, and business achievement.

Chapter 3: This chapter deals with effects of time period and expenditures exceed in building enterprises with the specific focus to determine and assess the occurrence of period time and expenditures exceed.

Chapter 4: Analyze the effects of period and expenditures overrun with determination of the correlation between enterprise time period and expenditures time period and expenditures exceed, to access the feature administration model in building enterprises.

Chapter 5: This chapter explains the conclusion.

2. LITERATURE REVIEW

2.1 INTRODUCTION

Several evolving regions, particularly African countries, have seen poor results from building development initiatives. Research on the successful achievement and administration of building works has been conducted all over the world, and it may be useful in tackling the problem. Discovered that achievement measures was a criteria to determine enterprise achievement in both monetary and non- monetary factors, as well as to evaluate achievement with regard to others, in terms of improving enterprise organizations' programmed feature and productivity. According [21], and many scholars and professional, including, believe that measures are required to trace, predict, and finally monitor these factors that are essential to an enterprise's progress. However, recognized poor feature as one of the key causes of low production. Based on field data from building activities.'s report suggests that efficiency maybe monitored and assessed on the enterprise grade. Enterprise success, according to, is defined as the finishing of an enterprise in a suitable schedule, expenditures, and feature, as well as the satisfaction of the customer. Investigated the way engineers assess an enterprise's progress and the amount to which the achievement of main enterprise stakeholders is related to enterprise progress. Resource availability is a crucial concern for consultants, according to due to the fact that it influences the task achievement of building enterprises. According to risk distribution among contracting portions in a building contract is a main decision that determines the enterprise's progress. The study by reveals that retraction schemes maybe a useful method for forecasting enterprise manager achievement in large-scale building enterprises. In their research, Invented a achievement index that building major executives and enterprise directors may use to size, control, and improve the present achievement of their connection based enterprises. According to design-build enterprises had much faster building speeds and enterprise submission speeds for each kilometre than model-bid-built enterprises. In past few years, much study has concentrated on examining time period and expenditures , with minimal study on schemes for optimizing building period, expenditures , and feature all at the same period. In the study domain, a multi-functional and diversified scheme has been developed which optimizes period-expenditures -feature utilizing the original algorithm approach, and is an supreme detector

algorithms. A survey was conducted to define the feature standard and weigh proportion for these criteria to assess the feature.

Project control and record-keeping procedures become crucial tools for managers and other building process participants during project execution. These tools perform two distinct functions: they record financial transactions as they happen and they tell managers of the status of projects and any issues that may arise. The old definition of a project as "a collection of vaguely related activities that are 90% complete, over budget, and behind schedule" [22] effectively sums up the issue with project management. It is difficult for project management systems to accurately identify the presence and severity of such issues.

This chapter examines concerns with project resource management, accounting, monitoring, and supervision. This talk will put a focus on how accounting data is used in project management. Until the project is finished, when it is too late to influence project management, it is typically difficult to interpret project accounting. Even after a project is finished, accounting outcomes can still be unclear. As a result, managers must understand how to analyze accounting data for project management. The goal of this paper is to introduce some popular accounting systems and practices rather than to provide an exhaustive survey of accounting procedures as we consider management problems. It is important to stress the project controls' restricted scope. Instead of offering suggestions for possible cost savings, the main goal of project controls is to spot deviations from the project plan. This trait reveals how far along a project is when limits become critical. Significant cost savings can be made during project planning and construction. Changes made during building are likely to cause delays or significantly higher costs. Therefore, rather than seeking out significant improvements or cost savings, the emphasis of project control should be on following the initial design plan or noting deviations from it. Because of this, project control will be more concerned with carrying out the initial design plan than it will be with finding significant improvements or cost savings. The integration of information-related problems must also be discussed. Although functional concerns and project management activities are closely related, many times the techniques employed do not allow for a thorough or integrated review of project activities. For instance, schedule data and cost accounts are typically handled independently. As a result, project managers themselves are required to put together a thorough picture using various project reports and their own on-

site notes. In particular, they frequently have to predict the financial effects of schedule changes without any help. Numerous beneficial outcomes can result from the sharing and combining of various kinds of information, but establishing project control procedures requires special consideration.

Construction plans and related cash flow projections can serve as a baseline for later project monitoring and control in terms of project cost management. By comparing individual activity progress and milestone accomplishment to the project plan, it is possible to track the progress of activities during scheduling. Contracts and work specifications offer a starting point for assessing and guaranteeing the standard of the necessary building. Final or comprehensive cost estimates offer a benchmark for assessing the project's financial success. the range of the detailed cost estimate will apply as long as expenses are contained therein, The undertaking is thought to be financially under control. Overruns within a specific cost category highlight existing issues as well as prospective ones. The categories that are covered by the final cost estimate are the center of cost-oriented construction planning and management. This strategy is especially suitable for jobs with modest workloads and lots of repetition, like grading and paving roads[23].

2.2 MEASURING PROJECT SUCCESS. THE CHALLENGE

In fact, determining the success of an undertaking is a challenging and complicated task. All organizations carrying out projects of any kind must evaluate their performance because without measurement, success cannot be improved. According to some researchers, it is difficult to evaluate a project's success exclusively in terms of objective criteria. Measuring performance is also challenging because

a. Project goals are fluid and alter over time.

b. The project objectives are defined and prioritized with input from a large number of participants representing a range of interests.

c. A few of the intended outcomes are arbitrary.

2.3 PROJECT PERFORMANCE INDICATORS

Cost, schedule, quality, and safety have historically been regarded as being the four factors most crucial to a building project's success. In the suggested research, eight performance indicators are listed along with a methodology for measuring them. The authors' experience and literature study led to the creation of the eight project success indicators. The performance indicators show effectiveness in terms of price, timing, billing, or revenue flow, as well as profitability, safety, and quality. They also show team and customer satisfaction.

2.4 EFFICIENCY OF FEATURE ADMINISTRATION SYSTEM MAINTENANCE

Feature administration application should be productive and functional in terms of improving an institution's achievement . A lot of research evaluating the influence of different feature administration strategies on feature achievement are discussed in the earlier feature administration revie, operational achievement , and business achievemen. The majority of the studies show that feature administration approaches have a vivid and important association with feature and functional achievement, but they have unimportant and uncertain influence on business achievement . Moreover, studies suggests that addressing customer needs when producing good-quality items to the mart can give the institution a competitive merit. The studies also proved that feature measurements that were applied in this research are associated with business achievement. however, those achievement guidelines are not proper for measuring building enterprises[24].

Enterprise achievement may indicate the success of a building enterprise. The progress of an enterprise was determined by different aspects, including enterprise difficulty, agreement arrangements, connections among enterprise participants, enterprise manager skill, and the skills of important enterprise members. Achievement measure was widely applied to determine and gag enterprise success. Achievement measurement was a standard way for collecting and reporting information about a building enterprise's inputs information, productivity, and functionality. Furthermore, measures are critical for chasing, predicting, and managing key elements to achieve enterprise progress. Generally speaking, it is well known that time period, money, and feature are important considerations in enterprise achievement metrics. According to a researcher, these three key components are shown as a "iron triangle" in Image 2.1.

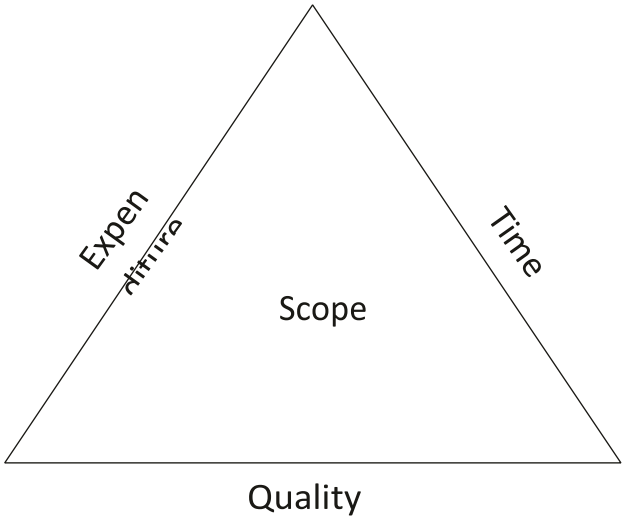

Figure 2.1: The Iron Triangle of Enterprise Administration [25].

Different factors, from another point of view, have been advised to be taken into account in an enterprise. achieving the required budget, time table, feature of labor, stakeholder approval, security and good health, and technology change are among the criteria. simultaneously, other studies have emphasised that other essential components employed in enterprise achievement evaluation include scheme achievement , security and good health, ecological administration achievement , final user prediction or approval, client approval, and commercial price. consequently, five major standards have been applied as predictors of enterprise progress. Expenditures achievement , time period achievement , feature achievement , security and good health, and user approval are all elements to discuss.

2.4.1 Expenditures Achievement

Bubshait and Almohawis, [1994] It is defined the limit which common situation encourage the execution of an enterprise in the predicted budget. In the building sector, the expenditures difference was the applied method for assessing an enterprise's design achievement [Salter and Torbett, 2003]. In addition, the budget difference method does not just apply to the calculation of the bid total, but to the whole expenditures that an enterprise from the beginning to the end. The whole expenditures contain all costs related to differentiation or adaptation job, moreover each legitimate demands done through the building time, like adjudication or claim. The expenditures variance was calculated as a percent of grid variation over the last expenditures . moreover, expenditures variance is been employed in

this research as a metrical for assessing enterprise achievement in a building enterprise with model issues [Andi and Minato, 2003]. In addition to this, expenditures have been recommended to be a way to assess engineering enterprise achievement [Georgy et al., 2005]. Apart from expenditures variance, cost performance index (CPI) is been applied to determine an enterprise's achievement in terms of the outcomes reliability and confidence. The factors' formulas and indications are listed below.

2.4.1.1 Costs variance (CV)

The enterprise was in theory in the estimated budget when the amount of CV was (0). If the CV amount was bigger than (0), it indicates the gaining of enterprise is more than the pre-planned gaining; so it was below budget. If the CV amount was smaller than (0), it indicates the gaining of enterprise is less than the pre-planned gaining; thus it was above budget.

$$CV = BCWP - ACWP \tag{2.1}$$

Where, BCWP was the budgeted expenditures of work performed and ACWP was the actual expenditures of work performed.

