

Importance of KPI Identification and Implementation in Kuwaiti Construction Industry

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Abstract

Key Performance Indicators (KPIs) play a vital role for organizations to measure project performance. The core objective of Key Performance Indicators is that not only organizations but also customers want their projects to be completed within the stipulated time and budget while maintaining the quality standards. Performance measurement is foundation for continual improvement. Subsequently, as a regular rule, benchmarking is the next step to improve contractors' efficiency and effectiveness of products and processes. Camp (1989) introduced benchmarking concepts and defines it as "*the continuous process of measuring products, industry leaders.*" It is a problem to measure the performance of large projects such as construction and communication projects using predefined KPIs. Objective of this research is to find a framework to improve project performance through benchmarking of key performance indicators, to identify the suitable KPI prevailing in the construction industry of Kuwait and develop and calculate the KPIs to assess the performance of the construction projects and making recommendations to improve project performances of construction industry. For this study two Kuwaiti construction companies are selected i.e. Company AA and Company BB. Performance of their financial and non-financial data is analyzed. Primary data is collected through questionnaires and in performance of Company BB. Data also revealed that Company BB's are having cost and time overrun. Organizations like Company BB have to investigate reasons of cost and time delays causing dissatisfaction. Decision of material selection and delivery time should be carefully taken. Organizations should improve its employment policies from selection to compensation, working conditions, motivations and availability of health and safety facilities; as satisfied customers can satisfy customers. Subsequently, Company BB management performance needs immense improvement at all levels and in all processes. Consideration of

design quality indicators (DQI) as per requirement of stakeholders and bio-diversity impacts, it is impossible to satisfy the internal or external stakeholders of construction projects. This thesis contributes useful and new knowledge to the Kuwaiti construction industry. This study reveals the importance of significant KPIs needed for the growth of medium construction organizations through benchmarking the bigger organizations. The ultimate goal of this study is to highlight the importance of KPIs to access success of medium construction organizations. Although it is believed KPIs could be used for benchmarking of bigger size organizations.

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Abbreviations

AA	Company AA
ANOVA	Analysis of variance
BM & M	Benchmarking and Metrics
BRE	Building Research Establishment
CABE	Commission for Architecture and the Built Environment
CBPP	Construction Best Practices Program
CII	Construction Industry Institute
CIRIA	Construction Industry Research And Information Association
CTD	Corporation for Technical Development
CURT	The Construction Users Roundtable
DEA	Data Envelopment Analysis
DETR	Department of Environment, Transport, and the Regions
DPM	Dynamic Planning and Control Method
DQI	Design Quality Indicator
DTI	Department of Trade and Industry
EKPI	Environmental Performance Indicators
EMR	Experience Modification Ratings
ERP	Enterprise Resource Planning
GNP	Gross National Product
HRD	Human Resource Department
HVAC	Heat ventilation Air Conditioning
ISO	International Organization for Standardization
KD	Kuwaiti Dinar
KPI	Key Performance Indicator
LTB	Larger-the-Better
BB	Company BB
MIS	Management Information System
NTB	Nominal-is-the-Best
OA	Orthogonal Array
QMS	Quality Management System
R&D	Research and Development
RFPI	Respect for People Indicators
SNR	Signal-to-noise ratio
STB	Smaller-the-Better
SWOT	Strength Weaknesses Opportunities Threats
TQM	Total Quality Management
UNRWA	United Nations Relief and Works Agency
RFPT	Respect for People Toolkit

CHAPTER 1 – INTRODUCTION

1.1. Research Background

Measurement of performance by the organizations is in vogue for many years, although a limited data is available and consistency is not so reliable. Organizations have always been hesitant in publishing data about their projects' performances and the success ratio of their projects. In order to measure the performance of the projects it is necessary to find out the factors that affect the performance of the projects. For this purpose, Key Performance Indicators (KPIs) play a vital role for organizations to measure project performance. The core objective of Key Performance Indicators is that not only organizations but also customers want their projects to be completed within the stipulated time and budget while maintaining the quality standards. In this way, projects need to be operationally efficient and effective enough to satisfy the customers. Customers do not appreciate rework; therefore they want the work done right at first time and without any defects, also assuring profitability for the organizations (Abu Shaban, 2008). If the projects are up to the standards and done without any reworks then they are highly appreciated. For clients, it is essential to confirm the suitability of any supplier or contractor before assigning any project and it can be done by the client through acquiring information about how suppliers or contractors answer about various indicators for instance price, delivery time, quality, after sale services etc. Through acquiring information from suppliers and contractors, customers would be able to collect primary information. Secondary information can also be considered with the clients from benchmark set by industries to assess the reliability of suppliers and contractors.

Now comparison of industries' benchmarking and particular supplier or contractor reply to various indicators can be performed to reach any suitable decision. Comparison of all level of construction supply chain can be advantageous to benchmark performances to identify weaknesses and strengths, and performance improvement areas. DETR (2000) classified Key Performance Indicators in seven groups that are cost, time, change management, quality, client satisfaction, business performance, health and safety.

Many construction projects fail due to the inefficiency and ineffectiveness of the procedures adopted by the contractors or suppliers. For instance in Gaza strip, many projects face the failure due to the inefficiency and ineffectiveness of performance measurement systems. The failure is not due to any single reason, the projects fail in different aspects like some fail in achieving the time constraint and others fail to be completed at estimated cost. The poor finish of the projects in 2006 was caused by many of the factors and the reasons were many such as material availability was poor, amendments proposed by the client, delayed decisions by the client or management of the contractor company, blockage of roads (UNRWA, 2006). The other reasons for the failure of the projects are cultural, political, and economic issues (UNRWA, 2006 & 2007).

As mentioned above about the Gaza strip, Kuwait construction industry can also face bad performance and failure of projects due to the political instability; therefore, it is essential for the construction sector to measure the performance according to the international industrial standards and benchmark the successful organizations in the industry. This is very critical for

Kuwait construction industry especially for the medium size organizations to strive for improvements in performance and to exist in the market successfully.

1.2.Introduction

Traditionally, companies achieve their objectives and long-lasting goals through integration of all their business functions (Johston, 2003). Similarly for many decades construction industry's main focus remained on achieving economies of scales with added profits. Sommerville (2000) criticized construction industry norm of profit maximization by arguing that it may divert focus for using time and financial resources in improving design and process of constructions. All construction activities such as design, structure construction, and finishing may have risks and uncertainty in some manner (CII, 2007). These risks are to be assessed and mitigated using some framework. According to Yu et al. (2007), performance measurement of businesses is performed for assessment of the management performance, human resource management and devising strategies at all the managerial levels of organizations. Niven (2002) described the importance of performance management for the complicated and integrated business activities in the sentence *“If you cannot measure it, you cannot manage it”*. Due to this fact, not only manufacturing but also service oriented organization realized the importance of efficient systematic performance management systems. In construction industry, measuring performance has always been a dilemma as different activities performed distinctively on the same project and also same activities are performed on different projects simultaneously. Construction industry has always faced a shortage of framework for measuring performances of the construction projects (Yu et al, 2007). The complex nature of simultaneous activities made difficult to measure performance as control and monitoring of input of resources remains weak. Kagioglou et al. (2001) noted that

most companies still assume profitability as a measure of performance although this is not so. The profitability is just an indication that you are getting work and doing it, the actual thing is the satisfaction on both side; customers and company. According to the Beatham et al. (2004), increased popularity of key performance indicators is mainly due to its ability to applicable on the construction industry and performance measurement of a construction company.

To minimize the limitation of performance measurement of projects unobtrusive countries' institutes have developed their own performance measurement criteria meeting their particular needs. For example, USA construction industry institute (CII), in United Kingdom Department of Environment, Transport, and the Regions (DETR) and the Department of Trade and Industry (DTI) and in Chile the Corporation for Technical Development (CTD) developed their own performance measuring systems appropriate for their national characteristics. Construction industry institute of USA developed its performance management system after conducting thorough research. According to Lee et al. (2005), the CII Benchmarking and Metrics (BM & M) is a systematic program which is developed on the basis of research findings. It includes defining of project performance standards, develops a general set of metrics, includes a benchmark data base of making comparisons and allows using a web based evaluation system. Most Performance measuring systems of construction industry have the limitation of measuring only current state of performance at a certain level of project completion. Lee et al (2005) noted that even the performance measuring system developed by construction industry institute of USA is not capable enough of recognizing company's performance at different stages of a project completion. As all the stages are equally important it is also vital to measure the performance at each stage. Consequently, availability of data regarding performance evaluation and its

comparison with the benchmark is limited. It can also create hurdles in developing a systematic approach for identification of problems of construction industry, evaluating different alternatives and taking corrective actions (Bassioni et al. 2005). In the views of Cheah et al., (2004), there is still a need of measurement system that could overcome the limitations of existing systems and can be used for measuring and comparing organization's performance.

According to the Luuet et al. (2008), performance measurement is foundation for continual improvement. It enables owners and employees of all cadres to determine the direction, enhance the specialization and fasten the speed of growth for their organization. Subsequently, as a regular rule, benchmarking is the next step to improve contractors' efficiency and effectiveness of products and processes. Camp (1989) introduced benchmarking concepts and defines it as *“the continuous process of measuring products, services, and practices against the toughest competitors or those companies recognized as industry leaders.”* Benchmarking systems are available in many countries in the form of software which specifically analyze companies' performance against set benchmarks which is usually based on ratios or percentages depicting the core characteristics of company's performances.

Organizations serious in performance improvement can apply benchmarking in order to measure the performance of its own against the performance of the industry leaders. This is done in order to identify the strengths and weaknesses in the performance of the company. Best practices in the industry can be learned through looking at the industry leaders as they are the best in industry, as a result extreme and superior performance can be there (Stapenhurst, 2009).

Based on the use of benchmarking its types are: (1) Performance as It involves comparisons of two companies (CII, 2007). Further it is also allows comparison with established standards in order to improve organization's own performance; (2) Process as it involves comparisons of business practices and approaches. It allows learning from the best and improve one's own processes; and (3) Strategic as it involves comparison of the available strategic options. Data of other organizations are collected and then compared it with organization's own strategic options and then best options are selected for own strategic planning (Adkins, 2006).

Benchmarking is applicable on all stages of construction project i.e. from material distribution to sites to production capacity. Rankin et al (2008) introduced five application levels of benchmarking as: (1) At task level, Dividing project related activities into discreet tasks for example allocation of materials resources at sites; (2) Project level, Estimation of project costs, phases in which project is to be complete, preparing schedules for design and construction, managing health and safety issues of employees and users of construction buildings; (3) At organization level, evaluation of profit margin of the company, training of human resources and measuring and enhancing productivity and innovation ability; (4) At industry level, evaluation of industry productivity and its ability to offer new and improved products, building good will and managing and retaining human resource; and (5) At economy level, measuring international competition, enhancing financial soundness to compete at international levels and also measuring productivity for remaining internationally competitive. According to Nguyen (2004), when an organization decides to use internal benchmarking then it compares current data with the data of previous years. Whereas CII, (2007) stated for external benchmarking comparison of own data and competitors data is conducted for making improvements. It means KPIs are also applicable

where organizations want to assess their performance in comparison to their last year performance. Comparison can also be made with KPIs of industry or any other organizations currently doing business in the same sector having higher performance. Setting as benchmark can help organization to assure continues improvement in processes and defining best possible way to perform routine tasks. David, (1999) suggested as “*Benchmarking should not utilize as a way to set goals rather it should be used as an improvement tool*”. There are number of factors like cost, time, customer satisfaction, environmental effects, employee satisfaction, and change management which are related to construction project performance.

Nguyen (2004) conducted a study “*A study on project success factors in large construction projects in Vietnam*” and found that management commitment, unskilled labor, poor management of time, resources and changes, poor/short term planning are the major problems which construction industry faces. Construction projects may show poor performance in terms of increased costs, delayed completion, non-compliance of customer demands regarding change in projects, high employee turnover, inefficient material management and poor design. The major causes of bad performance can be such as poor home work of the constructor, changes in the original drawings and time schedules. As mentioned by UNRWA (2000), there can be other causes which can make a construction project a failure such as bad management, lack of leadership, unsuitable contractors, lack of coordination and cooperation, lack of motivation, lose control and monitoring of management and lack of courage of making bold decisions, ineffective management information systems, inadequate infrastructure, cultural barriers political instability and unhealthy economic conditions.

In construction industry benchmarking is now very common for the purpose of improving performance and staying competitive having some limitations too. Each individual indicator tells about a specific operation of company. For instance cost performance indicator can only reveal that company has managed to complete its project with the stipulated budget or not and how much variance remains in contrast to the benchmarked indicator. Therefore for evaluating companies overall performance range of variable would be require which will present a comprehensive analysis. It is very difficult as the list of indicator may be too lengthy for computation and cannot be easily handled for comparison. According to Sanvido et al. (1992), completion of a building project demands combination, coordination and collaboration of different forces, participants and activities. Activities may be planned or unplanned performed by different stakeholders throughout life of the building. All the stakeholders work in ever changing external and internal environment (Sanvido et al., 1992). Construction industry inherits inconsistencies. It is uneven and sometimes trends remain only for short period of time. Inconsistent factors effects the performance of project teams and specifically enhances level of complexities for project managers. The essence of making of project successful remains in improving the current state (Chan, 2001). Concept of improving current operations is not clear in the minds of many project managers. According to the Freeman and Beale (1992), many project managers take it as improvement arising naturally from continuous activities therefore they adopt old fashioned way of allocating and managing resources as they have to work on many projects at the same time. Number of researchers have discussed concept of successful project management; however a generalized framework is not yet developed. Different people have different perceptions about a successful project and define it in distinctive manner. Criteria of a project being successful are become more enriched and complicated with the passage of time.

According to the Chan (2001), a systematic and conceptual framework for measuring project success on both quantitatively and qualitatively ground is always demanded by the stakeholders which can also identify pitfall in existing literature.

Organization must take into consideration those entire objectives which contradict with each other. A systematic approach is needed to prioritize the key performance indicators. For example company has to take into consideration the service level it wants to deliver, investment and profit margin. For the delivery of high level of services can require huge investments leading to decrease in profit margin. Similar to this, many conflicting management goals can arise to whom organizations has to solve. According to the Camanho et al. (2010), KPI cannot be used solely to set performance improvement goals as each indicator has to compare with some benchmark without considering the other features of the organizational activities which may have effects on that particular indicator. However, it is concrete fact that any negative value of indicator whether it is quantitatively or qualitatively needs improvement. Organizations which have not a systematic framework in place for collection and analysis of data and also not capable enough for making comparing of achieved target with desired targets limits the management's abilities to evaluate the current state and identify improvement required internally and externally. For managing, controlling and monitoring construction activities, it is necessary to explain relevant practical measures to assure correct key performance indicators. For instance, this can be attained by enhancing the customer satisfaction levels by without increase in investment or forgoing profits. This stresses the organization to incorporate appropriate key performance indicators for the management of the projects and achieving competitive advantages. In this study, both selected companies have external and internal customers where

Enterprise Resource Planning (ERP) system of company A is effective whereas company B's ERP system is not effective enough to output the required information. ERP is system software that enables the management to integrate the functions of organization for better control and effectiveness (Shehab et al., 2004). In company B, there is no trained staff capable of using ERP system and retrieving information for the purpose of providing assistance to the management in their decision making.

1.3.Problem Statement

It is a problem to measure the performance of large projects such as construction and communication projects using predefined KPIs. Those KPI's are selected which are most critical for projects performance and benchmarking is done to enhance companies own performance. There is no sufficient research done in Kuwait on the performance of the construction industry based on the selection of important KPIs. Although many researches are conducted on a good level, there was still a gap in evaluating the performance of large construction industries and medium construction industries based on the significant KPIs (as identified in Chapter Four). Therefore, this research is conducted to fill this gap and provide the valuable recommendations related to the Kuwaiti construction industry.

1.4.Aim

The aim of this research is to find a framework to improve project performance, manage projects efficiently and effectively, and improve the profitability with reliability and satisfaction.

1.5.Objectives

This thesis focuses on the following objectives:

1. to identify the suitable KPI prevailing in the construction industry of Kuwait
2. to develop and calculate the KPIs to assess the performance of the construction projects
3. to develop a framework for benchmarking in the construction industry
4. to develop a conceptual framework for improving project management in Kuwaiti construction industry
5. to measure the performance of large projects of construction industry

1.6. Significance of the Study

The role of construction industry has always been vital in the development of the nations and the achievement of goals by the nations. Construction industries are considered to be most critical and important industries for the success of the industrialization of countries. The contribution of this sector to the total gross national product (GNP) of most industrialized countries is approximately about 10% (Navon, 2005). Involvement of number of parties, complicated nature of agreement and strict limitations of government made this sector complex. According to Navon (2005), state of countries' economy affects the growth rate of the construction industry.

For Kuwait, well-organized construction projects can offer a strong footing in order to gain the momentum of this sector again. It can also help Kuwait in attaining a balanced and independent economy which is mainly dependent on oil export. Inefficient construction projects not only exert negative impact on economy but also on quality of life of residents, health and environment suffer also. Project performance in Kuwait suffered in the era of Kuwait Iraq war. Kuwaiti government had to impose strict regulations on movement of capital. As a result projects' efficiency was compromised due to the strict regulations and hesitation of investors in making investments in war affected economy. It can be stated that after the end of war Kuwaiti government spent enormous funds on the development of infrastructure giving rise to construction activities and attracted huge investments from abroad.

Construction activities increased since the Kuwaiti public sector took the responsibilities. Kuwaiti construction sector has worked hard enough in difficult political, environmental and social circumstances. Since last decade performance of construction sector has been impressive due to the presence of supporting policies of government, friendly environment for investment and strict competition among construction services providers. Government has been successful in providing comprehensive framework of policies which is practical and workable for all the stake holders involved. According to the Camanho et al., (2010), construction industry has become more competitive which are forcing companies to remain aware about their weaknesses, strengths and challenges offered by competitors. Companies are now more willing to adopt systematic approach of measuring performances for gaining competitive advantage. According to the Chan (2001), each industry is dynamic and same is the case of construction industry. A rapid change in technologies, financial limitations and complex development processes has made

this sector more dynamic. This study is conducted to make an effort to help construction industry to find out more appropriate measures for improving performance using benchmarking which in return benefit them to adopt the changes taking place at rapid speed. Managers can be in a position to conduct their SWOT analysis more easily and can explore their key performance improving areas.

1.7.Research Outline

This study focuses on finding a framework for improving project success through determining Key performance indicators and measuring performance of construction projects and comparing them with the benchmark. This study is based on six chapters in total. Chapter Two is about a review of existing literature, developing and defining key performance indicators. Developing case study, for benchmarking of key performance indicators, compare and evaluate of success level of project against set benchmarks. Chapter Three includes research methodology and focuses on the research techniques used in this research. Chapter Four is based on developing case studies and identification of Key Performance Indicators along with their calculations. Chapter Five analyzes the collected data for the case studies and shows the results of benchmarking as well. Data collected from two different companies of Kuwait name will not be mentioned on the especial request of companies. In Chapter Six, discussion and recommendations are made in order to improve project performance where negative variances are observed. At the end limitations and guideline for future research are presented as a framework for the further research in future.

CHAPTER 2 – REVIEW OF LTERATURE

This chapter focuses on the previous literature discussed relevant to the objectives of this research. The objectives of this research are as follows: (1) to identify the suitable KPI prevailing in the construction industry of Kuwait, (2) to develop and calculate the KPIs to assess the performance of the construction projects, (3) to develop a framework for benchmarking in the construction industry, (4) to develop a conceptual framework for improving project management in Kuwaiti construction industry, and (5) to measure the performance of large projects of construction industry This also explores the different studies and methods used previously to design and develop KPIs. This part of thesis also discusses different studies and approaches in order to explore different methods and techniques to improve the project management in the construction industry.

2.1. Background

In order to get success in a challenging situation faced by Xerox Corporation with its competitors from Japan, the company employed the method of benchmarking for the first time in the year 1970 (Isoraite, 2004; Lankford, 2000). One of Xerox officials, Robert Camp's process of 10 steps was applied to this approach. Most of the Camp's activities were related to the benchmarking and the credit for first time using the term of 'benchmarking' is also going to Camp (Committee for Oversight and Assessment of U.S. Department of Energy Project Management, 2005). The approach of benchmarking in various fields of business has been used since then the Camp introduced it as a 10-steps process, and today most of technical reports,

academic papers and journals are best described by using this method (Camp, 1992; Barsky, 1996; Kozak, 2004).

Term benchmarking has been defined by a number of authors in their own words. Pioneer of this method Camp (1989) has defined it as “*the search for industry best practices that will lead to superior performance*”. Furthermore, the author also suggested that in terms of achieving supremacy in competition, it is more important to learn the value of external and internal best practices.

Benchmarking has been declared by Bent and Humphrey (1996), as an industrial foundation for the process of TQM (Total Quality Management). Moreover, both stated benchmarking as an assessment method about company procedures and quality of the present individual level of skills and then making a contrast with the up to date practices available in the field of management science.

Benchmarking has been described by Behara and Lemmink as an element of searching for and implementing best successful and appropriate strategy among the different available best practices in the world (Behara and Lemmink, 1997). Generally, it has been revealed by many researches made in the past that any business related with construction field can take lots of practical benefits through utilizing the technique of benchmarking (Ng et al., 2001; Walker and Vines, 2000). Many authors have agreed that method of benchmarking can enhance important development in performance. It has been viewed that leading firms and organisations have

gained vital improvement in improving their organizational capabilities by utilizing the benchmarking (Lock (2001) via Sylvia Codling, Gower, Aldershot, 1998).

Many researchers have believed that those companies who make full utilization of benchmarking technique for searching the best practices and building; those findings for their business operations can be more flourishing. Managers and leaders of such organizations can be in a position to put the maximum in improving management processes of firms through inspecting and learning the best practices being employed by their challengers (Mavlor, 1999; O'Connor and Miller, 1994).

There are mainly two basic questions arose regarding the kinds of benchmarking i.e. 'What is compared', and 'to whom it is compared with' (Andersen and Pettersen, 1996). There can be three kinds of benchmarking on the basis of first question and they can be regarded as process, performance and strategic (Garnett and Pickrell, 2000). The division of benchmarking related to the environment is considered as external and internal (Kozak, 2006; Kozak and Rimmington, 1998).

Many researchers have greatly focused on the topic of benchmarking since the last three decades. In the late 1980s and early 1990s, Chan has performed a complete assessment in terms of determining real success about projects (Chan, 1996; Chan, 1997). Most of investigators have argued that there is a powerful association exists between performance and main goals of projects for instance quality, cost and time since the early 1990s (Atkinson, 1999; Navarre and Schaan, 1990; Hatush and Skitmore, 1997). Thereafter, some examiners tried to find and build other main contributing agents for the success of any project. Furthermore, many research have

been conducted to reveal the leading factors that support in building the process of project success (Chan and Chan, 2004).

There have been fifteen success factors for any project accumulated under 4 major COMs: communication, commitment, comfort, and competence that have been defined by Nguyen et al. (2004). However Shenhar et al. (1997) has defined four different aspects to evaluate the success of any project i.e. emphasize to the clients, project efficiency, monitor business growth and planning for the future. It has also been verified by Wateridge (1997) that normally users have concerns about their pleasure with personal efficiency in business operations whereas managers of firms seldom consider the successful features without having any criteria for project success. Generally, the success of project leaders is measured through the project quality (Tukel and Rom, 2001), therefore criteria of good performance is utilized rather than using conventional performance factors of meeting costs and time.

There are two dimensions of properties that help in measuring the performance of project leaders suggested by Wysocki et al., (1995). From this point of view, performance factors are those skills which can be improved, determined and observed through proper training. It is not an easy task to develop competencies or skills through training that are normally considered as hidden qualities under the visible level. Therefore, competencies cannot be determined simply as they just can be seen in performance. Wysocki et al., (1995) further described five various kinds of competencies needed for a successful project leader that are problem solving approach, business accomplishment, influence skills, management of people and personal management as well.