2.4.1.2 Cost performance index (CPI)

The enterprise was in theory on budget if the amount of CPI was (1). If the CPI amount was smaller than(1), it indicates the enterprise was above budget. If the CPI amount was bigger than (1), it indicates the enterprise was below budget. An enterprise with perfect achievement should preserve its CPI amount as equal to one as probable.

$$\mathrm{CPI} = \frac{\mathrm{BCWP}}{\mathrm{ACWP}} \tag{2.2}$$

Although cost management can be viewed as a continuous process, it is useful to divide the function into four steps: resource planning, estimating, budgeting, and control. However, it is possible that changes in resources may occur during the course of a project, necessitating adjustments to the budget. In addition, variances observed during the control process may require revisions to the estimates. Let's take a closer look at each of these four steps.

2.4.1.3 Planning project resources

The method of determining the resources required to carry out and finish a project is known as resource planning. People (such as workers and contractors) and equipment are examples of resources. (e.g., infrastructure, large construction vehicles, and other specialized equipment with limited supply). Before starting the project's real work, resource planning takes place. To get started, the project manager must first create a work breakdown structure (WBS). After examining each subtask in the WBS, the project manager must determine how many people with what skills are required to finish each subtask, as well as what kind of tools and materials are required. You must inquire: How many individuals with what qualifications are required to accomplish this task? The project manager can produce an accurate and thorough inventory of all resources by using this task-level approach, and this inventory can then be used as input for the next step, cost estimating. As you go through this procedure, keep the following in mind::

a. Before choosing subtasks and associated resources, look over previous schedule and man-hour statistics.

b. Ask the SME and team members for their opinions. When working on projects for which historical data is unavailable, collaboration is particularly effective.

c. Assess the effect of time on resource needs. For instance, a resource might not become accessible for several months, which could cause the project's schedule to be pushed back. This could influence expense projections..

d. Even though this process is done during the planning stage, project managers still need to take local conditions into account. For instance, they should think about hiring a contractor or training a team to bring them up to speed if they recognize the need for a resource with a particular expertise but such a resource is not already present within the company. These factors all have an impact on expense management.

2.4.1.4 The iron triangle of enterprise administration

Calculating the prices of all the resources needed to complete a project is the process of cost estimating. The following data is needed to conduct costing.

a. Requirements for resources (outputs from the previous step)

b. The cost of every resource (e.g., labor cost per hour, vendor hiring cost, server procurement cost, materials cost per unit, etc.)

c. The amount of time that each resource is required.

d. A list of requirements

e. Possibile dangers

f. Past project costs and benchmarks for the business (if available)

g. Details on the company's cash standing and reporting structure

One of the most challenging jobs in cost management is estimating. This is so because estimation precision is crucial. Project managers must also take into account variables like overhead, inflation, time worth of money, and fixed and variable costs. The likelihood of the project succeeding decreases as the gap between estimates and actual expenses widens. But there are numerous varieties of estimating algorithms. When there is a wealth of historical cost information for projects that are similar, similarity estimating is suitable. Some businesses favor quantitative strategies like PERT or parametric modeling. (Program Evaluation and Review Technique). Following that, a top-down or bottom-up strategy can be chosen. In general, the top-down strategy works well when historical costing information is accessible. In this situation, the project manager typically has expertise carrying out related projects and can make the right choice. Bottom-up approaches work well for projects where the group lacks a lot of experience. Making cost estimates at the task level and rolling them up to the top makes logic.

2.4.2 Cost Estimating as a Decision-Making Tool

It's crucial to keep in mind that expense estimation is done during the planning stage, so nothing is set in stone. The cost estimate will decide how to move forward with the project even though the project team will frequently have several options in mind. This comparative study can be carried out using a variety of costing techniques, such as activity-based costing, job costing, and life-cycle costing.

For instance, life cycle costing takes the whole life cycle of an undertaking into account. For instance, maintenance costs are frequently overlooked in IT projects, but life cycle costing

takes a long-term perspective and accounts for resource utilization all the way to the end of the cycle. Similar to this, reducing future service and replacement expenses is the aim of manufacturing projects. Teams can evaluate and cut costs using the estimating method. Value engineering, for instance, assists the team in getting the most out of an undertaking while cutting costs.

2.5 COST BUDGETING

Cost budgeting can be seen as an independent procedure or as a component of estimating. The process of budgeting involves allocating expenses to a portion of the project, such as individual tasks or modules, for a set amount of time. A contingency fund is included in the budget to handle unforeseen expenses. Consider a project where the estimated total expense over the course of three years is $2 million. However, the project manager chooses to focus on just the first two quarters for the time being because funding allocation is a function of time. He lists the tasks that need to be accomplished and allots, say, $35,000 in funding for them during this time. The WBS and some of the estimating techniques mentioned in the preceding section are used by the project manager to arrive at this number. The project's cost performance can be continuously tracked and assessed using the budget as a benchmark for costs. Without a budget, the overall estimated cost would continue to be an arbitrary figure that would be challenging to gauge along the way. Assessing project success gives you the chance to decide how much money needs to be set aside for later stages. The fact that organizations frequently depend on future cash flows for funding is yet another reason to adhere to a budget. Project managers must establish goals in accordance with the limited resources they have in the early stages.. It is similar to building the foundation and first floor of a house in the first few months and then later completing the rest of the house as savings grow [26].

2.6 COST CONTROL

Cost control involves identifying cost deviations from the baseline and adjusting the budget or project size to close the gap. Project cost control is continuing. Measurement and timely, accurate reporting are stressed here. Expense control relies on the cost management plan and baseline. This plan details how the project's performance will be assessed, what the allowed amount of deviation is, what will happen if it's surpassed, and who will make judgments.

2.6.1 Time Performance

From the costumer point of view, final users, practitioners, people, the first standard to assess progress of the enterprise was the finishing time period. So, it was important to finish the building enterprise during the required time. It is when the enterprise progress is assess the enterprise progress from the overall view. Time period variance (TV) has been suggested as one of the techniques of assessing achievement of enterprise in building industry. The equation for time period difference was illustrated as:

$$TV = BTWP - ATWP \tag{2.3}$$

Where, BTWP is the budgeted period of work performed and ATWP is the actual period of work performed.

The significance of the time factor could present knowledge for enterprise managers to know that the enterprise was not progressing as it is planned. Furthermore, submission of enterprises on time is been regarded as the customers' first need in the contraction arrangements [27].

2.6.2 Quality Performance

Quality was defined as the overall attributes needed by a product or duty to meet a given demand; suitability for function. In another way, quality in building sector assures the ability to meet the quality criteria. Requirements was defined by customer in contract arrangement, and they are the desired features of outcomes, operations, and duties. All of the sections in the enterprise should know those standards and sequences to get a high quality enterprise that corresponds to customers' feature predictions. Feature achievement could be determined by examining the non-conformance report (NCR) in the ISO 9000 credited institution. Furthermore, feature achievement could be assessed by looking through the eyes' needs.

2.6.3 Customer's Approval

Satisfaction is defined as a way to make comparison between an idea of the output by the person and the prediction of it. The customer's approval is becoming a crucial factor in the last decades in the building field. Usually, costumers in building sector have this discontent

in various arias including overspending in enterprise expenditures , slowness of finishing, bad feature, and unfit enterprise teams such as subcontractors and advisers. It was examined that to have a good relationship was five times more costly than to preserve an existing … build up relationship with a new client in the building industry was five periods more expensive than to maintain existing one. The studies also present that building companies could rise their advantages by 100 % when they keep 5% or more of their previous customers. so, customers ' approval was an important achievement indicator in the building manufacture. There must be always advancements in the achievement when they want to evolve and foster in the universal mart. However, feature achievement of the outcomes and duties services that the customers get in a fixed time and expenditure was closely connected to customers approval.

2.6.4 Security and Wellbeing

Security and wellbeing were defined as the level to which the general conditions boost the finishing of an enterprise with 0 death rate or damages. Measures of security were basicly looking at the number of accidents that happen within the building period. Building duties are popular classified as the most challenges and the riskiest actions in the universe due to the large number of people who are hurt and murdered each year. The previous studies show that building employee has 3 times larger chances of passing away and 2 times larger chances of being hurt. The security achievement was determined through the use of statistic information of damage and death. The major aim in measuring Security and wellbeing achievement was giving data on the success and the status - quo of building action to monitor Security and wellbeing and damages. Furthermore, measures were considered efficient if it were showing the damage degrees and investigating the cause that is responsible for damage or injury. Finally, the feedback actions were taken into consideration to boost enterprise achievement.

2.7 DISTINCTION BETWEEN DELAY AND PERIOD EXCEED

Delay and period overruns are very similar terms frequently used to represent the lack of progress in building industry replacing each other, but there was a slight distinction between them. Delay refers to lack of enterprise progress within the baseline building schedule as compared to it, whereas time exceed was any postponement after the deadline of building

time table. Period exceed itself was a major effect of building postponement, which was followed by expenditures overrun. According to,, postponement was a condition when the provider and the enterprise owner together or individually cause the non-completion of the enterprise on time. Postponements happen in all building enterprises, whether easy or difficult. In building factory, postponement could be paraphrased as longing the time in the finishing of the enterprise. Briefly, postponement means disability to finish in the period preset and budgeted expenditures. The happening of a postponement may simultaneously affect the enterprise finishing time with other factors. When the enterprise completion date was exceeded, the amount of period by which the enterprise completion date exceeded was known as period overrun of the enterprise [28]. Published the building enterprise with expenditures overruns as well as dealy. They collected data from public roads along with some building structure. They preferred ANOVA method for analysis purpose. They concluded that Expenditures overruns and delay were not good for successful enterprise. had discussed about the expenditures overruns. They proposed classification algorithm based on data mining. Numerical data were used for prediction purpose. The model has an accuracy are about 43.72% [29]. Reported about factors which affects the budget. It is quantitative method based on questionnaire. They considered PLS approach for research. Bhargava et.al [2010] published about period–expenditures analysis. They observed that many factors impact the achievement of the enterprise. Also, they had discussed about the relationship in-between expenditures and period. They discussed the least square regression model [30]. Discussed about the feature administration. They had considered the QMS model which is depending on questionaries' 'for effective administration of feature they consider the OMS system. [31] published about the achievement of the period expenditures of the building enterprise by the earned value method. Under this research they have disused about some parameters such as CPI, SPI, etc [32].

Evaluated the achievement of the enterprise depended on the various parameters such as budget meeting, achievements, scheduling, utilization of the plant along with health and safety related parameters. They observed some increase the enterprise expenditures as the enterprise is beyond the deadline. They suggested the corrective actions are seriously taken into consideration for successful implementation enterprise [33]. Low productivity with poor feature issue was discussed by[34]. In similar manner, analyzed the enterprise with productivity measure in the field of building line. Enterprise success with the proper deadline

is well defined Ugwu and Haupt focused on the resource availability as an important parameter which impacts the achievement of the enterprise success [35]. The achievement appraisal of the building enterprise is still the number one competitive case of this millennium. Achievement rating is an important section of administration and is known as the approach of measuring both productivity and functionality of an activity[36]. One achievement concern contains “What should measure?”, “What measurements are taken?”, “The way in which the measurement is done?” and “How can it translate outcomes?” [37]. Previously achievement has been calculated in terms of monetary achievement. Usual administration systems are therefore widely attacked for poor behaviour [38]. This disapproval cause the creation of “equal” or “multiple” achievement rating structures in the seventies [39] said institutions that depend on monetary estimates in its own, can determined their previous achievement, but not the contribution to achieving that achievement . In addition, [40] emphasized that "in addition to calculating 'what' organizational achievement was, how this achievement must be consistently determined'. This has made it possible to align the leading achievement rating indicators by backward index’s. stated achievement rating as number one step in each development approach that aids end costumers and organizations. [41] emphasized that achievement rating is essential for organizations to assess their real intentions with predetermined objectives to ensure that they perform in a good way in a competitive setting. usually, achievement rating in building approaches in 2 methods: in terms of outcome as an institution and in the way of product manufacturing as a method. Though the same group of method levels is included throughout the enterprise, the building industry is an enterprise-focused industry where every enterprise is distinctive and maybe regarded as an example [42]. So, assessing building achievement is pretty much focused on enterprises than building organizations. scholars and industrial specialist indicate that the low quality achievement standards is one obstacles to advancing development in the building industry discussed that usual factors such as expenditures, time period and feature are inseparable, providing a perfect perspective of enterprise achievement. Researchers also say that the application of the 3 usual factors on building enterprises is reflected finally the enterprise and can be organized as achievement indicators of 'failure'. Salminen (2005) developed a system for measuring the achievement of a building site. The scholars analyzed the measurement outcomes to assess the progress characteristics of a building site. [43] have indicated that enterprise achievement is going to be sent to all parts in the enterprise. The

measurements is going to have each of company issues and enterprise implementation. Various applications were noticed for key achievement indicators (KPIs) in building industry created group of KPIs to calculate the progress of building enterprises. The scholars applied 3 scenarios to assess the suitability of the suggested KPIs. 259 depending to previous documents, it is clear that achievement measuring models like achievement prism, SMART system, achievement appraisal survey, integrated achievement measurement system, EFQM framework and benchmark card (BSC), and decision-taking methods are as conditional as quantitative engineering. and the analytic hierarchy (AHP) process applied in the building industry to test achievement . Anyway, few of the tools mentioned above such as benchmark card and AHP have been applied for achievement testing in the building industry, discretely[44]. It was also identified that achievement was not assessed by value and quality in the building field. There is a deficiency in the measurement method of the achievement level of a building enterprise, so this gap makes us in a need to improve a better method to evaluate the achievement level of an enterprise. The basic aim of this research is to give a multidisciplinary achievement scheme with benchmark card priorities and Key Building Enterprise Achievement Indicators (KBPPIs) to evaluate the achievement of a building enterprise, using a multifaceted decision-taking tool like analytic hierarchy. The framework of the paper starts with the introduction of the achievement rating and updates the achievement rating in the building industry. Phases 2 and 3, scan the benchmark card and analytic hierarchy methods and their application to the building industry. The 4th part forms a functional scheme and gives a metaphorical outline. The 5th part introduces the enterprise achievement evaluation scheme and the last part sums up the closures found in all the study findings and advices for improving enterprise achievement[45] .

After extensive literature review, it is worth to investigate the QMS effectiveness with other achievement indicators. Moreover, very few researches are available regarding building industry to measure the QMS maintenance and practices effectiveness. Several factors cause the overall delay in the building enterprise. To overcome all issues in a building enterprise, we improve the achievement evaluation based on period and expenditures in building building enterprise.[46].

2.8 GREEN SHIP

According to the Greenship workflow, green building development begins in the initiation phase. It begins at the initiation stage. Therefore, understanding the concept of green building is already necessary for all green building initiators. It is necessary to understand the The evaluation of a green building is determined by a group of green building professionals and can result in a Design Certification (DR). Certification (DR). During the construction phase, the building is constructed according to the design recognitions Recognizing the need for full integration of building stakeholders such as the owner, consultants, and contractors, the building is constructed according to the design. Contractor Each phase of construction will be supervised by a Greenship Association professional. At the end of construction, the Green Building Council will make a final evaluation based on the experts' and determine the level of achievement of the Green Building Assessment Tool. The project will enter the operation and maintenance phase. Certification at this stage is called Final Assessment (FA) certification. For new buildings (NB), the certification is Final Assessment (FA) certification. Green building monitoring during the operation and maintenance phase is performed by the building manager and evaluated by the Green Building Council. Green building monitoring walks through the operation and maintenance phase by the building manager and is evaluated annually by the Green Building Council team [13]. The final results of the Green Building Council team's monitoring are used as evidence for building certification during the operation and maintenance phase, called the final assessment. The Final Assessment (FA) certification of the existing building will be used as evidence for building certification during the operation and maintenance phase. to be obtained. The flow of the green building assessment process based on the Green ship Assessment Tool is shown in Figure 2.7.

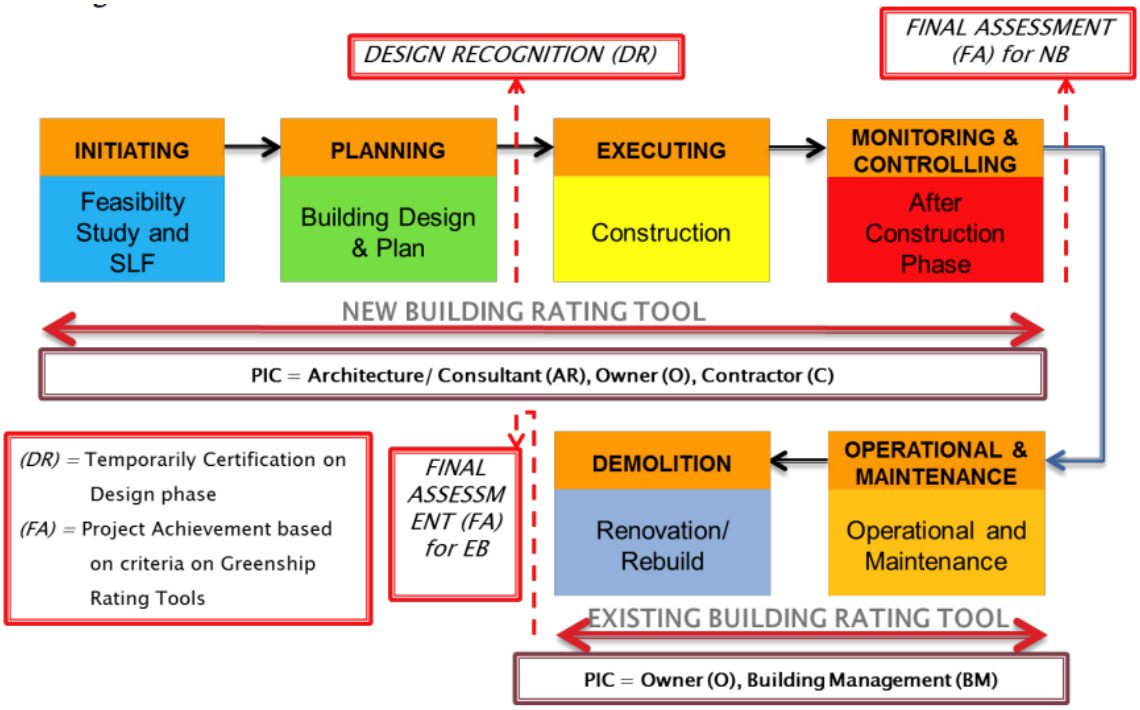

Figure 2.2: Green Ship Assessment Tool.

3. METHODOLOGY

3.1 INTRODUCTION

The study's research strategy and methodology are described here. Population and sampling design are covered. Research methods, model, sampling design, and sample size. Data gathering and analysis methods to achieve research goals are also covered in the chapter.