Meredith et al. (1995) have classified the competencies required by a project leader into six main areas: organizational, leadership, team building, technological skills, communication and coping.

Meredith and Mantel (2000) contrasted in other research that requirements for functional manager are quite different by a project leader. The assessment of performance on the basis of KPIs (key performance indicators) related to project management or criteria for real victory has achieved a huge amount of capital in the field of project management. Many articles have shown the information related to various probable KPIs to evaluate performance of project management in recent times; Moreover modern dimensions have been suggested to identify the project success and also to discuss the success criterion required for project management (Atkinson, 1999; Chan and Chan, 2004; Mohammad et al., 2007; Isabel et al., 2009; Navarre and Schaan, 1990). The main objective of key performance indicators in any project especially in the construction business is to determine the organizational and project performance (Parfitt and Sanvido, 1993). Benchmarking methods in measuring the performance about any construction firm can be performed through the growth of KPIs (Chan and Chan, 2004). After analyzing many research papers, this fact has been revealed that current debate still in progress to find the best KPIs to be employed. The proper KPIs that best depict the achievement in business field of construction on the basis of factors involved in construction atmosphere (Chan and Chan, 2004; Pinto and Pinto, 1991).

Today CBPP (construction best practices program) also recognized as KPI model has the main distinction among the major three models available in this field. The metrics and measures of performance together with the models of benchmarking were built up by the end of the year 2007 as suggested by El-Marseille et al. On the basis of gaining outcomes on their researches, they suggested models of benchmarking through the use of data analysis (Mohammad et al., 2007).

In 2004, Chan and Chan conducted a study to build a structure in order to measure the success of any project. Through the thorough review of their studies, a set of KPIs (key performance

indicators) were determined and built. Additionally, the consistency of such suggested key performance indicators were also checked using three different case studies. Thereafter, the deficiencies in the proposed KPIs were argued that the method of benchmarking through the progress of KPIs can measure and evaluate the performance of projects related to the construction business (Chan and Chan, 2004).

In Portugal, Horta et al. (2009) performed an investigation that was on the basis of DEA (data envelopment analysis) as a technique to balance the information acquired by different groups of KPIs. According to this study, score for efficiency was assigned to every company then evaluated the leading company. Consequently, factors for development determined by the leading company are set as standard for those who were not practicing these improvements (Isabel et al., 2009).

Koushki and Kartam (2004) conducted a study to investigate the causes of negative cost and time variance in housing projects of Kuwait. Results indicated that material selection and their availability in market, supervisors at site, owner's social and economical factors all have significant effect time delays and cost over run

Koushki, Al-Rashid and Kartam (2005) conducted a study to investigate the problem suffered by Kuwaiti residents during construction process and upto what extent problems results in cost increase and time delays. Results revealed three main causes of time delays were: change order, owner's limited financial resources and lack of construction related experience. Causes of increase cost were grouped in three categories: Contractors related problems, material related problem and owner's financial problems. Researchers recommended that for avoiding cost and time variances availability of sufficient funds, preparing proper time schedule, allocation of reasonable time and money resources at design phase, competent and experience construction consultant and contractors.

2.2. Benchmarking in the construction industry

In order to enhance the productivity of the construction industry, different best practices related to modern benchmarking have been suggested (Shenhar, Levy and Dvir, 1997) that also support in finding the important success features for developing the construction project (Wateridge, 1997). Chan and Chan (2004) also proposed a group of key performance indicators in terms of building structural benchmarking to evaluate and measure the success in choosing Construction Company. Construction companies in the UK have concentrated more on implementing different models of benchmarking (Barros and Alves, 2004) and selection of contractors has been improved in Hong Kong for the construction industry (Wysocki, Beck and Crane, 1995). It is a capable approach to implement benchmarking technique. The methods of benchmarking can provide support to enhance general achievement in terms of total quality management in construction companies of UK (Lankford, 2000), to judge security environments of contractors and employees performing job in an agreement of partnership (Meredith and Mantel, 2000), to assess construction security administration in China (Meredith, Posner and Mantel, 1995) and to investigate the value of project development for chosen firms in Middle East (Mohammad et al., 2007). More importantly benchmarking has also been proposed as one of effective technique to manage and examine the changes occurred during construction projects (Barros and Alves, 2004). Different studies showed that efforts towards the implementation of benchmarking to evaluate PMP about contractors are very few in developing countries where normally companies related to construction business play very vital part in the development of economy. Therefore, the main purpose of this research is to formulate and design such a theoretical framework in order to improve PMP of large scale developments in Kuwait through benchmarking method. For this purpose, a group of KPIs and their related sub KPIs need to be discussed and

investigated completely using case studies and concerned literature. For this study, Author has selected two different main contractors that are engaged in this research for certifying the determined KPIs and suggested framework.

2.3. Defining project management key Performance Indicators (KPIs)

The measurement of the latest approaches of performances is very essential in accomplishing the battlement of policy of the management. Amaratunga's (Sanvido et al., 1992) statement was assured this reality "*You can't manage what you can't measure*" in addition Hayward (Shen et al., 2000) stated: "*if you can't measure it, how can you improve it*". Thus, the determination of appropriate KPIs in order to evaluate performance of management for a project towards the identified aims and targets of management related to any project is the main purpose of this phase. Beside this, the KPIs and the situations obsessing the construction business in the Middle East must be steady to each other. There are number KPIs in the construction business that have been revealed through many research papers. Additionally, the providers from the construction companies have a minimum concentration on the existing criteria for the performance of project leaders which will be helpful in its success. Conclusively, the proper KPIs should be chosen for the particular aim of the research (Pinto and Pinto, 1991).

Most of the scholars like Atkinson stated that this reality, the excellence of the manager of a project cannot be displayed by the factors which are target oriented base (Atkinson, 1999). Furthermore, the result of a project is influenced by the intangible features, for instance, anticipations of stakeholders, culture, supervision policy, politics and economic conditions etc. They all distinguished totally from one another. In particular, the project managers are not responsible for the success of project because most of the beneficial factors are not under control by them. It can be said that benchmarking technique in project management would be purely

misguiding due to those targets oriented features that are beyond control by the project leader (Pinto and Pinto, 1991). By considering the abovementioned facts, it can be observed that if the performance of the project manager is outstanding, then the project results can be improved. For example time, financial factors, and quality can be improved through the better project results. Apparently, the best comparison aligned with a sequence of accepted competences can be formulated by influentially assessing the management quality and by contrasting the administration competencies which are already displayed by a project leader.

2.4. Productivity/Performance Measurement

In the process of construction, when the influence of specified change is measured, one usually point out the outcomes as productivity change to the project that is being assessed. Conventionally, productivity is defined as by comparing the output with its related input of a production method that means the ration of output to input. This change in growth of the construction industry can be usually measured in the form of working units which are fully obtained during a specified course of time while the related expenditures are measured in the form of dollars or working-hours (Navarre and Schaan, 1990).

On the other side, there are two dissimilar functions of management i.e. Performance evaluation and productivity measurement. The assessment of productivity consists of the information collected regarding several tasks particularly; performance in the field and the associated work hours over a specified time period. Moreover, performance assessment consists more understandable analysis of the above mentioned factors; thus productivity is only an element of performance. Productivity, quantities and work hours are measured in line with the baseline or

designed qualities utilized in project estimations (Pinto and Pinto, 1991). Existing performance is usually evaluated aligned with designing productivity or chronological information to obtain in the general sense of efficiency.

A baseline should be first to determine if one wants to recognize correctly the KPIs related to the construction methods. A standard of earlier period performance is defined by a historical baseline. It gives an indication spot to benchmark if one knows about past performance against the future performance and also measure that performance (Sadeh, Dvir and Shenhar, 2000). It can be said that a baseline may be collections of data from projects completed in previous years or rapid assessment of project performance before making any necessary changes for improvements. Several times, any change from the standard anticipated degree of performance is a symbol of change in performance. However, changes may be of both types; in negative and positive and must be responsible for a cause for more management explanation to identify main reasons (Sadeh, Dvir and Shenhar, 2000).

Measuring and maintaining performance have some state of the art qualitative and quantitative approaches. Despite of difficulties in measuring, quantifying construction activities, construction process inherit maintenance function. Today construction industry is under continuous pressure to enhance the quality of their construction and design features. On the way of enhancing quality it remains a challenge for organizations to not let the cost and time overrun (Tsang, 2002). Mata and Aller (2008) noted that organization resist against measurement of performance as organizations considered it as wastage of cost and time resources even though modern hardware and software has made it very easy. But industry has also suffered with the problem of information overload. Therefore value of data to be considered for the organization where there

is difficulty in collection and analyzing data. Furthermore number of KPI must be limited. It is important for the organization to develop of data ownership approach and collaboration between all departments of the organization. It is necessary to respect data collection department's rights. Real time data collection and analysis will reflect the performance and help in taking actions. There are two types of indicators one are *Leading* indicators warns the organization before the completion of task that tasks is not going to be achieved whereas *Lagging* indicators reveal the performance after the completion of certain task for instance in construction industry cost per square feet or return on investment etc. The strong relationship between both leading and lagging indicators helps in controlling the construction process. Alsyouf (2006) has described the qualities of a good performance measurement system:

- It can realize the importance of maintenance of performance in achieving business objectives
- It can reveal the strengths and weaknesses of prevailing maintenance strategies
- A comprehensive strategy for bringing improvement in current process with the help of qualitative and quantitative data analysis
- It can re-evaluate the benchmarking criteria

In short, a state of the art performance measurement system must have qualities for improving not only the construction industry performance but also the performance improvement system. Kumar et al., (2013) found that a maintenance performance includes both qualitative and quantitative methods. Quantitative approaches include ratios, score card, value-based, system audits, statistical and mathematical calculations and production maintenance indices. Qualitative approaches include human factors. Qualitative approached are used in performance measurement where other approaches have limitations of measuring complex functions.

KPIs have subjective elements. LEALE solution (2014) define subjective KPIs as **“KPIs that are derived from factual data but contain an element of subjectivity.”** Frequently used subjective element in KPIs is comparing estimates and actual data. Vandersluis (2010) declared that challenges that manager face in conducting KPI exercise is that managers want to invent KPI which cannot be measured. Subjective KPIs have figures which is a result of someone’s subjective decisions. Basis of decision wholly depends on manager’s personal opinion, thoughts or intuition. Managers have to make decision on daily basis and whether decision are of corporate or strategic nature they may have subjective elements and inclusion of intuition into KPI decision may not be effective. Inclusion of subjective elements in KPI and present it in figure or data score form may lead business to negative direction as data have no reliability.

2.5. Quantitative Performance Indicators

The most widely recognized indicators related to performance can be determined physically by means of man-hours, units or currency. Construction companies’ first look forward to those regions that show a variation in the value of returns produced like other kinds of business do. Most of managers can take the variation as a failure if that decrease quantifiable productivity and also increases the cost in order to gain the measurable growth. An overview of the definitions about the quantitative kinds of measurement which exists in the literature is for that reason warranted (Sanvido et al., 1992).