3.2 RESEARCH DESIGN

Research designs organize an examination to answer research questions. Analyzing the research problem reveals its structure and how to gather empirical evidence. Research design is how a researcher investigates an issue and expands knowledge. Clear, well-articulated research plans improve validity and minimize mistake during study exploration[46]. Several criteria should be examined before choosing a research method. First, the research topic. Inductive approaches are best for novel topics with minimal literature, although deductive ones are more common. Studying requires attention to time. Inductive research takes longer to collect and analyze data because ideas arise slowly. Risk is another issue. Inductive research risks not finding useful data patterns and theories. Deductive research is known to be low-risk. Despite "non-return of questionnaires" dangers.Deductive explanations help this thesis achieve its purpose. It also quantifies topic data. The study used judgemental sampling. This sampling method works well for group data (Fellows and Liu 2008). This sampling process's shortcoming. This sampling procedure lacks randomization, hence the data are biased. Neuman (2006) proposes choosing the most trustworthy expert or authority to prevent this problem. This study focuses on these two criteria and data collecting. The CIDB, which collects data, is the major government agency for construction industry development, and MAFM is the sole FM professional association in the country. Only MAFM represents FM specialists in Malaysia. These partnerships were intended to produce respondent consensus and high-quality data. Such partnerships, if consensus among respondents could be achieved, would ensure the reliability and quality of this survey's Information for this survey

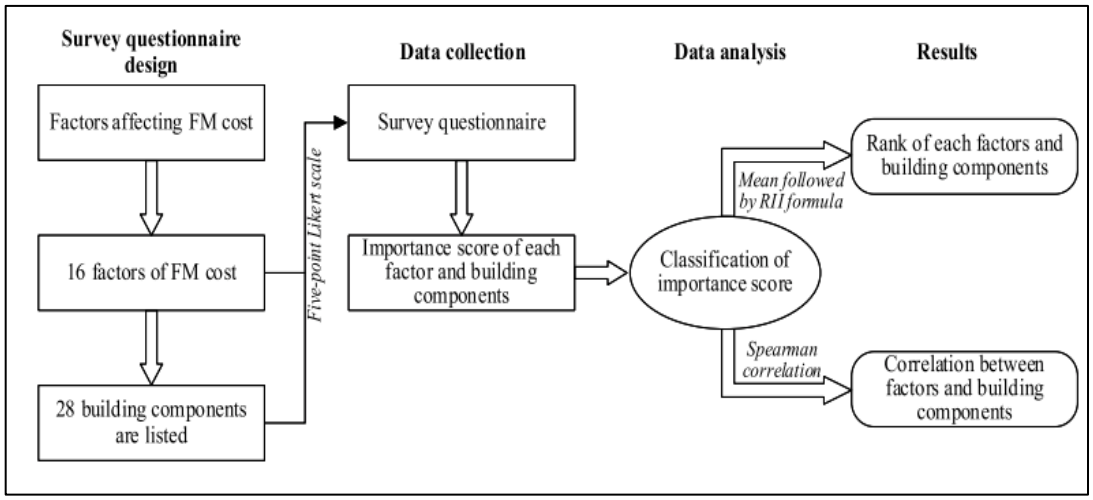

Figure 3.1: Research Design.

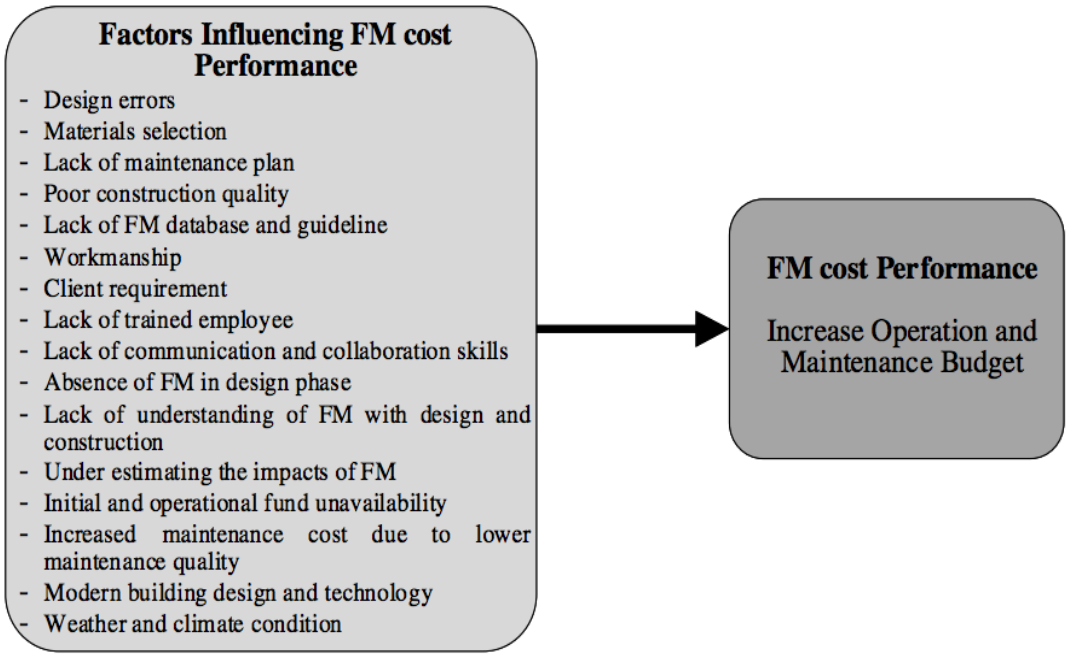

Figure 3.2: Theoretical Framework for Factors Influencing FM Cost Performance.

3.3 PRIORITY BASED BUILDING ENTERPRISE ACHIEVEMENT EVALUATION SCHEME

Different research methods are carried out the research for investigating the feature achievement in the field of construction and civil Engineering industries. In earlier years, different techniques are used to observe the achievement named as: smart system, European foundation for feature administration (EFQM) formwork with stabled scorecard,

achievement prism, questionnaire-based achievement measurement, analytic hierarchy process (AHP) system which shows multiple conditions-based choice making, integrated Achievement evaluation system etc.

This study uses the model developed by (K. et al., 2010) which is a “multi- dimensional performance measurement model for building construction project performance evaluation by integrating BSC and AHP tools”.

Balanced Scorecard (BSC): In 1992, David Norton, president of Renaissance Solutions, and Harvard business administration professor Robert Kaplan jointly developed the Balanced Scorecard (BSC) as a tool for assessing and enhancing organizational performance. It includes indicators for customers, internal/business processes, and learning and development in addition to financial measures. Each viewpoint has a wide range of potential supplemental measures (Kagioglou et al., 2001). BSC can be used to assess a construction company's efficiency. Key Performance Indicators (KPIs) are used in the construction sector to measure success. A set of measures called key performance indicators (KPIs) is used to evaluate the efficiency of a construction operation. In addition, "KPIs play a crucial role in giving information on the execution of construction jobs, projects, and enterprises." Due to the growing significance of a wide range of quality and performance issues, key performance indicators (KPIs) are being used more frequently in the building sector (Adhiprasanggaa et al., 2016). Although earlier studies have shown that the BSC methodology is relevant to the construction industry, there are a few industry-specific considerations that must be made if the method is to be employed successfully and without hiccups (Mbachu, 2008).

Kaplan and Norton (1993) state that BSC serves as the basis for the company's attempts to define and communicate its primary interests to its management, employees, investors, and consumers. The BSC's technological foundation rests on efficiency logic, which holds that the BSC is in high demand because it offers the promise of enhanced organizational performance (Ax & Bjrnenak, 2005). According to Kaplan and Norton (1996), the underlying relationship is that metrics related to organizational learning and growth will affect metrics related to internal business processes, which will influence metrics related to the customer perspective, which will ultimately change the financial metrics. The balanced scorecard is one component of a more thorough performance management system that is based on three essential factors that contribute to the system's success (Basu, 2004). The

BSC's central idea is to establish a causal link between performance indicators and the factors that influence them. It is possible to use non-financial variables in the Balanced Scorecard to foretell financial outcomes (Nrreklit, 2000). To adequately reflect the whole scope of the organization, the BSC should incorporate a wide variety of performance indicators (Aidemark, 2001). Financial, customer, internal process, and learning and growth are the four pillars of the balanced scorecard idea proposed by Kaplan and Norton (1996), which seeks to create a genuine indication of performance across all corporate functions. According to Pineno (2002), the BSC allows managers to track key performance indicators and make informed predictions about the future of a company's financial stability and well-being. Using a fast and scalable strategy translation, BSC is able to exert strategic control over the business and reveal hidden assets and information. According to Kaplan and Norton (1992), BSC provides an all-encompassing reference on the financial front as well as other crucial areas. Businesses can take advantage of BSC's capacity to enhance their vision and strategy, and then put those improvements into action, to build an executive team that provides the full framework necessary to translate a company's strategic goals into a unified set of performance indicators. Financial indicators form the basis of a strategic vision that organizes the essential steps. Customer happiness, internal processes, and innovation and development efforts of the organization should all be in sync with the operational actions that will drive future financial performance. Kaplan and Norton (1996) explained that the BSC is a framework for measuring success across all aspects of a company by focusing on four key areas: finances, customers, internal operations, and training and development.

3.3.1 Building Project Performance Indicators (KBPPIs)

Key performance refers to a technique for evaluating a company's overall long-term performance using quantifiable measurements. In other words, project shareholders would be able to keep tabs on project progress and make decisions that would contribute to the company's or organization's success. As a result, the firm will be able to examine the data from KPIs and develop new plans (Madushika et al., 2020).

The first place to look when attempting to determine a business's success is at its KPIs (KPIs). According to Kagioglou, Cooper, and Aouad (2001), performance management heavily relies on measurement as an information system. This study will establish the key performance indicators (KPIs) for the construction firm and then use a balanced scorecard

to analyze them. According to Kagioglou, Cooper, and Aouad (2001), a company's organizational structure ought to serve several purposes. The ability of the business to raise fresh capital, keep and grow its client base, preserve its position as the industry leader, increase its bottom line and share price, and other internal and external factors all depend on this. Conventional financial measurements are no longer adequate to support and expand the business due to a lack of focus and the inability to provide reliable data. When determining which actions will best meet a company's strategic objectives and key performance results, performance metrics should be taken into consideration (Butler, Letza, & Neale, 1997). An addition to the balanced scorecard is the KPI plan map. The strategy map, according to Kaplan and Norton (1992), specifies the objectives for crucial internal activities that create value as well as the intangible assets required to support those activities. According to Kaplan and Norton (2001a, 2001b), performance evaluation concentrates on managing behavior, whereas the BSC offers opportunities to motivate organizational members to achieve their goals that complement the long-term vision. Because it strikes a balance between long-term strategic goals and short-term actions, BSC is essential in the integration of strategic management systems. According to Bean and Geraghty (2003), effective communication tactics are necessary when involving employees. An employee-by-employee summary of the scorecard's highlights, which should cover both successes and opportunities, should be evaluated by leaders. The financial outcomes of the usage strategy map, exhibiting the visual graphics from the bottom up, are linked to internal processes and customer activities, which in turn are related to investments in employee training, IT, and innovation. A road map could be put up, updates could be sent out on a regular basis, town hall meetings could be scheduled, and so on. Inefficiencies must be properly identified in order to allocate additional resources to the regions that require them.