The units of quantitative measurement must be easy, easy to apply and easy to collect, besides not creating more burden on field employees. Same kinds of units can be utilized in costing/budgeting system as well as in the system of production measurement in many cases (see Figure 2-1 below):

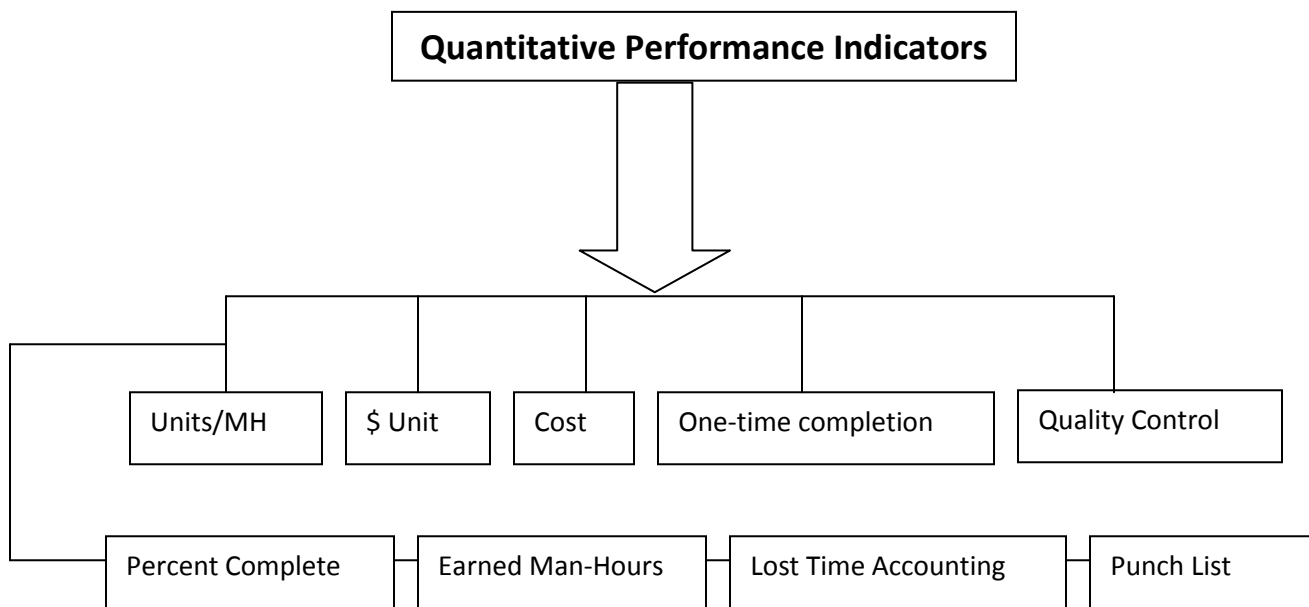


Figure 2-1: Quantitative Performance Indicators

Units/MH - One of the two approaches of basic quantitative reports which usually present in the construction industry is the Units/MH reporting process. This process calculates the number of units completed by an individual number of working hours (Sanvido et al., 1992). This process consumes short time to apply and collect information and could be utilized on any fundamental activity or task.

\$/Unit - The second quantitative reporting approach is the \$/Unit indicator of performance. One can simply define the worth of the dollar by putting whole completed units in place, covering the cost of labour, equipment, waste and material together. Like Units/MH, this method is also very easy to implement and commonly enough for performing fundamental activities. These both methods of reporting provide a very simple access to the project performance measurement and thus are used more widely which is based on the literature review. These methods offer fast data collection for many tasks on the job because the measurement unit can be changed easily. This kind of performance indicator is enabled to collapse the components of production to a level of measuring whenever the units include a larger amount of work attempt. For instance, one can break down the keeping of one building material unit either into the dollars per unit or the number of working-hours per unit with some mathematical calculation. It is necessary to use new indicators of performance when the magnitude of the work easily exceeds measurable elements. That is the point when correct performance reporting needs thorough assumptions and timeline in order to manage operations appropriately or references to baseline (Sanvido et al., 1992):

Cost - The success or failure of whole construction effort may quite be presumed by the Job cost reporting. Monitoring performance is required for Job Cost which is attained by comparing latest costs accumulated; the estimated costs in terms of dollars assigned to the task in progress to be concluded in time (Shen et al., 2000). This method is commonly not meant for single out specific tasks but offers the whole abstract of observance of the cost.

On-Time Completion - The On-Time Completion method and the Job Cost approach, both are parallel in the sense that they depict performance on the basis of scheduled time and both are frequently integrated to comprehend the latest construction performance much better. If the construction process is going on as according to the time chart specified then it can be observed that milestone of on-time is achieved. Only on the basis of spending time acceptable productivity can be measured according to the whole specified time chart (Shenhar, Levy and Dvir, 1997).

Resource Management - The calculation of changes and productivity during construction performance by the amount of equipment applied, tools and materials are also another quantitative indicator of performance. Resource management can be proved very helpful in examining the waste of materials before any change to be made and then contrasting the values before and after the change (Shenhar, Levy and Dvir, 1997).

Quality Control/Rework - Conventional for a construction project, rework utilizes 6 to 12 % of the total expenses. On the other hand, the costs related to rework are at best and thus, they largely maximize the total cost of the work. For the measurement of whole project performance, the calculation of change in number of working hours and re-monitoring equipment or material expenditures used to repair the work in progress that may be an influential tool. By decreasing the rework amount on a job, those profits which are associated with the particular activity can dramatically increase (Shenhar, Levy and Dvir, 1997).

Percent Complete - The supervisor or foremen at the workplace are responsible for estimation of the Percent Complete method. This method is beneficial for relatively small activities, usually which are duration, on those places where other expensive and long term methods cannot be validated (Sadeh, Dvir and Shenhar, 2000). This commonly accepted method used widely in the preparation of application per month for reimbursement request. This Percent Complete approach of reporting is based on the caliber of a person which is responsible for its evaluation. It can be said that as much as experience a project manager gets, the accuracy in method can be increased. A substitute method of Percent Complete can take evaluated values complete ratio of the overall budgeted quantity to calculate the progress of the Percent Complete method (Sanvido et al., 1992).

Earned Man-Hours - Another famous baseline process of performance measurement is known as the Earned Man-Hours approach. In order to fulfil work in place, man-hours are earned. Formula of number of man-hours earned for the specific activity to date is “*presumed unit rates multiplied by the amount of work complete units*”. While the indicator of job productivity is obtained by deducting the real amount of man-hours alleged to an activity from the value of earning man-hours (Shen et al., 2000).

Lost Time Accounting - Lost time accounting is another pivotal portion which can simply be transformed into a huge return. Same as rework, lost time is simply a no return on wasted work-hours. This approach measures productivity with respect to the number of man-hours lost because of the inoperative time like waiting for orders and guidelines, daily work instructions or equipment. The productivity of labours can maximize if minimizing the average labour

inoperative time is happened. The company would only have an expense to already decided operation of construction in order to maximize efficiency (Shenhar, Levy and Dvir, 1997).

Punch List - Punch list approach is the last indicator of the quantitative performance to be explained. Several ways are present to explain punch list items which include the man-hours for punch items as a *“percentage of the overall man-hours for the entire job or the total value of the punch list items v/s total contract amount”*. Punch list reporting is used at the end of any specific activity or project (Songer and Molenaar, 1997).

2.6. Qualitative Performance Indicators

Qualitative performance indicators are based on the quality as indicated by the name. Due to difficulty in perception and inability in measurement, qualitative performance indicators are not generally recognized as trustworthy method of evaluation of performance and the battle tools to evaluate productivity. These indicators are different from quantitative performance indicators because qualitative indicators do not become visible in the estimating / costing system which is used by many of the construction companies.

Moreover, these indicators are described as *“Qualitative data consists of detailed descriptions of situations, events, people, interactions, and observed behavior; direct quotations from people about their experiences, attitudes, beliefs, and thoughts; and excerpts or entire passages from documents, correspondence, records, and case histories”* (Songer, Molenaar and Robinson, 1996). Thus, it can be inferred that the objective of this exploration as, qualitative indicators can be defined as indicators which have the power and energy for the measurement of

attitudes of labour at the workplace. The qualitative performance indicators given below are discussed further in this study and every component are discussed separately in the later part of this segment:

Security - A big concern for each construction industry is complete safety, whatsoever the kind of work is being done. Incidents rates and EMRs Experience Modification Ratings are helpful in measuring the security quantitatively. The purpose of a security plan is to omit damages which occur by the weak working procedures which can make an effect on the well-being of employees (Torbica and Stroh, 2001), and in this research for the same reason; this is categorized as a qualitative KPI. One can use security for performance reporting with the help of measurement of changes in the number of accidents or of the problems associated with security at the workplace. The job can be harmfully affected due to poor security. For instance, when accidents are happened in a working environment, it may stop work in that environment and that leads to drop the moral of the workers and consequently declined the productivity (UNIDO, 1985). The company can allow seeing the advantages because of training of workers or because of alteration of the construction process by following the work performance through the use of security. However, these changes are not regarded as a consequence of instant cost savings.

Turnover - Turnover is such a predicament that can make deteriorate the construction business and thus maximizes the total costs indirectly. Measurement of the expenditures of those workers who leave the organization and searching job at other places, and expenditure of training of new comers who fill those positions, is a worthy tool to determine total performance in construction business. On the site, huge percentages of workers turnover yields in smaller average employee abilities and that may have an impact on the quality of work performance. Additionally, the

expenses used for the training of upcoming workers can maximize the expenditures related to the construction processes. A company can measure the effects on the performance by simply examining the variation in its turnover (Walker, 1995).

Absenteeism - The evaluation of performance that depends on absenteeism provides more solid measurement units. One can measure absenteeism through the modification in working hours lost because of absents during the working time of construction project. A slight reduction in man-hours lost in a project is straightforwardly affected the output or production growth of the construction company. If some company makes an effort to control the absenteeism, then it can support the company to manage the employees in its budgetary limits which is needed for the completion of work within a specified schedule (Walker, 1996).

Motivation - Worker motivation is the most complicated indicator to measure. Motivation is defined for this study as the attitude of an employee for the job as well as the atmosphere created in the workplace. Furthermore, motivation can be defined as the employee willingness to do the work at hand to satisfy the management (Wateridge, 1995).

The impacts of qualitative performance indicators are very factual on the cost of project though they cannot be classified under a cost account / approximation. Practically, in each region of a construction process, qualitative performance indicators perform a fundamental part. Managers may fail to know one pivotal region which has great impact on evaluating performance, those who do not integrate such qualitative performance indicators (Wuellner, 1990).

2.7. Applications and benefits of Taguchi methods in industry

In 1980s, the Taguchi methods which are known as methods of experimental designs were introduced in the US. There was a great progress in the ratio of products and process quality of a number of the main companies of America including Xerox and Ford and AT & T, after the implementation of Taguchi methods (Antony, 1996). The use of Taguchi methods was started into UK industries in the 1980s and 1990s. After the implementation of this method, the success of this method was proved in many construction and manufacturing areas which include, metal fabrication, automotive, plastics, process and semi-conductors. Currently, Taguchi method is used for handling a number of service delivery and time-related problems (Antony, 1999). In the US, Taguchi method is used at big scale to improve the working abilities of several companies that are expert in dealing with small software (Kumar et al., 1996).

In non-manufacturing areas, the use of Taguchi method is not in considerable quantity. The performance of service industry can be recognized and accurately measured by the use of Taguchi method. The behaviour of human beings during the service delivering is a main factor upon which the best performance of the service process is based.

The main applications of Taguchi methods in the service industry are as follows (Antony, 2001):

- (1) A comparison of those strategies that are competitive in the improvement of latest services,
- (2) Lower the time to act in response of customer problems,
- (3) Minimizing the problems with service instructions,
- (4) Minimizing the time required for the service delivery to client (for example dealing with restaurants, Banks, and hospitals),
- (5) Try to minimize the problems of transactions in banks,
- (6) Minimizing the time duration of stay in an emergency room of hospitals, and
- (7) Reducing the mistakes in billing of utility companies.

2.8. The Taguchi's quality philosophy

The word “quality” has more than one meaning for people of different kind and it can be elaborated in different ways. Moreover, it is required that definition of quality should reflect the needs and expectations of customers to attain the competitive status with the help of quality. Crosby, Deming, Garvin, Feigenbaum and Juran are known as quality gurus of the world but the approach of quality of Taguchi is different from these quality gurus. This difference is on the basis of the fact that Taguchi focused on the aspects of engineering of quality as compared to philosophy of management of quality. Taguchi practices around a particular targeted value are to minimize the differences in the functioning of a product's performance with the help of statistical analysis. The philosophy of Taguchi's quality in assuring product and quality of products can easily understood by following seven discerning features. The complete explanation of each and every point of these discerning features is available in a paper entitled “Taguchi's Quality Philosophy: Analysis and Commentary” (Antony and Kaye, 1996). The quality of the product /service is the loss reported by the product/ service to society at the time when the product is shipped (if it is associated with the product) and at the time when the product is delivered to customers. The meaning of the word “quality” changes with the change in the situation in which it deals. It was reported by Taguchi that quality can be measured by the calculations of the difference in the functional performance of a product/service from its target performance. If the difference in the functional performance is greater, then the loss in the quality will also be the greater. Following are the examples of the loss incurred to the society by a product/service (Antony and Roy, 1998): (1) In certain services failed to meet their customer requirements (2) Failed to attain the required performance and to reduce dangerous side effects caused by the

product, (3) Company reputation directly affect by the Cost of customer dissatisfaction, and (4) To maintain the competitive advantage of an organization there should be a continuous progress in product/process/service quality and cost reduction programs.