The model is based on Comprehensive literature review and preliminary survey approach were used to develop a novel extended BSC model with key building project performance indicators (KBPPIs) in each perspective as shown below:

a. Client perspective: includes the following KBPPI

   i. Satisfaction of client for service

   ii. Satisfaction of client on time completion

iii. Satisfaction of client on budget

iv. Degree of quality of finished project

b. Financial perspective:

i. Project cost

ii. Project profitability

iii. Project cash flow

iv. Meeting budget

c. Internal business process perspective

i. Project quality level

ii. Machinery and man power capability

iii. Defects level

iv. Project efficiency

d. Project Team perspective

i. Project team satisfaction level

ii. Degree of project teamwork and partnerships

iii. Project team efficiency

iv. Proper selection of project team

e. Innovation, Learning and Growth

i. Investment on research and development

ii. No. of Continuous Professional Development (CPD)

iii. No. of skills developed

iv. Technical enhancement

f. Heath, safety and socio-environmental perspective

i. No. of Health and Safety issues

ii. Level of construction waste and sustainability

iii. Environment Impact Assessment (EIA)

iv. No. of socio-environmental complains

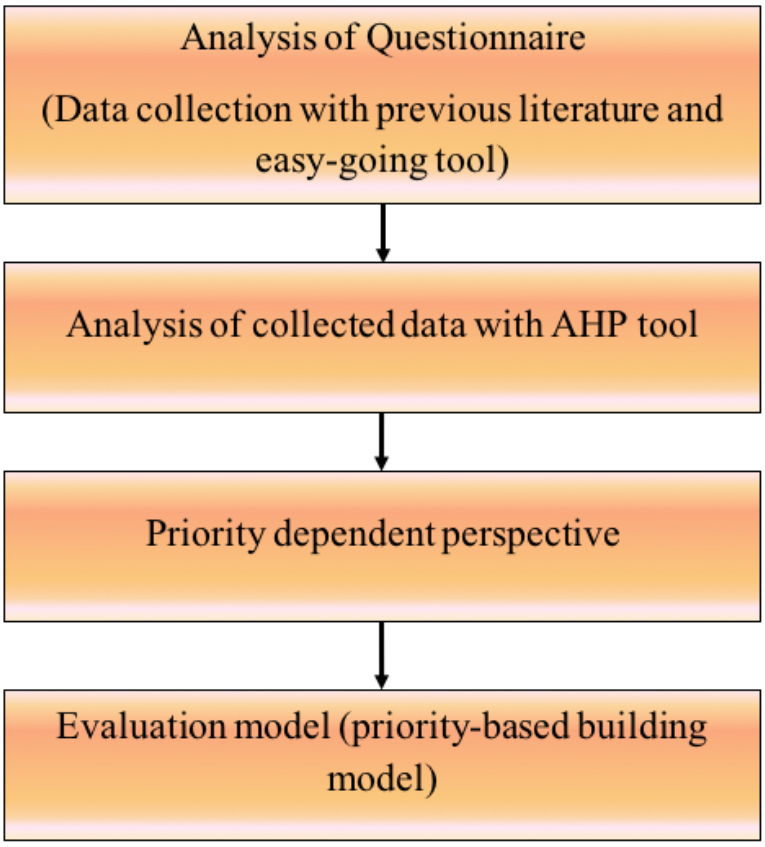

Figure 3.3 : Priority Based Building Enterprise Achievement Evaluation Model.

3.4 RESEARCH STRATEGY

Construction firms that are very active in their activities were surveyed for this research using questionnaires. 51 pairwise comparisons and 9 items make up the survey. The final two inquiries sought to learn more about the respondents' profiles. The KBPPI of each

perspective is compared pairwise in questions 1 through 6, which are all examined independently. The respondent is asked in question (7) to compare the six perspectives that were mentioned before and are crucial to the appraisal process of a building project. In comparisons, a nine-level significance scale is employed, which more accurately captures respondents' thoughts than a five- or six-level scale. The questionnaire can be found in Appendix I at the conclusion of this report.

3.5 SAMPLE SELECTION

The population of interest was defined as construction companies that are active in Iraq. Since we were interested in concepts related to evaluation of performance key building project performance indicators (KBPPIs) from different perspectives, the respondents are the decision makers of those companies operating in construction and building projects.

3.6 SELECTING SAMPLING TECHNIQUES

The fundamental tenet of sampling is that we can infer information about the complete population by choosing a subset of its components. The subject of the measurement is a component of the populace. A community is the entire set of components from which we want to draw conclusions. We used non-probability sampling in this paper. In the sample selection portion of this thesis, sampling was unrestricted and a variety of non-probability sampling techniques were employed. We used judgmental sampling method in the pre-test while taking into account the use of convenient sampling. It's true, Although only five highly active companies were chosen to investigate the proposed multi-dimensional performance measurement model for building construction project performance evaluation by integrating BSC and AHP tools, the emphasis of this research is on construction companies that are active in Iraq. They also make up the bulk of the investors in Iraqi construction ventures.

3.7 RESPONDENT SELECTION

Respondents should be those with the most suitable knowledge in order to increase validity. In the construction industry of Iraq, we focused on selecting companies with long experience and well-known performance in the construction industry. Thus, we end up choosing 5 companies after filtering most of the other companies based on experience and popularity in the construction industry.

3.8 DATA COLLECTION

Primary data and auxiliary data are two different types of data. Primary data are gathered through surveys or interviews from recent sources. These are brand-new, never-before-used data that have just been created. However, secondary data are those that have been gathered from publications, networks, and earlier research. Although they are both significant, primary data can be more timely, expensive, and useful. Typically, original data are preferred by market researchers over secondary data. (Malhotra and Peterson, 2006). There were no primary data sources to draw upon because this study was not done in Iraq. Due to the new definitions and questions in this study, the construction industry also requires new ideas; managers should have addressed these questions with fresh discussion topics. A survey is used to gather data for this study. As we already stated, the primary objective of this study is to investigate Iraq's notable achievements in the building and civil engineering fields.

4. RESULTS AND DISCUSSIONS

In this study we investigated the 'Building Project Performance Evaluation Model' with perspectives and KBBPIs. The mean of respondents' response to the questionnaire was translated using pair-wise AHP analysis and the following performance score was obtained:

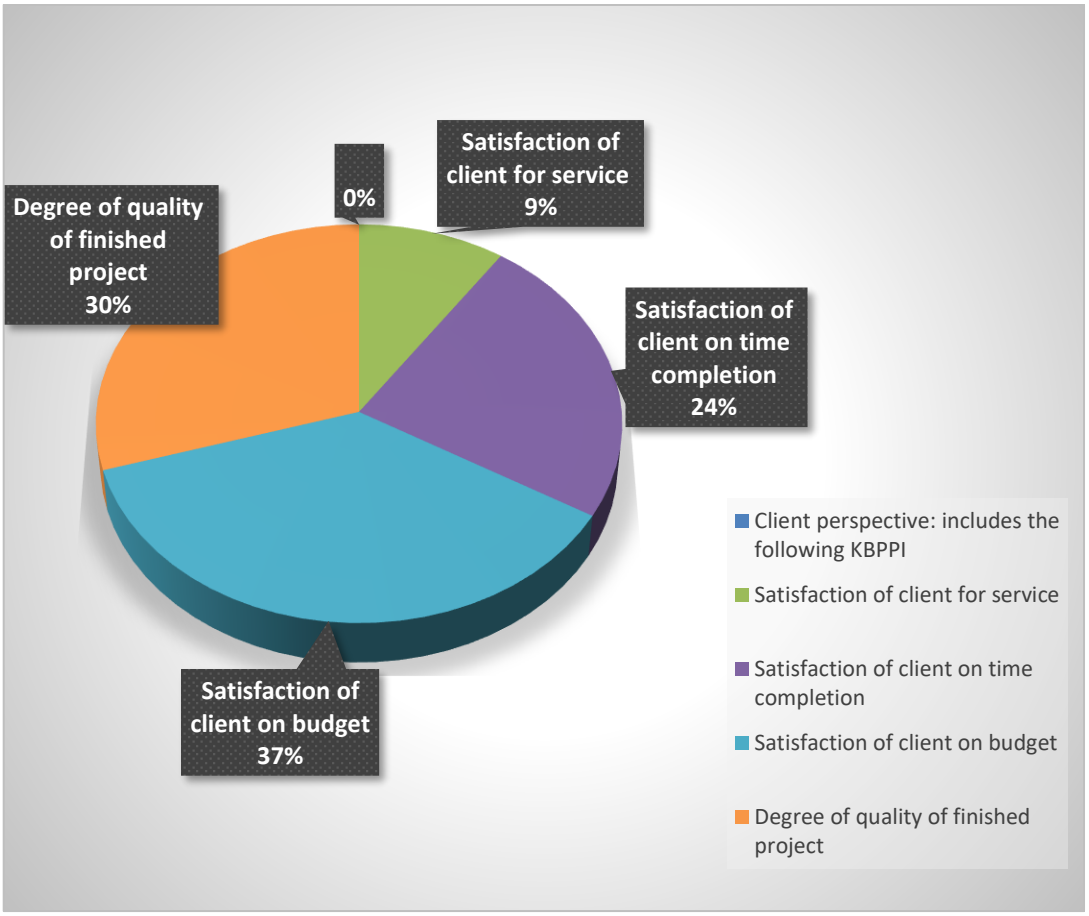

Figure 4.1: Mean Values of all Perspective as Collected from Questionnaire.

Table 4.1: Mean Values of All Perspective as Collected from Questionnaire, Client Perspective: Includes The Following KBPPI.

	Satisfaction of client for service	Satisfaction of client on time completion	Satisfaction of client on budget	Degree of quality of finished project
Satisfaction of client for service	1	4.4888888	1.3019048	2.0583334
Satisfaction of client on time completion	2.4872222	1	1.875	0.8983334
Satisfaction of client on budget	3.84	2.8285714	1	1.8
Degree of quality of finished project	3.09	4.0666666	1.2333334	1

Table 4.2: Mean Values of All Perspective as Collected From Questionnaire, Financial Perspective.