Bessant et al. (1994), defined that the continuous progress of a company is based on its special attention towards company-wide process and incremental improvements. After analyzing the development levels of continuous progress across all departmental operations, it was concluded that by using these analysis, good indicators of company's future competitive potential can be obtained. It is difficult for a company that cannot earn a reasonable profit to stay in today's competitive global market as a business competitor. If the progress in market share is required then the product should be of good quality and low in price including R&D, manufacturing and maintenance costs. The use of parameter design was suggested by Taguchi to make an increase in market share (Blosch and Antony, 1999). A good performance of products at low cost is the aim of a parametric design. The continuous reduction in the differences of functional and targeted performances is an objective to attain continuous improvement in quality.

In a number of organizations, the view of quality is that, quality is an analysis that purely conform the requirements of organizations. This view of quality must be a gateway for an organisation not a finishing point. The aim of continuous improvement in the quality of a product is to reduce the differences in the functional and targeted performances constantly. Inconsistency in the performance of the product which is caused by the extreme differences of the functional and targeted performance is the reason of poor quality. Organisations should struggle to minimize functional differences in the performance of that characteristic of product which are related to the targeted value and consider as a key task of parameter design (Brassington, 1990).

The deviation in the performance of a product from a targeted value is called the difference in the functional and targeted performances of that product and the approximately square of this difference of a product is considered as loss in quality of that product.

There is a specific targeted value which is the measurement of good quality performance of a product, if the performance of any product deviate from this value then the difference of the functional and targeted performances of a product is called ‘quality losses’ of that product. This quality loss consists of the costs which are related to the dissatisfaction of customers (reason of this dissatisfaction is the loss in reputation of the company) and the costs related to certain services which are failing to meet their customer requirements is also the part of this quality loss. It was proposed by Taguchi that the difference in the functional and targeted performances of a product is proportional to the square of the loss in financial conditions.

Following basic quadratic form is used by this loss function (Coleman and Montgomery, 1993):

$$L(y) = k(y-m)^2 \text{ (2.1)}$$

Where:

“L(y)” = Loss in monetary terms

“m” = The target value for a certain performance characteristic

“y” = The individual performance characteristic

“K” = a constant which depends upon the financial importance of the product characteristic and it is called cost constant or quality loss coefficient.

With the help of engineering designs and manufacturing process of the products the final quality of a man made product along its final cost can be determined to a large extent.

With the help of any traditional procedure like screening and inspection, it is difficult to achieve quality of a product. Therefore to make the healthy performance of a product during the manufacturing procedure quality of the product must be produced at the designing stage.

The differences in the functional and targeted performances of a product which are caused by undesirable outsider influence can also be controlled at the product design phase. In the universal market, only those companies can maintain their competitive reputation who struggles to construct insensitive behaviour of their product including their designing and manufacturing procedures to all kinds of variations like environmental and product to product variations (Dale, 1994). The differences which are produced in the functional and targeted performance of a product (from its targeted point) can be minimized by applying non-linear effects of the product parameters on its functional performance. Those processes and their products can be considered as good in their performance as well as their quality, whose production performance is slightly sensitive to all noise factors. The factors on which this production performance is based are to control the value of noise factor with the help of non-linear function. The combinations of process and product parameters design values produces small amount of variations in the functional and targeted performance of a product. The objective of a robust design is to locate the combination of these values with the help of non-linearity. The quality loss of a product can be reduced at low cost with the help of non-linearity (Finney, 1945).

The parameters of process and product settings which can minimize the variations in the functional and targeted performance of a product can be identified by applying the experiments that are statistically planned. Process and product settings parameters are those parameters that can reduce the variability in the functional and targeted performance of a product. These experiments are applied which are well designed and statistically planned for the determination of these parameter settings. It is necessary to recognize the key parameters to minimize the variations in the functional and targeted performance of a product from its targeted value. Because of applying a carefully designed experiment on these parameters, the great impact of these (parameters) on the performance of process and their variability can be determined.

2.9. A systematic methodology for the Taguchi approach to experimental design

The systematic experimental design of Taguchi methods to handle the problems related to the quality of process and products at the industry level is elaborated in this section.

Following are four main phases of this experimental design which are shown in figure 2-2: (1) Planning phase, (2) Conducting phase, (3) Analyzing phase, and (4) Implementing phase.

2.9.1. Planning phase

Planning phase consists of seven steps which are discussed in detail in the next section (Kackar, 1985):

Step 1: Problem recognition, formulation and organization of the team

It is important for the success of any industrial experiment design firstly to locate the problem and then make possible solutions to handle this problem. There is a need of experimental approaches to determine a possible solution of the existing problem. A problem can easily be understood if it is explained in an appropriate and concise statement. Some general problems of the manufacturing process are as follows and experimental approach can be used to deal these problems: (1) Improved the performance of already existed process/products and development of new process and products, (2) Improved the performance of those processes and products that are directly related to customer's needs and prospects, (3) Reduce process production as the process is not working in most favorable conditions, and (4) Extreme variability in process performance which is the reason of poor process potentials.

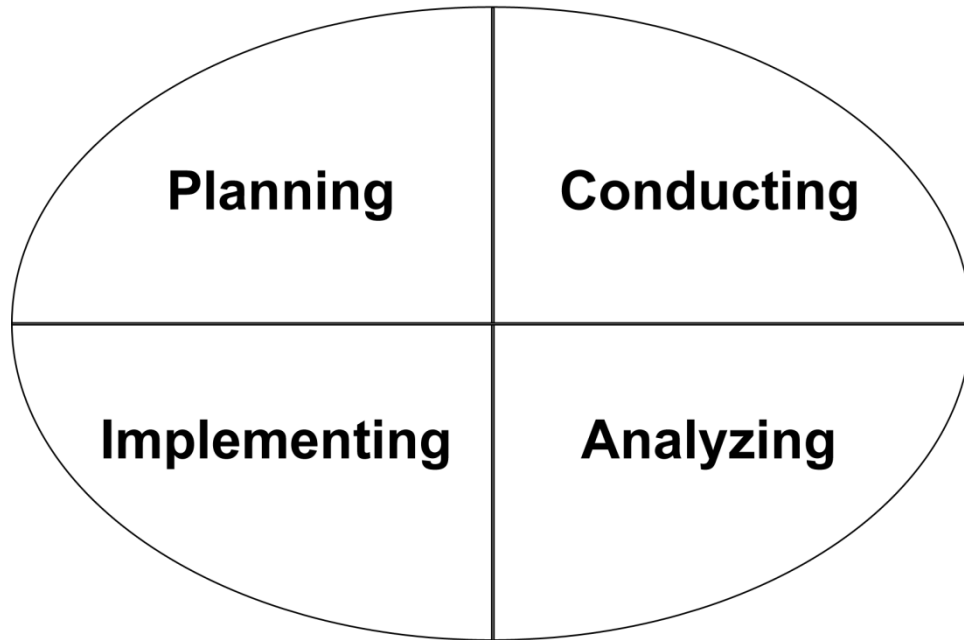


Figure 2-2: the main phases of systematically experimental design of Taguchi methods

Step 2: Selection of quality characteristic (QC) and measurement system

It is important for the success of any industrial experimental design to make the quality of its product according to the customer expectation. The quality of the products can directly affect the number of experiments that are statistically significant in the production to measure the quantity of production of an industry (Kackar, 1986). The nature of the productions of experiments at industry level can be variable or attribute. In industry level production, some factors like dimensions, viscosity, efficiency and strength etc. are known as variable characteristics of a product and these provides more information about experimental design as compared to the characteristics which are attribute (*pass/fail, good/bad, etc.*) in nature. A less number of experiments are required to obtain the level of significance with the help of variable characteristics as compared to the attribute characteristics that required a great number of experiments to obtain the same level of significance. It is necessary to ensure that the choice of the quality

characteristics for an experiment must be closely related to the basic manufacturing mechanism of the final product.

A Taguchi method which is known as experimental design includes five types of quality characteristics that are given below:

1. Smaller-the-Better (STB) quality characteristics:

During an experiment to measure the parameters like surface finish, shrinkage, number of defects, surface finish and tool wear etc., STB quality characteristics are applied.

2. Larger-the-Better (LTB) quality characteristics:

During an experiment to measure the parameters like strength, efficiency and hardness LTB quality characteristics are applied

3. Nominal-is-the-Best (NTB) quality characteristics:

During an experiment to measure the parameters like diameter, thickness, length, viscosity, force and width etc., NTB quality characteristics are applied.

4. Classified attribute quality characteristics:

During an experiment to classify the data as good and bad with grade A-D these classified attribute quality characteristics are applied.

5. Dynamic characteristics

During an experiment when a specific factor directly affects the production quality then these dynamic characteristics are applied. The quality of parameter with which factor is directly affected is known as signal factor. If, one consider the drying procedure of a fabric the quantity of dye may be a signal factor because it directly affects the performance of dying procedure. In the same way, in an injection moulding process the signal factor is the dimension of die because it directly affects the dimension of injected part.

A measurement system of an experimental design is the system with the help of which one came to know that what to measure, with which unit, where and how to measure. It is necessary to describe the measurement system just before experimentation to understand the input of the variations. Continued uncertainty in measurements can be produced by a number of key inputs like operators, methods, parts and environment. These input factors are considered as responsible for the variations in the measurement process. It is important to ensure that the variables in the measurement system would not bias the results of the experiment. On the other hand, the measurement system must not be affected by the changes in the operator as well as in environmental circumstances. Moreover, the measurement system should be quick, correct and stable and consistent. Evaluating the Measurement Process (EMP) technique can be used to obtain a stable measurement system (Kackar sand Shoemaker, 1987).

Step 3: Selection of design/process parameters (or factors) that may influence the QC

In this step, make sure that the selected design and process factors provide only more related and necessary information about the problem. The parameters the knowledge before time and practices are very beneficial in the detection of design and process. The most important step during an experimental procedure is to choose their initial step parameters on the basis of some important factors. These factors include flowcharts, Brainstorming and effect analysis; if these important factors could not be considered during the experiment then the final results of the experiment could not be up to the mark. How many design and process considerations are involved in the first step of an experiment? This question belongs to the size, budget and resources of an experiment. Application of screening experiment to select the most important factors that impact the quality characteristics of interest is a good exercise. The screening experiment must be done at least number of levels. Usually, two levels are recommended for the screening experiment at this stage instead the number of experiments that involves many design/process parameters. It is important to ensure that at the initial stage of the screening process of any industrial designed experiment, the financial investment should not be exceeded more than 25 percent of total budget (Antony, 1996).

Step 4: Classification of design/process parameters into control, noise and signal factors

After selecting the design/process factors, these factors are classified into three categories which are as follows: (1) Control factors, (2) noise factors, and (3) signal factors. The engineers of both design and manufacturing process/production can control some factors in the production environment; and these factors are called the control factors. On the other hand, there are some factors that are expensive as well as difficult to control and sometime cannot be controlled at

any cost such type of factors are called noise factors. Such factors that have no impact on the variability in the product and process performances but directly affect the targeted performance characteristics are called a signal factor. For example, in a process of injection moulding cure time, speed and pressure of injection may be control factors, machine operators, the ambient temperature can be considered as noise factors. Moreover, the dimension of dye with which the final size of mould can be determined may be its signal factor.

Step 5: Determination of the number of levels for design/process parameters

The numbers of levels of a selected factor based on a character of design/process parameters; either the selected parameters are quantitative and qualitative in nature. Speed and pressure are considered as quantitative parameters at starting point in experimentation and usually two levels are required to deal these parameters. On the other hand, there is a requirement of more than two levels for the qualitative parameters (type of material, type of supplier etc.,) at the starting point in experimentation. Simply, the quantitative parameters required least number of experimental levels in the initial stage of experimentation as compared to the qualitative parameters.

The important point for the selection of suitable values of design /process parameter level is that, one should be technically experienced to select these values. In experimentation, the selected level must be in the operational range. Taguchi has selected three levels in experimentation to estimate non-linearity in the quality characteristic of control factors (Kapur and Chen, 1988):

Step 6: Determination of the interactions to be studied

When two parameters show different quality characteristics at different level during same experimentation then there must be some interaction between these parameters. It is important to list the possible interactions of interest when the interaction between control factors is produced. There are a number of questions that may be raised during the experimentation like either interaction can be removed by adding some factors or not? Is it necessary to study about these interactions at the initial stage of experimentation or not? Therefore, team of that project must be ready to answer these questions before the preparation of appropriate layout design of experiment. The interactions between noise and signal factors are not considered and it is thought that exploring the interactions between these factors are only waste of resources at industrial designed experiments. However, it is a good exercise to study the interaction between signal and noise factors to achieve robustness. It is also recommended to determine the optimal level of control factors that increase the impact of noise factors on the performance of the product (Kumar, Motwani and Otero, 1996).

Step 7: Choice of appropriate orthogonal array(s) and assignment of design/process parameters and their interactions

Orthogonal arrays (OAs) are applied to investigate the impacts of the various control and noise factors on the quality of a product with the least number of tests. There is a need of only two Orthogonal arrays (OAs) in experimentation to deal with noise factors. According to the Taguchi, OAS can also be used for the preparation of a layout for design/process experiment. Orthogonal arrays (OAs) depend upon a number of factors like the objective of the experiment, number of levels, experimental budget and resources, and interactions to be examined. Therefore, all these factors must be studied before the selection of these arrays. The following differences must be satisfied to ensure the sufficient degrees of freedom with the use of selected OA design during the experiment (Logothetis, 1994): ***“Number of degrees of freedom for the OA ≥ Number of degrees of freedom necessary for studying the interaction effects”***. After the selections of the suitable OA design (s) for the experiment, some factors are assigned and interactions are located in the next step. Standard OA can be applied as such for some experiments or sometime modification has to be done in the selected OA. When, factors and relations of interest are assigning to OA then confusing structures and interaction tables must be constructed.

2.9.2. Conducting phase

Step 8: Conducting the experiment and recording the results

Physical experiment or computer simulations are two alternative ways by which optimization, experiments can be done. It is important to ensure that during the experiment everything must be according to plan because any kind of mistake at this stage can destroy the strength of the experiment. It is necessary to consider the following points before performing the experiment:

- Selection of suitable location:

The selected location for the experiment must be unaffected by any external change. There should be exactly replicated between the environments of both user and exponential.

- Availability of experimental resources:

All the required materials and apparatus must be available before the start of the experiment.

- Cost-benefit analysis:

It should be confirmed that only necessary experiment must be done and defend because performing experiments will exceed the costs of material, labour as well as the cost of data analysis.

- Preparation of data sheets:

The experiment must be run with the help of un-coded data sheets and data must be analyzed with the help of coded data sheet. All the information like date and duration of experiment, information about an experimental operator must be listed on the data sheet. There should also be some extra space for the entry of output response and recorded values in the data sheet.

- Randomize the experimental trials or runs (if necessary)

The experimental trials are depends upon two main points, the investment of cost for randomization and time-dependent factor (which may be known or unknown) will directly affect the final results of an experiment.

- Replicate the experiment

Replication is a process of performing an experiment more than one time. Replication must be done after resetting of all trial conditions and the invested cost for the replications must be written in account. A functional table for the number of replicates (that is sample size) has been provided by Schmidt and Launsbyto identify the effect of some important factors in experimentation (Schmidt and Launsby, 1992).

2.9.3. Analysis phase

Step 9: Analyzing the experimental data and interpreting the results

The data of that study must be analyzed statistically to prove the objective and the conclusion of a study. If, all the steps involved in an experiment must be according to the plane then the results of the statistical analysis will be valid.

The possible objectives that must be obtained in the design/process optimization experiment are as follows (Logothetis, 1994): (1) To fix the design and process constraints which directly affect the mean performance of the product/process, (2) To resolve the design/process constraints which influence the differences of product/process performance, (3) To determine the levels of design parameter which produce the optimum performance from a technical and functional point

of view, and (4) To determine the possibilities of any future improvement in the performance of product and its operations.

Signal-to-noise ratio (SNR) statistic is used in Taguchi methods of experimental design to analyze performance of product/process. The performance of the product/process is considered as good as those factors during the experiment are selected which may produce maximum values of SNR. Analysis of variance (ANOVA) is applied for the determination of key interactions and key design/process parameters. The analysis of SNR is applied for ensuring design and process strengths and forecasting of performance in ideal conditions. Taguchi's system of experimental design can be used for all the calculations in the analysis of SNR (Sirvanci and Durmaz, 1993). A suitable SNR is selected on the basis of the quality of the product. The multiple signal-to-noise ratios obtained from derived from the Taguchi's quality loss function can be used for more than one quality characteristics (Antony, 1996).

Recent graphical tools such as probability Pareto plot, normal plot, are also given by the Taguchi's methodology which elaborate the results in simple and correct way. Explanation of data in detail makes the results easy to understand by the readers and after understanding these results they can easily suggest any modification for the improvement of experimental design. It should be kept in mind that in the explanation of data all, the provided information must be relevant to the experimental results. Moreover, data must be supported by experimental conclusions and significant in the stakeholder's world in the case of interpreting the data.

2.9.4. Implementation phase

Step 10: Confirmation run/experiment (or follow-up experiment)

A follow up experiment is necessary which is called a confirmatory test to confirm the conclusion of the study. The insignificant parameters of design and process must be set at their economic level to perform this confirmatory test. Sometime, confirmatory test does not provide satisfactory results and the causes of variations in the results may be as follows: (1) The selected OA for the experiment may be inappropriate, (2), The standardization of quality characteristic may be wrong, (3) During the experiment some important factors may be misplaced, (4) The management of noise factors may be poor which may cause variations in the product/process performances, (5) Possibilities of fundamental errors in the calculation of data, and (6) Missing of important interactions of experiment.

The next step after obtaining the satisfactory results is taken for the improvement of the product and process. A newly designed parameter with the participation of top management must be applied for this improvement. The quality characteristic of design/process parameters must be controlled with the help of the appropriate control chart after the implementation of solutions (Phadke, 1989).

2.10. Least necessities of outworker performance

2.10.1. Time performance

Yeung et al. (2008), declared time variance as crucial in project design/process success. Time variance is “*variation of actual completion time expressed as a percentage of finally agreed completion time*”. This crucial element was proved as a minimum performance output by all the contributors during their interviews. It was also suggested by some members that changing in internal drivers may be a result of these outputs. When, a participant takes time as key output, in fact he welcomed the variation in time in term of complete his goal before targeted time. It can be recommended that the combination of time scheduling and decrease in delivery time is the key measurement of performance. It was clear after the interviewee of Participants that all they were interested to achieve their targeted goals.

Moreover, it was also their desired wish to complete their projects before time. The required performance of a project is to make all its deliveries on time but consistently beating in performance and whilst keeping the customer informed is considered as the outstanding performance of that project. As, the customers have understood the cost of time which may save during potential gain and construction process; time has become a key of delivery factor in front of cost and quality. This study is slightly different from the other latest researches (Yeung et al. , 2008) which focused on the constructions.

2.10.2. Cost performance:

According to Yeung et al. (2008), the key factor of cost performance is the performance against its original budget. The participants for this research have become a reason of increase of capital cost. The main variation found in this research was that the performance in opposition to a financial plan was not constantly followed according to the customers' perspective. It was concluded after the analyzing the results that there is a requirement of unavailability of cost to measure the performance of a project within their KPI set. When, the construction department by choosing a contractor is controlled by an accounting section then the key driver is the lowest cost (Chan and Chan, 2004).

2.10.3. Quality of manufactured goods

The faults at the initial point can be controlled easily because of the slow pace of outputs. However, it was concluded from the discussion that if a layout of an experiment is not prepared under controlled environment then no one can achieve their targets on their program (Bassioni, Price and Hassan, 2004). It can be observed that during the discussion with customers that desires of least defect were undoubtedly at the front position of construction customers' mind. A successful organization would be that, who have the least number of defects and never repeated the defect caused mistakes more than one to avoid these defects. It was seen from the results of the previous study that no one has measured their defects and collected data relating to defects. It was admitted by the participants that the most significant point of view on defects was complexity of obtaining data. All these defects were measured by means of numbers and time by all participants to correct these defects. This method of measurement may be simple to obtain

because it was unlikely to present that how these faults were disturbing the business visibility (Chan et al., 2006).

A good performer could make possible efforts to keep away their customer's business from the harmful defects. If, efforts are done at the cost of two very slight defects for the safety of customer's business from the harmful defects then a poorer quality KPI (*key performance indicator*) is obtained. The aim of this study is to make a disconnection between trendy KPIs and also considered that the customer's business is affected by what kind of genuinely matters. It is necessary to be borne in mind during the establishment and delivery of a successful project.

2.10.4. Health, security and environmental reflection through employee health and site disaster rate, decrease of waste and decline of environmental objection

For a second time, that member interviewed in a study for this investigation were those who viewed these listed (Health, security and environmental reflection through employee health and site disaster rate, decrease of waste and decline of environmental objection) elements as the smallest amount of requirements. Most of them are currently officially authorized for observance, although extra stringent observance necessities may be applied by the customers on their service provider that are required by rule of their in-house strategies. This tends in the case of the ecological aspect than in the health and safety aspect, probably due to the health and safety policies (The Construction (Design and Management) regulations 2007) are already in strength (Chan et al., 2006).

The discussion about the elements of ecological complaints and waste decline was limited to the interviews not any more. The members of organizations' own customers were interviewed instead of the general community, although these two assemblies were mostly the same in some cases to discuss about the elements of ecological complaints. More willingly than any quantitative measure, the main issue to the costumers was usually tied up in their contractors' perception which is discussed in the later sections of this study (Crane et al., 1999).

2.10.5. A nonappearance of claims and arguments

Claims and arguments were acknowledged as not familiar by the contributors in this research. It was concluded that requirements for arguments and proceedings in the customers' large programmes of works can be replaced with the help of good communication. Service providers who favoured a litigious way to handle the problems of contractual and development were not reception member in their deliver chain. Further claim or arguments were not pointed out by the participants in any way. Whereas, this result recommends a deficiency of argument and claims, it does not actually achieve the altitude and efficiency of communication (Crane et al., 1999).

2.10.6. Differentiators and presenter of brilliant performance

Admirable dealings with the help of peak administration assurance, valuable relations, sky-scraping level of belief and admiration offer results in the form of satisfaction of service provider team and first-rate intellectual relation between purchaser and supplier.

It was suggested by participants in a study (Crane et al., 1999) that various elements like peak administration assurance, valuable relations, sky-scraping level of belief and admiration are important to deal with customer if good performance is required. On the other hand, the opinions of some participant were not in the support of this phenomenon. Top administration commitment was also discussed as an insubstantial quality provided by the superior service provider which was not considered in any obvious manner.

According to Yeung et al. (2008), the key performance was exposed by the percentage of top management attendance at a meeting with partners. It was not easy to observe from the meeting which were carried out during the research that how measure demonstrates first-rate performance Yeung et al. (2008). Whereas, it was illustrated in the interviews in the previous study that it is a simple measurable metric and comprise public in a room that does not express strong commitment. Just be present at meetings may not ensure their commitment for the project; they may not be attentive or demonstrate neutral behaviour in conditions of not representing an affecting affection. Hence, the involvement of the non-committed community at peak administration level may lead to compromised on performance from a contractor's delivery contribution.

This research exposed the requirement to buy first-tier service provider administration potentials as an element of the overall package offered. Such potentials were observed as add value from the administration of practical delivery and preparation. In such a delivery model, first-tier service provider is responsible and accountable to deliver required services. Such an approach needs a better contract of first-tier service provider administration assurance than they were

simply bringing project which were to be paid by the customer to them (Kagioglou et al., 2001). Affecting brainpower was elevated as a more important differentiator among first-tier service provider in condition of administration assurance. Clients can recognize those service providers who treat the program of mechanism given to them as simply a profits flow and those who have commitment. Participants recommended that such commitment was one of the lines of first-tier service provider's perception that what they desire as a customer. This was a key point in generating first-rate performance as the service provider could support themselves to deliver what the customer necessitate from their service delivery. A less-than-excellent service provider was observed as tending towards given ordinary service depends upon what they were utilized for performing for other customers (Kagioglou et al., 2001).