	Project cost	Project profitability	Project cash flow	Meeting budget
Project cost	1	5.6222222	3.4	1.7585714
Project profitability	1.9257936	1	1.7916666	0.4
Project cash flow	0.44	2.7066666	1	0.73
Meeting budget	4.225	3.8	5.2666666	1

Table 4.3: Mean Values of All Perspective as Collected From Questionnaire, Internal Business Process Perspective

	Project quality level	Machinery and man power capability	Defects level	Project efficiency
Project quality level	1	4.3066666	3.2	0.1852382
Machinery and man power capability	1.69	1	4.225	1.0916668
Defects level	0.3666666	1.7566668	1	0.174127
Project efficiency	5.6	4.25	6.2	1

Table 4.4: Mean Values of All Perspective as Collected From Questionnaire, Project Team Perspective.

	Project team satisfaction level	Degree of project teamwork and partnerships	Project team efficiency	Proper selection of project team
Project team satisfaction level	1	3.2666668	1.6285714	2.865
Degree of project teamwork and partnerships	2.6555556	1	3.6333334	2.8785714
Project team efficiency	2.34	1.38	1	2.9066666
Proper selection of project team	2.74	2.345238	1.7888888	1

Table 4.5: Mean Values of All Perspective as Collected From Questionnaire, Innovation, Learning and Growth

	Investment on research and development	No. of Continuous Professional Development (CPD)	No. of skills developed	Technical enhancement
Investment on research and development	1	3.311111	2.25	2.1833332
No. of Continuous Professional Development (CPD)	4.2507936	1	1.59	2.2733334
No. of skills developed	1.3	2.4333334	1	0.5785714
Technical enhancement	2.095238	2.4	5.1	1

Table 4.6: Mean Values of All Perspective as Collected From Questionnaire, Heath, Safety and Socio-Environmental Perspective.

	No. of Health and Safety issues	Level of construction waste and sustainability	Environment Impact Assessment (EIA)	No. of socio-environmental complains
No. of Health and Safety issues	1	2.5	0.3285714	3.0916666
Level of construction waste and sustainability	2.0733334	1	3.14	1.795238
Environment Impact Assessment (EIA)	3.8	1.6583334	1	2.8971428
No. of socio-environmental complains	2.335238	2.5333334	3.8571428	1

Table 4.7: Pair Wise Comparisons of KBBPI.

Perspectives and Key Performance Indicators	**Performance Score**	**Percentage**
Client perspective		
Satisfaction of client on budget	0.273	27.3%
Satisfaction of client for service	0.264	26.4%
Degree of quality of finished project	0.256	25.6%
Satisfaction of client on time completion	0.205	20.5%
Financial perspective		
Meeting budget	0.390	39.0%
Project cost	0.327	32.7%
Project profitability	0.147	14.7%
Project cash flow	0.134	13.4%
Project Team perspective		
Degree of project teamwork and partnerships	0.294	29.4%
Project team satisfaction level	0.255	25.5%
Proper selection of project team	0.233	23.3%
Project team efficiency	0.216	21.6%
Internal business process perspective		
Project efficiency	0.463	46.3%
Machinery and man power capability	0.254	25.4%
Project quality level	0.197	19.7%
Defects level	0.084	8.4%

Table 4.7: Pair Wise Comparisons of KBBPI." Table Continued"

Perspectives and Key Performance Indicators	**Performance Score**	**Percentage**
Innovation, Learning and Growth		
Technical enhancement	0.295	29.5%
No. of Continuous Professional Development (CPD)	0.284	28.4%
Investment on research and development	0.266	26.6%
No. of skills developed	0.153	15.3%
Heath, safety and socio-environmental perspective		
No. of socio-environmental complains	0.290	29.0%
Environment Impact Assessment (EIA)	0.269	26.9%
Level of construction waste and sustainability	0.234	23.4%
No. of Health and Safety issues	0.206	20.6%

(Table 4.1) summarized the pair wise comparison of key building project performance indicators (KBPPIs) in each perspective, in client perspective satisfaction of client on budget lead in this perspective with a score of (0.273) followed by satisfaction of client to service, degree of quality of finished products and satisfaction of client to time completion with scores (26.4, 25.6,20.5) respectively.

For Financial perspective the most important KBPPI is meeting the budget with score of (0.390), second most important recorded a score of (0.327) which project cost, project efficiency and project cash flow ranked the third and fourth with scores of (0.147 and 0.134).

Project team perspective KBPPIs have Degree of project teamwork and partnerships leading the group with score of (0.294), Project team satisfaction level coming as second in the group

scoring (0.255), Proper selection of project team positioned as third with score (0.233), and fourthly Project team efficiency with score of (0.216).

According to the analysis Internal business processes perspective recoded Project efficiency, Machinery and man power capability, Project quality level, and Defects level with scores (0.463, 0.254, 0.197, & 0.084) respectively.

The analysis also reveals that Technical enhancement (0.295), No. of Continuous Professional Development (CPD) with score of (0.284), Investment on research and development (0.266), and No. of skills developed (0.153) are the KBPPIs ranked from the most to least important with respect to Innovation, learning, and growth perspective.

Finally, in terms of Health, safety and socio-environmental perspective we noticed that the most important KBPPIs is Number of socio-environmental complains with score of (0.290), second important is Environment Impact Assessment (EIA) scoring (0.269), third in the list is Level of construction waste and sustainability with score of (0.234), and fourth is No. of Health and Safety issues with score of (0.206).

Table 4.8: Pair Wise Comparison of Perspectives.

Perspective	**Performance Score**	**Percentage**
Client perspective	0.296	29.65%
Financial perspective	0.291	29.17%
Project Team perspective	0.128	12.81%
Internal business process perspective	0.175	17.50%
Innovation, Learning and Growth	0.070	7.05%
Health, safety and socio-environmental perspective	0.038	3.81%

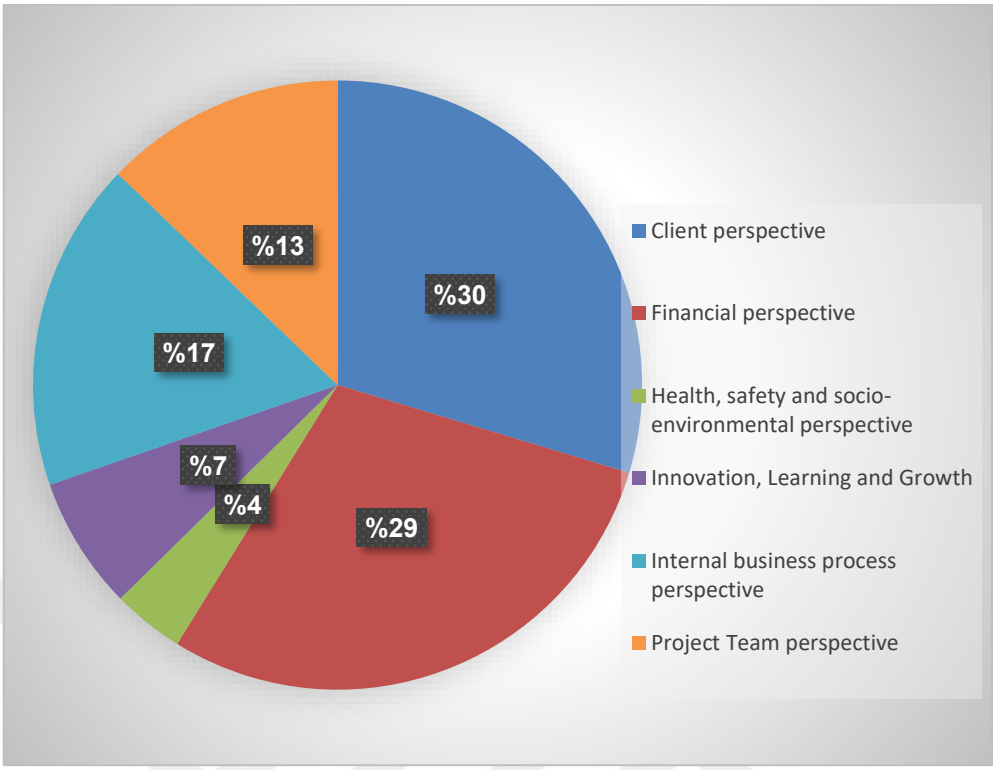

Figure 4.2: Pair Wise Comparison of Perspectives.

The pair wise comparison for the perspectives is shown in Table 4.2, Client perspective is the most important criteria in building project evaluation scheme with score of (0.296), coming as the second most important perspective is Financial perspective scoring (0.291), Project Team perspective ranked the third between the perspectives with score of (0.128), in fourth position its noticed that Internal business process perspective scored (0.175), Innovation, Learning and Growth perspective and Health, safety and socio-environmental perspective are ranked the fifth and sixth with score of (0.070 and 0.038) respectively.

Table 4.9: Pair wise Table of Perspective.

	Client perspective	Financial perspective	Internal business process perspective	Project Team perspective	Innovation, Learning and Growth	Heath, safety and socio-environmental perspective
Client perspective	1.00	1.00	3.00	2.00	4.00	6.00
Financial perspective	1.00	1.00	3.00	2.00	3.00	7.00
Internal business process perspective	0.33	0.33	1.00	1.00	2.00	4.00
Project Team perspective	0.5	0.5	1.00	1.00	4.00	5.00
Innovation, Learning and Growth	0.25	0.33	0.5	0.25	1.00	2.00
Heath, safety and socio-environmental perspective	0.17	0.14	0.25	0.2	0.50	1.00

Table 4.10: Consistency Calculation For Perspectives After Multiplication of Columns in Table 4.3 By Their Performance Score.

	Client perspective	**Financial perspective**	**Internal business process perspective**	**Project Team perspective**	**Innovation, Learning and Growth**	**Heath, safety and socio-environmental perspective**	**SUM**
Client perspective	0.296	0.291	0.384	0.350	0.281	0.228	1.833
Financial perspective	0.296	0.291	0.384	0.350	0.210	0.267	1.800
Internal business process perspective	0.097	0.096	0.128	0.175	0.140	0.152	0.790
Project Team perspective	0.148	0.145	0.128	0.175	0.281	0.190	1.069
Innovation, Learning and Growth	0.074	0.096	0.064	0.043	0.070	0.076	0.424
Heath, safety and socio-environmental perspective	0.050	0.040	0.032	0.035	0.035	0.038	0.231

Table 4.11: Consistency Calculation Continue.

Perspective	SUM	Performance Score	SUM/ Performance Score
Client perspective	1.833	0.296	6.181
Financial perspective	1.800	0.291	6.173
Project Team perspective	0.790	0.128	6.170
Internal business process perspective	1.069	0.175	6.107
Innovation, Learning and Growth	0.424	0.070	6.044
Heath, safety and socio-environmental perspective	0.231	0.038	6.074
Total	**6**		**6.124**

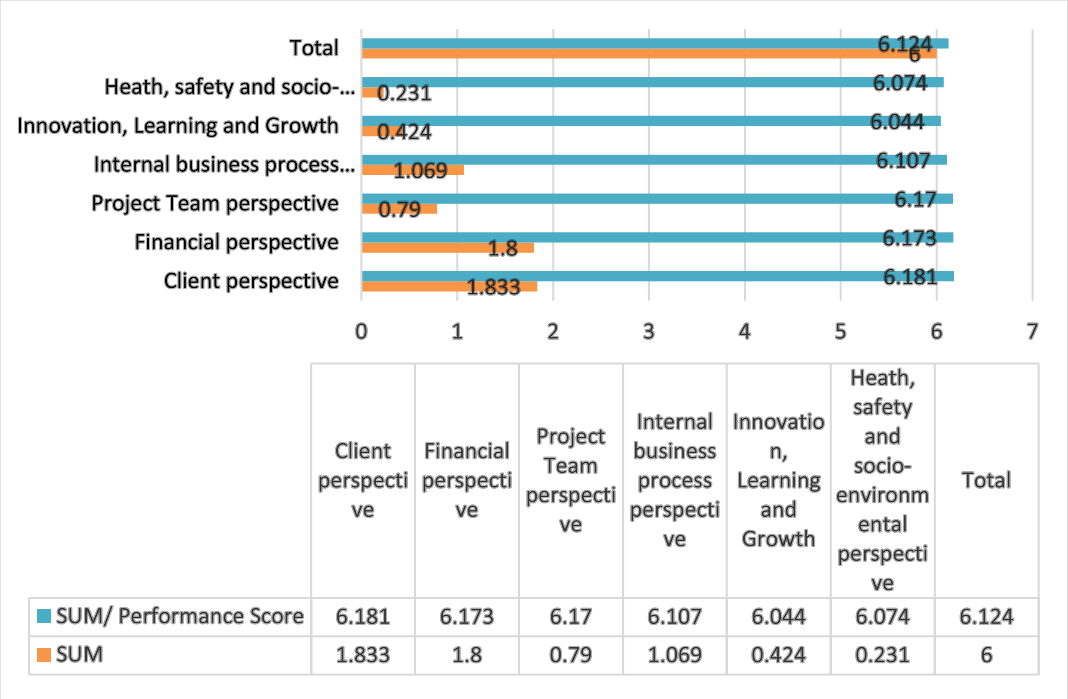

Figure 4.3: Perspective Between SUM/ Performance Score and SUM.

$$\lambda_{max} = 6.124 \quad (4.1)$$

$$CR = \frac{\lambda_{max} - n}{n-1} \times \frac{1}{1.24} \quad (4.2)$$

Where, n is the size of pair wise matrix

Random index is taken as 1.24 for pair wise matrix of n=6

Thus, *CR= 0.02*

5. CONCLUSION AND FUTURE WORK

5.1 CONCLUSION

The study employed the "Building Project Performance Evaluation Model" to evaluate the performance of construction companies in Iraq with respect to their building projects. The model was assessed utilizing AHP and Balanced Scorecard (BSC) methodologies. A questionnaire utilizing pairwise comparison methodology was distributed to active construction enterprises in Iraq with the aim of eliciting their perspectives and Key Business Performance Indicators (KBPPIs) for subsequent analysis. Upon conducting an analysis of the gathered responses, both the perspective and the BPPI assigned scores to evaluate the performance in relation to the established criteria. The presented performance scores demonstrate the significance of individual perspectives and Key Business Performance and Process Indicators (KBPPIs) in relation to the organization. The data analysis was deemed appropriate as the Perspective Consistency Ratio (CR) was found to be less than 0.10. Analysis showed that "Client perspective" is the most important perspective for construction projects to be successful, followed by "Finance perspective," "Project team perspective," "Internal business processes perspective," "Innovation and learning," and "Health and socio-environmental perspective." This study of the "multi-dimensional performance measurement model for building construction project performance evaluation by integrating BSC and AHP tools" provides a framework for companies to evaluate their own performance and analyze the key enablers for construction companies to succeed and make wise decisions that will help them reach their goals. The carbon emissions of PPB exhibited an upward trend with increasing assembly rates, followed by a subsequent decline within buildings. The rates of assembly exhibited both increments and decrements in parts per billion (PPBs). Assembly rate reduced building carbon emissions the most. The greatest improvement in carbon emissions was observed during the building phase, while operation and design had a relatively minor impact. Impacts operation and design little. As the rate of assembly increases, there is a corresponding decrease in carbon emissions and prefabricated construction costs. It is projected that the rate will eventually stabilize at 60%. As the assembly rate increases, then increases. The utilization of prefabricated pile foundations is deemed inappropriate for fabricated sections. The utilization of pile foundations results in increased building costs and carbon footprint, rendering them unsuitable for prefabricated

elements. significantly. The employment of in-situ piling is a highly recommended method for establishing foundations. The suggested approach is to utilize a foundation. Prefabricated houses in Japan have been found to effectively decrease environmental impact (EI) and energy consumption. The findings facilitate the identification of pre-manufactured structures in accordance with the construction industry framework and societal production level of Japan. The data depicts the expansion of Japan's prefabricated construction industry. The achievement of successful construction projects has the potential to serve as a valuable educational resource for other nations. The study culminates in a conclusion.The feasibility of incorporating green building practices into various phases of construction. This facilitates the implementation and dissemination of prefabrication technology in a focused manner. This enables the implementation and dissemination of phase-specific prefabrication technology. The present study reports on the assembly rates of prefabricated buildings with different characteristics. There is no correlation between high assembly rates and a reduction in energy consumption or carbon emissions. This indicates that nations in the initial phases of prefabricated construction advancement do not pursue them without careful consideration. This indicates that the advancement of prefabricated building construction is still in its nascent stage and that achieving elevated assembly rates should not be pursued indiscriminately.

5.2 FUTURE WORK

Cost performance can be ascertained objectively and subjectively by also objectively converting quality costs. However, evaluating how contract terms and conditions, along with cost performance, affect project success evaluate is a typical study that reflects a more subjective study. It is a subjective study. Therefore, it is important to conduct a systematic study that how to link studies of benchmarks and contract terms and conditions that will lead to project success. It is also also important to divide cost/performance into customer and provider perspectives to find the optimal point. It is also important to separate cost performance into customer and provider perspectives in order to determine the optimal profitability of the project. Therefore, it is important to apply the CRASP methodology and Applying and looking at the CRASP methodology is essentially analyzing the project and deriving the scope of the cost-benefit analysis. appropriate tuning for the success of the project and conducting a cost-benefit analysis. Additionally based on the CRASP

methodology framework for benchmarking the development of construction projects reasonably consider stakeholder objectives, expectations, and priorities for the project.

From the analysis of primary data, this study found that Factors affecting FM cost performance vary from project to project. Common factors found to be design errors, lack of maintenance planning, lack of understanding of FM in design and construction, underestimation of FM impact, and high maintenance costs due to low cost. General factors such as lack of understanding of FM in design and construction, underestimation of the impact of FM, and high maintenance costs due to low maintenance quality were shown to be the five main factors that significantly affect the cost performance of FM. These are the five major factors that significantly affect the cost-performance of FM. Among the building components, the roof Among the building components, roof, building joints, façade, HVAC, and sewer ranked high in terms of maintenance difficulty. In addition, the results of the correlation test revealed a statistically significant relationship between design errors. Correlation test results also revealed statistically significant relationships between design errors, lack of maintenance planning, lack of FM in the design phase, and lack of understanding of FM in the design and construction phases.

The results of the correlation test also revealed statistically significant relationships with design errors, lack of maintenance planning, lack of understanding of FM during the design and construction phases, and underestimating the impact of FM. Finally, the results of the statistical analysis found that each of the top 10 factors had at least one building component that was significantly correlated with higher FM costs after occupancy. FM costs have become a major concern in Malaysian building projects and globally and is a major issue worldwide. mitigating the impact on building performance. Based on these results, several recommendations are made. First, the facility manager should be involved from the design phase. will help minimize design flaws and their impact on maintenance. Second, an appropriate maintenance plan should be included in the design documents and should be included in the design documents. Finally, proper training can improve worker skills and productivity and productivity. This study provides evidence of the most important factors affecting FM costs and identifies the building components that are most difficult to maintain. It also identifies the building components that are most difficult to maintain. Therefore, this paper has practical significance for designers and facilities managers. It can focus on the

most important factors affecting FM costs and thus encourage building facility managers to reduce FM costs. The problem of increasing FM costs is a the problem of increasing FM costs is so wide-ranging that its scope is not limited to the current study. The subject is not limited to the current study, either. The study recommends innovative solutions and management systems. To further pursue maintenance cost minimization, this study recommends innovative solutions and management systems cost minimization will be discussed. In addition, a case study approach is proposed to examine the importance of FM cost factors to building performance.