Stating an express connection as a differentiator among service provider was noticed to be a motivating viewpoint as it recommended an intellectual assurance being made by the service provider's administration. This was a complicated aspect to determine but was observed to emerge from the practice of customer and service provider interactions. As participants stressed on the point, it was obvious that such an assurance was undoubtedly impressive they were looking for in their first-tier service provider.

According to Yeung et al. (2008), there is a requirement that communication should also be outstanding for the outstanding performance. His spot, once more, is that it must be a Likert extensive measure of key stakeholders' estimation of the usefulness to make a distinction of service provider performance. An enhancement in the belief area had thus removed a potentially improvident communication footstep and added importance to all social gatherings. A small number of participants surrounded by the research reported here argue that performance of

projects can be enhanced by having effective communication with stakeholders. Others argue in favour of exhaustive commitment compulsory to launch a long-term development policy with their first tier service provider in order to reach the goals set by both associations. Another argument is that develop an official grouping with their first tier service provider which well-balanced communication at various stages.

The dilemma of construction industry is that they have not paid much attention to improve effectual and reliable communication with their stakeholders. Apparently a lot of remarks related to the poor performers also come into view on the poor communication. For a few customers, the skill of the service provider to pay attention was a huge differentiator between outstanding performers and the poor performer. This was a motivating point of view and apparently not considered in detail in previously published literature. It also robustly alluded to mutual communications being a true differentiator, while the previous research had focused extra leading how the service provider conveys messages to the customer. The outstanding performing service provider can demonstrate ability for faster understanding and align themselves at the back the message upcoming from their customer with the help of marvellous communication. The output main concerns may be modified in quality standards, time schedules and financial cost by changing in existing construction plans after receiving customer feedback (Lam et al., 2007).

With the assumption that customer has knowledge related to construction design and process and understand the impacts of changes, contractors can quickly decode messages received by customers and fulfil their needs. The outstanding performing service provider was as to a great extent near to customers giving them an accurate message as the service provider understanding it. Further participants stated in the same research irritation at service provider who connects their supply chain and attempt to read out what should be significant to the customer rather than pay attention to that message. Again, this finding suggests the importance of two-way communication.

One aspect of communication from service provider to the customer could be considered as an element of outstanding performance that was the tendency to take a promise with the customer's organization for the improvement of their current performance. One particular applicant confirmed that a service provider, who performs as "yes men" when the customer commits a noticeable error, was not first-rate performers. This disagreement was different from imposing what was imperative to the customer; it is related to work as an advisor to facilitate the customer in understanding what was imperative with no creation a fault. This two-way communication can be demonstrated as a relationship among top administration associations and communication (Crane et al., 1999). An additional elevated attention-grabbing perspective was that the outstanding performing service provider possesses an "assurance to steady dissatisfaction". This perspective recommended that fulfilment was analyzed by customers in the present day as a journey with possibly no ultimate objective. Respondents confirmed that outstanding service providers were those, who never matter that how good they have already performed and always try to give their best for the next time. One key examination here was the point of view of the

customer's fulfilment. The output of program as opposite to position of fulfilment was being pleased in the employment (Lam et al, 2007). It was observed to be totally achievable that the two were individual and the alike, but such a result is further than the scale of this article.

The approach was observed to be an additional component which customers were at the moment looking when an allowance for outstanding performance was in creation. It was not observed as customers only wanting to work with that service provider who were the similar to their point of view to business, but undoubtedly it can help. There are more than a few key characteristics which were stated by the interviewees like honesty, the strong commitment to create goodwill for their business,, a strong wish to be specialized, and an embedded society of association building (Lam et al., 2007). The customers, who structured their first-tier service provider into an association delivery, stressed on the need of continuous learning and building of a strong association. These customers value their first-tier service providers more than an element of a group of people, or even more than a few communities. Those communities (who effort to standalone and the other who known as interlinked communities) were seen to be fundamental introducing the desired output of their program. It came into view that the accurate attitudes and behaviors were the main factors in constructing long-standing programmes and alliances victoriously.

According to Chan et al (2006), position was associated for production of brilliance relies to a degree leading a mutual civilization and move toward to business without organisational limitations. It turned out to be understandable from the present research that organizations were looking for that workforce that is more inclined towards giving input for the betterment of their organizations.

From study, it was observed that with the true attitude and behavioural capacities projects could be accomplished through sustainable learning and improvement. Various study results also indicate that customers prefer those service providers who come with already established qualities required for high performance rather than just have them on papers. Outstanding performance also distinct in establishing association with employees for delivery of services the truthful attitude and behaviour.

2.11. Improvement in the course of learning established and the capacity to value handle the assignment solution

Improvements are analyzed as a first-tier service provider has the capabilities to add improvements to the construction procedure that was stated in the contract or scheme. According to the few researchers handling on site problems is the key element which brings differentiations between good service providers of bad service providers. On the other hand, improvement can be introduces at the design progress phase which supported in eliminating the miss treat at a construction/development level.

Yeung et al.'s (2008) stated that improvement was that cost saving methods which was resulting from the assessable keys of innovation but this declaration was not being of the same mind with the information collected from the interviews. It was also stated by Yeung et al.'s (2008) that the most significant yield to the customers was considered in shape of expenditure. On the other hand, the key point of the present research was that the main motivating yield of the construction program is modification, such an outlook for modernization required widening.

According to Yeung et al. (2008), position becomes visible to be extra similar to value administration which was not discussed in details during the interviewees in this research. "Designing out waste" can signify cost, but it could also signify time or basics of the plan that compromise the purpose or practical necessities of the completed manufactured goods.

Those customers who accomplished the bulk of the extent at a production level become visible to appreciate the power of learning as a performance differentiator. Customers realized that production measures might be imperfect due to the doubtful character of construction mechanism. Participants recognized that inaccuracy would be made at some stage in projects and on the other hand, customer may also be the reason of this inaccuracy. It was recommended by Kagioglou et al. (2001) that the capacity to learn from practice as an organization was a quantifiable element of a process/performance measurement scorecard, while it must be determined in association with on the whole visualization and policy.

2.11.1. Sharing of knowledge

It was also noticed during the present research that the knowledge of excellence in jointly performed projects (performed at large scales by the service providers) must be shared with one another. If, one service provider on a big scale was performing brilliantly and others are not, then this affects the customer instead of the situation, if all were performing accordingly. It can be observed that outstanding performers were those who enhanced their skills with the help of training and shared learning with their peers. If, the "bar is elevated" by all customers and service providers in a program, then, they can take this improvements and apply with more specialization it to another customer work stream. Consequently, all service providers who contribute in learning and sharing in order to improve, at the same time as the customer can expand their scope (Wang and Huang, 2006).

2.11.2. Responsibility of the customer

The outstanding contractor performance characteristic is closely linked with the function of the customer in design and construction processes. This is the responsibility of the customer to communicate and give feedback related to the above mentioned matters. Customers are aware of that; contractors can only be performing outstanding with their guidance. If customers do not take initiatives that are obvious and support outstanding performance, then, it is improbable to get it from their suppliers (Yin, 2003).

2.11.3. Performance administration

Current study recommends that there is a requirement to shift in organization's approach to measure and supervise its first-tier contractor. Consequently this research also suggests that customers should enhance their performance administration abilities than to just to rely on the use of production KPIs. Customers who remain all-embracing production KPIs may have to trim down these for further adding in the below mentioned input measures which are as follows (Miller, 1991): (1) Emotive assurance and possession of the program, (2) Effective mutual communication, (3) Service provider enhancing their business profiles to bring into line according to the customer expectations, (4) Effective and suitable confront of customer judgments, (5) Business plan with assurance of steady dissatisfaction, (6) Clearness in performance of business, (7) Reliability of manner, performance and culture, (8) Satisfaction of the customer's stakeholders, (9) avoid affecting the customer's business from construction activities, (10) Elasticity and sensitivity to program transform; and (11) Paying attention to improving and learning with substantial outputs.

It can be observed that customers must have to build up a layout in the region of these input measures in a way that meet their business requirements. The result aspect of the research gives in detail a suggestion for adopting a best-practice model. It is conventional that one wants a definite sum of greater thought and training than an easy output KPIs. Further the need can also be that customer should be able to improve and supervise the service provider in the energetic necessary behaviours. Service provider could not have any choice except achieving KPI measures. It is crucial for the customer to not compromise on their own KPI while not ignoring what is significant to their customer (Long et al., 2004).

The latest best practice performance administration aspects can be calculated quantitatively; However the most significant concern is that they should be recognized and proactively handled as an "input KPI suite", then, the customers could necessarily characterise that what she/he desires the behaviours established by everyone. The necessary behaviours have to be obvious sufficient to be espousing and paying enough attention to improving them. It can provide a valid value to the customer's programme and customers' satisfaction could be achieved together with those which helped them to be satisfied (Long et al., 2004).

It is recommended that these input features of KPIs are modernized quarterly as an element of a controlled performance development programme. Performance enhancement schemes can be planted for the support and progress of each of the behaviours. This is suggested as a contemporary approach to performance development that can also develop the service provider businesses in obtaining outstanding performance to the customer.

The customer and the service provider should work collectively to achieve quality standards. Moreover, output KPIs can be improved all the way through the administration of the outstanding performance participation. Resulting longer term enhancement of the participation level is more probable to obtain a continued improvement in outputs than making efforts to handle the outputs unaided (Yin, 2003).

Service providers themselves demand to start investigate about the level of services and satisfaction they have provided to the customers and also try to know how they keep themselves on the track of continual improvements. This study is provided as a first step help service providers in being focused upon proactive approach. Now customers are getting more knowledgeable in the production delivery procedure and becoming more confident and certain about what they desire from their service providers. As a result, service providers who can make it possible that they are becoming more skilled in these points to take a demonstration on their opposition (Long et al., 2004).

2.12. Summary

The studies explored in this chapter prove that importance of KPIs and benchmarking in the engineering businesses. The later chapters discussed the development of KPIs' Identification and verification of KPIs and Benchmarking approach. The research tools used for this research are designed through considering the fact found and observed in the literature discussed in this chapter. The questions designed in the questionnaire are based on the literature review. KPIs are also designed for this study by evaluating and assessing the KPIs discussed in the literature and are used to collect the data for this research. These KPIs development and list of KPIs can be seen in the chapter 4 of this thesis.

CHAPTER 3 – RESEARCH METHODOLOGY

3.1. Introduction

This chapter addresses the research methodology used for this study. It discusses relevant information which helps to understand the approach used to collect the primary data for this research. Primary data is collected through benchmarking approach with key performance indicator factors. The current section also gives the knowledge about benchmarking and key performance indicator factors. Furthermore, this section describes the importance of the research methodology use for this study and explains the purpose of using the current research approach for primary data collection.

In addition, this section illustrates the relevant limitations to the benchmarking approach. It also shows the factors which helps in indicating key performance indicators for the projects in given case studies used in this thesis.

3.2. Research Approach

The research is conducted in order to the research objectives and in this regard a proper research methodology is needed to be chosen. In this type of study the most prominently selected and used methodology is based upon the Benchmarking. In the beginning, it was related to production concerns only; however with the passage of time it encapsulates almost all fields of research and improvement. In the situations, where performances are desired to be observed and improved, methodology of benchmarking proved successful.

Benchmarking is the process of determining and comparing the best practices and standards of two or more businesses with one's own standards and practices. The literature review suggested that most of the work done using benchmarking was related to the scope of manufacturing, but nowadays it has become a management tool and it is applied in almost every field of life. It is so common that most of time it is implemented in the routine life activities. It is also stated that the systematic process is said to be benchmarking while identifying and implementing the better or the best practices.