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APPENDIX A

Client perspective: includes the following KBPPI				
	Satisfaction of client for service	Satisfaction of client on time completion	Satisfaction of client on budget	Degree of quality of finished project
Satisfaction of client for service	1	8	0.166667	4
Satisfaction of client on time completion	0.125	1	0.25	0.125
Satisfaction of client on budget	6	4	1	0.5
Degree of quality of finished project	0.25	8	2	1
Financial perspective				
	Project cost	Project profitability	Project cash flow	Meeting budget
Project cost	1	4	6	8
Project profitability	0.25	1	0.333333	0.166667
Project cash flow	0.166667	3	1	0.125
Meeting budget	0.125	6	8	1

Internal business process perspective				
	Project quality level	Machinery and man power capability	Defects level	Project efficiency
Project quality level	1	8	6	0.2
Machinery and man power capability	0.125	1	0.125	4
Defects level	0.166667	8	1	0.142857
Project efficiency	5	0.25	7	1

Project Team perspective				
	Project team satisfaction level	Degree of project teamwork and partnerships	Project team efficiency	Proper selection of project team
Project team satisfaction level	1	9	0.142857	6
Degree of project teamwork and partnerships	0.111111	1	4	3
Project team efficiency	7	0.25	1	2
Proper selection of project team	0.166667	0.333333	0.5	1
Innovation, Learning and Growth				
	Investment on research and development	No. of Continuous Professional Development (CPD)	No. of skills developed	Technical enhancement
Investment on research and development	1	9	6	3
No. of Continuous Professional Development (CPD)	0.111111	1	0.5	0.2
No. of skills developed	0.166667	2	1	0.125
Technical enhancement	0.333333	5	8	1
Heath, safety and socio-environmental perspective				
	No. of Health and Safety issues	Level of construction waste and sustainability	Environment Impact Assessment (EIA)	No. of socio-environmental complains
No. of Health and Safety issues	1	0.333333	0.142857	0.333333
Level of construction waste and sustainability	3	1	6	0.333333
Environment Impact Assessment (EIA)	7	0.166667	1	7
No. of socio-environmental complains	3	3	0.142857	1

All Perspectives						
	Client perspective	Financial perspective	Internal business process perspective	Project Team perspective	Innovation, Learning and Growth	Heath, safety and socio-environmental perspective
Client perspective	1.00	1.00	3.00	2.00	4.00	5.00
Financial perspective	1.00	1.00	3.00	2.00	3.00	7.00
Internal business process perspective	0.33	0.33	1.00	1.00	2.00	4.00
Project Team perspective	0.50	0.50	1.00	1.00	4.00	5.00
Innovation, Learning and Growth	0.25	0.33	0.50	0.25	1.00	2.00
Heath, safety and socio-environmental perspective	0.20	0.14	0.25	0.20	0.50	1.00

APPENDIX B

QUESTIONNAIRE SURVEY

Under Project Tile: Building Project Achievement Evaluation Based on Period and Expenditures Relationship.

Participant,

Building project performance evaluation is a novel research interest in performance measurement (PM) and it is the process of quantifying the efficiency and effectiveness of construction activities.

The purpose of this research work is to measure the building project performance based on apriority of perspectives and activities. The perspectives and criteria of activities are selected based on the proposed model of the Balanced Scorecard (BSC) and the key Building Project Performance Indicators (KBPPIs) from the literature of previous studies.
In the following sheets, we would like to elicit your opinion in order to select the alternatives. The pair-wise comparison scale is used to express the importance of one element over another (Table 1).

Table 1: Saaty Comparison Scale

Explanation	**Numeric Value**
If Option A and Option B are equally important	1
If Option A is moderately more important than Option B	3
If Option A is strongly more important than Option B	5
If Option A is very strongly more important than Option B	7
If Option A is extremely more important than Option B	9
Use even numbers for intermediate judgements	2,4,6,8

Example:

Given Options A & B, you can judge their relative importance as shown below example: if you think the option ‘Satisfaction of client for service’ in column A is strongly more important than the option ‘Satisfaction of client on time completion’ in column B, then you mark 5 with (X) on the left-hand side.

if you think the option ‘Satisfaction of client on budget ' in column B is extremely more important than the option ‘Satisfaction of client for service’ in column A, then you mark 9 with (X) on the right-hand side.

Option A	**Extremely**	**Very**	**Strongly**	**Strongly**	**Moderately**	**Equally**	**Moderately**	**Strongly**	**Very**	**Strongly**	**Extremely**	**Option B**						
Satisfaction of client for service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Satisfaction of client on time completion
Satisfaction of client for service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7			

1. Please determine the importance and priority of factors in the right side of this table to the factors in the left side regarding “Achieving success of building project from client perspective”. (for instance in the first row of the table please determine how important is “Client satisfaction to for service” and “Client satisfaction on time completion” compared to each other regarding “Achieving success of building project from client perspective”) for more information about the factors, please read the table attached to this questionnaire. The white columns show importance level between two main levels.

Option A	**Extremely**	**Very**	**Strongly**	**Strongly**	**Moderately**	**Equally**	**Moderately**	**Strongly**	**Very**	**Strongly**	**Extremely**	**Option B**						
Satisfaction of client for service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Satisfaction of client on time completion
Satisfaction of client for service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Satisfaction of client on budget
Satisfaction of client for service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Degree of quality of finished project
Satisfaction of client on time completion	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Satisfaction of client on budget
Satisfaction of client on time completion	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Degree of quality of finished project
Satisfaction of client on budget	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Degree of quality of finished project

2. Please determine the importance and priority of factors in the right side of this table to the factors in the left side regarding “Achieving success of building project from Financial perspective”. (for instance in the first row of the table please determine how important is “Project cost” and “Project Profitability” compared to each other regarding “Achieving success of building project from Financial perspective”) for more information about the factors, please read the table attached to this questionnaire. The empty columns show importance level between two main levels.

Option A	**Extremely**	**Very**	**Strongly**	**Strongly**	**Moderately**	**Equally**	**Moderately**	**Strongly**	**Very**	**Strongly**	**Extremely**	**Option B**
Project cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project profitability
Project cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project cash flow
Project cost	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Meeting budget
Project profitability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project cash flow
Project profitability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Meeting budget
Project cash flow	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Meeting budget

3. Please determine the importance and priority of factors in the right side of this table to the factors in the left side regarding “Achieving success of building project from Internal business process perspective”. (for instance in the first row of the table please determine how important is “Project quality level” and “Machinery and man power capability” compared to each other regarding “Achieving success of building project from Internal business process perspective”) for more information about the factors, please read the table

attached to this questionnaire. The empty columns show importance level between two main levels.

Option A	**Extremely**	**Very**	**Strongly**	**Strongly**	**Moderately**	**Equally**	**Moderately**	**Strongly**	**Very**	**Strongly**	**Extremely**	**Option B**						
Project quality level	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Machinery and man power capability
Project quality level	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Defects level
Project quality level	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project efficiency
Machinery and man power capability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Defects level
Machinery and man power capability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project efficiency
Project efficiency	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Defects level

4. Please determine the importance and priority of factors in the right side of this table to the factors in the left side regarding “Achieving success of building project from Project Team Perspective”. (for instance in the first row of the table please determine how important is “Project team satisfaction level” and “Degree of project teamwork and partnerships” compared to each other regarding “Achieving success of building project from Project

Team perspective") for more information about the factors, please read the table attached to this questionnaire. The empty columns show importance level between two main levels.

Option A	Extremely	Very	Strongly	Strongly	Moderatel	Equally	Moderatel y	Strongly	Very	Strongly	Extremely	Option B						
Project team satisfaction level	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Degree of project teamwork and partnerships
Project team satisfaction level	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project team efficiency
Project team satisfaction level	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Proper selection of project team
Degree of project teamwork and partnerships	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project team efficiency
Degree of project teamwork and partnerships	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Proper selection of project team
Proper selection of project team	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project team efficiency

5. Please determine the importance and priority of factors in the right side of this table to the factors in the left side regarding "Achieving success of building project from Innovation, Learning and Growth Perspective". (for instance in the first row of the table please determine how important is "Project team satisfaction level" and "Degree of project teamwork and partnerships" compared to each other regarding "Achieving success of

building project from Innovation, Learning and Growth") for more information about the factors, please read the table attached to this questionnaire. The empty columns show importance level between two main levels.

Option A	**Extremel**	**Very**	**Strongly**	**Strongly**	**Moderate**	**Equally**	**Moderate**	**Strongly**	**Very**	**Strongly**	**Extremel**	**Option B**						
Investment on research and development	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No. of Continuous Professional Development (CPD)
Investment on research and development	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No. of skills developed
Investment on research and development	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technical enhancement
No. of Continuous Professional Development (CPD)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No. of skills developed
No. of Continuous Professional Development (CPD)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technical enhancement
No. of skills developed	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technical enhancement

6. Please determine the importance and priority of factors in the right side of this table to the factors in the left side regarding "Achieving success of building project from Heath, safety and socio-environmental perspective". (for instance in the first row of the table please determine how important is "No. of Health and Safety issues" and "Level of construction waste and sustainability" compared to each other regarding "Achieving success of building project from Heath, safety and socio-environmental perspective") for more information

about the factors, please read the table attached to this questionnaire. The empty columns show importance level between two main levels.

Option A	Extremely	Very	Strongly	Strongly	Moderatel	Equally	Moderatel	Strongly	Very	Strongly	Extremely	Option B						
No. of Health and Safety issues	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Level of construction waste and sustainability
No. of Health and Safety issues	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environment Impact Assessment (EIA)
No. of Health and Safety issues	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No. of socio-environmental complaints
Level of construction waste and sustainability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environment Impact Assessment (EIA)
Level of construction waste and sustainability	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No. of socio-environmental complaints
Environment Impact Assessment (EIA)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No. of socio-environmental complaints

7. Please determine the importance and priority of perspectives in the right side of this table to the perspectives in the left side regarding “Achieving success of building project”. (for instance in the first row of the table please determine how important is “Client perspective” and “financial perspective” compared to each other regarding “Achieving success of building project”) for more information about the factors, please read the table attached to this questionnaire. The empty columns show importance level between two main levels.

Option A	Extremely	Very	Strongly	Strongly	Moderately	Equally	Moderately	Strongly	Very	Strongly	Extremely	Option B						
Client perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Financial perspective
Client perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Internal business perspective
Client perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project team perspective
Client perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health, safety and socio environmental perspective
Client perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Innovation, Learning, and Growth perspective
Financial perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Internal business perspective
Financial perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project team perspective
Financial perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health, safety and socio environmental perspective
Financial perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Innovation, Learning, and Growth perspective
Internal business perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Project team perspective

Internal business perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health, safety and socio environmental perspective
Internal business perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Innovation, Learning, and Growth perspective
Project team perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Health, safety and socio environmental perspective
Project team perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Innovation, Learning, and Growth perspective
Health, safety and socio environmental perspective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Innovation, Learning, and Growth perspective

Respondent profile (optional)					
How long have your company been operating in building projects?	Less than 10 years ( )	More than 10 years ( )			
Does your company performs assessments and evaluation regularly ?	Not at all ( )	Slightly ( )	Moderately ( )	Very ( )	Extremely ( )