According to Fryer et al (2004), Companies observe a professional as a successful professional and then observe his attributes (key performance indicators) and then attempt to implement those indicators in our professional carrier. But it is not as simple as it seems to be in the larger organizational scope. The stated benchmarking is often done unconsciously while someone is at work. People compare and learn from the behaviour of the other constantly. The same is applied at an individual level in the organizations. The scenario is changed when it is applied to a large scale organization like in the case of a contractor organization. At an individual level the benchmarking is seen to be applied by: (1) Talking to the colleagues and having information from their expertise, (2) It may be done by willingly consulting with the experts, and (3) Developing a network with the other people at different organizations and their people at different seminars, forums and conferences. Therefore, once it has been decided to perform the benchmarking then it is required to decide that how to measure it. In this situation the objective is to find out that how the leader has reached the best position and how to reach there. As in this study, the selected organization is synthesized first in order to find out the success factors as Key Performance indicators (KPIs). Benchmarking is not taken as alone but it is a portion of the large

efforts undertaken in the process of re-engineering and the initiatives for the quality improvements (Bernard, 2012). Now a day, most of the large and successful organizations use benchmarking as a tool to learn and improve on continuous basis. A study conducted by Global Benchmarking network (2010) revealed that benchmarking is one of the tools for improvement that are expected to gain popularity in coming years. It is also suggested that the use of informal benchmarking is 68 %, the performance benchmarking is 49 % and the best practice benchmarking is 39% are in practices.

3.3. Benchmarking Approach

The Benchmarking is accepted to be one of the successful tools in the performance improvement; for this reason the benchmarking can be useful in the current scenario of the research. As it focuses mainly on the improvement of the efforts which are guided towards the success of the organization, the benchmarking ensures that fact of the implementation as it cannot be taken as a non-achievable task due to the reason that it has been already implemented and measured by a leading organization. Therefore, it cannot be declared that it is not possible to be achieved. The benchmarking ensures the confidence that the organization is being compared with the leading organization of the industry and organization makes an effort to implement something that has been successfully implemented by a leading organization. The benchmarking is also beneficent in the situation where an organization implements the best possible activity and change (Stukhart et al., 1995).

The benchmarking can be taken as a more useful tool in the following research if the sequence of the benchmarking process is properly tailored and implemented. These sequential steps are considerable and described in this section. There must be a clear understanding that what is expected to be improved and why this improvement is desired or what sort of losses are expected to be faced if such improvement is not made. This analysis is critical for the success of benchmarking tool. This analysis is normally done by the senior managers. The organizational objectives are the keystones to the success therefore these objectives must be in line with the benchmarking. It is carefully decided that which organization is needed to be selected for benchmarking. There must be a clear cut distinction between the performances of both of the organization. If there is no difference in performances it could not be decided that who will benchmark against whom (Chaman et al., 2006). The targets must be decided in order to harmonize all the efforts so that the targets must be obtained. The willingness is a key to success; therefore the willingness of the participants to improve their processes and performance areas. To search for the best possible practices, the particular and same sort of industries are searched however it is not the compulsion as the other type of industries can also be searched to get the best process or product produced by them.

In this research, the aforementioned steps are considered carefully when benchmarking is conducted. Company AA has been chosen to benchmark its best practices for Company BB (AA and BB are the two real companies in Kuwait. The real names of the companies have been changed because of data protection reason).

Case studies of the both companies can be seen in Chapter Four (from Section 4.2).

3.4. Benchmarking Objective

The activities are undertaken while considering the objectives that would be gained through undertaking those activities. Moreover, such objectives also enable the organizations to control the processes. In short, the objectives of the benchmarking is to “identify, understand and evaluate” the current situation of the business and the best practices of the other businesses. Consequently, the areas are needed to be identified that seem to be lacking in performance and expected to be improved (Thorpe et al., 2004).

3.5. Advantages of benchmarking Approach

The worldwide acceptance of benchmarking shows that it apparently has some advantages. In the following section, these advantages are collected together. The first and foremost advantage is a complete scan of own system which is vital to be performed before proceeding for the implementation. Second is the clear understanding of the cost that is incurred on the project. The data is sorted to make a comparison and ultimately support in utilizing the same data in favour of the organization. It also enables the organization to figure out that how successful the business is running. Thirdly, it allows to improve the working practices of own business. It helps in finding the strengths and weakness of the business and provides a mean to find out the strategies to make improvements in the business. It also provides privilege to make a change in the organizational structure. It means making changes in plant, supplies, suppliers, finding new markets, overcoming the obsolete policies (James, 1998). Finally, it helps in improving the quality of the product and services by making a focus on better working situations and practices which are expected to result in a better return on investments.

3.6. Characteristics of Successful benchmarking

The characteristics considered while conducting benchmarking in this research are stated in this section. The benchmarking process can be better implemented if it is done using a set pattern or procedure as suggested. The planning is a critical and foundational time in which it is recommended to find what is actually needed to be improved. The importance is judged for the organization and the customers. In this process, the data collection methodology must be determined as in this research is the Key performance indicators with the help of case study and questionnaires. Thereafter, analysis is done in which it is determined what is the performance gap against the competitor, or the industry, and the reasons for this gap are also identified. After analysis, the benchmarking is moved to the action step in which development of the improvement plan is made and performance standards are finalized. The controlling stage deals with the monitoring of the performance against the set standards. The last consideration is the being the regular as the benchmarking may become the habit of the institution for the performance improvement (Cooper, 2004).

Along with the advantages of the benchmarking, organizations have to face a few considerations that may result in an undefined situation. To avoid such situation, author has considered that only a few things should be benchmarked rather than selecting so many aspects for benchmarking. The time is the key to success and especially in case of benchmarking it may happen in extending the benchmarking process and the things may become entirely changed and fruitless. The collected data must be gathered in the most precise manner.

In most of the situations, the benchmarking process is given up just after execution; practically the benchmarking may give late results. The process of benchmarking must be prolonged to have the desired results. The priorities of the targets can be changed as the situation changes (McGeorge et al., 2002).

3.7. Types of benchmarking

There are following benchmarking techniques and varieties that can be considered in this type of research:

3.7.1. Process benchmarking:

In this type of benchmarking the firm who is initiating the benchmarking focuses more on observation and investigation of the processes of business with the objective of identification of the best practices from the other firms. For this process, an activity analysis is required on which the objects are to be benchmarked. The cost of this process, the efficiency is also considered that may result in an outsourcing. This benchmarking is useful where the improvements are required to be seen in processes of any organization.

3.7.2. Financial benchmarking:

The benchmarking is performed to determine the financial analysis and afterward comparing the results for the assessment of the competitiveness.

3.7.3. Performance and Competitive Benchmarking:

In these benchmarking approaches, the business willing to improve their business with the help of benchmarking considers their position with respect to the key performance indicators and their characteristics for the products and services. This benchmarking is restricted to the same sort of businesses. In this method, the confidential data is supposed to be at stake therefore, the permission would serve in the best way while collecting data for these purposes. This is suitable where the performance indicators of the one organization are compared with the performance indicator of the other. In case of a found gap procedure are adopted to be bridge the gap and due to this reason, author has adopted this type of benchmarking approach. This benchmarking enables the users to determine their own competitive position by making a comparison of products and services.

3.7.4. Product benchmarking:

This benchmarking is used to design a new product or to upgrade an existing product. Sometime a reverse engineering is implemented.

3.7.5. Strategic benchmarking

This benchmarking allows to observe that how the others are competing. It is not an industry specific benchmarking and can also be used by other type of organizations as benchmark. In this type of benchmarking, the organization accepts to improve their performance by analyzing and studying the overall strategies in long term. These are related to the factors like core competency, an attempt to develop new products.

It may be related to the making changes in the external environment. It is applied where the business strategies are not found up to mark and needed to be re-tailored. In these benchmarking approaches, the implementation and execution is a difficult task and it takes a long time to materialize the results.

3.7.8. Functional benchmarking

This benchmarking is performed while focusing on a single function of the organization and also done to improve a single function (Harris et al., 2006).

3.7.9. Internal Benchmarking

This is one of the interesting and latest benchmarking adopted by many organizations. In this type of benchmarking instead of analyze the businesses of the other to select as a benchmark, the own business is analyzed to find out the performance indicators which are contributing to the success in the most prominent way. One of the most important advantages of this benchmarking is the easy access to the confidential data. The data is readily available in the standard and desired format. That is why less time is required to process this type of benchmarking. The barriers are fewer in number and the implementation is easier as compared with the other types of benchmarking. However on the other side, the innovation will be lacking in this type of benchmarking; and that is why most of the people avoid this benchmarking and choose external benchmarking. It is used in a situation where same sort of business units operates (Jones et al., 2003).

3.7.10. International benchmarking

It is a benchmarking in which the organization does not find any business or organization relative to the environment in situation in which they are operating. Moreover, they wish to expand their scope regarding administrative skills, processes and products. The aspect of global village and information technology has made it more possible to select this benchmarking. However, this benchmarking takes more time to complete the data collection and analysis. But it is most feasible tool where the organizations strive to attain an international and world class standard.

This research focuses on Performance and competitive benchmarking because of the nature of the research and keeping in mind the characteristics of each aforementioned type. In this research, two organizations (Company AA as a large scale and Company BB as a medium size) are compared and analyzed to adopt the benchmarking approach to reveal the useful measures in order to improve the performance of the company.

3.8. Process of Benchmarking

The benchmarking is related to the study of comparison among standards and practices. It can be done outside the business, an organization, an industry, the region or the native country. In this process, the procedures adopted by others are analyzed and figured out that how they have become successful. On that track, the organizations can find the reasons behind the excellent performance of the other organizations. If the data collected from the situation analysis are properly implemented in own organization they result in an improved performance not only in the critical function of the organization but also in the overall performance.

The benchmarking should not be taken as a once exercise, instead it can be taken as a continuous process in the organization; so the areas of improvement must be identified regularly and situation and performance can be improved by implementing the benchmarking. Listed below is the process considered by this study due to the nature of the benchmarking used in this research.

3.8.1. Understanding current business process

While initiating a benchmarking process first and foremost activity is to determine the current situation of the own business so that it must be identified that whether the improvement is required or not; and if it is required to go for an improvement process than the factors are demanded to be highlighted that needs an improvement. The current resources held by the business are also categorized and identified so that it should be managed to use them in the later process of performance improvement. The objectives and targets of the organization are helpful in determining the area of improvement as the fields that are lacking in objective attainment are supposed to be considered.

3.8.2. Analyzing the business processes of others:

After analyzing the personal or own business, it is desired to find a business that is needed to be taken as a role model as in this research Company AA organisation is taken (See Chapter Four, Section 4.2). A step of desired and fruitful business is the key for success in benchmarking. Once a wrong organization is selected that will serve as just the wastage of time and resources and hence no results. In this regard, the organizations that are very similar to the business in maximum regard are selected. The outcomes and results of that selected business are also vital as the selected organization must show better results than our business. Similarly, the factors are determined that leads the industry through giving highest possible results.

3.8.3. Comparing both:

The selected factors that are taken as key performance indicators are compared with one another and it is desired to find out the differences between them either in terms of results and procedure. If the selected organization is found to be performing well in the key performance indicators it is advised to benchmark. If it is so then procedure to be implemented are analyzed and the organizational culture do not oppose the analyzed procedures they are adopted as it is, otherwise changed in the favour of the organization before implementing.

3.8.4. Necessary step to bridge the Gap:

In most of the cases, a gap is found in the working of both the organizations with one are leading and the other is following. Some necessary steps must be undertaken to bridge this gap which are as follows: (1) Determine in area that shows a gap, (2) Analyzing the reason why this gap is?, (3) Changing the procedures to the best possible level so that a better output could be produced, (4) Convincing and training the employee for a change so that they participate in the activity willingly, and (5) The results of the change must be observed and controlled on regular basis till the termination of the process.

3.9. Limitation of Benchmarking

One of the answers for the limitation of the benchmarking is “Plagiarized with pride”. For this reason, a certain school of thought is at stealing the ideas of the others and for the same reason it is not accepted by some of the organizations. They dare to find out their own way to success instead of relying on the other organization. Moreover, they do not want to jump into a state of inferiority by accepting them as leaders.

3.10. Key Performance Indicators (KPIs)

Measuring performance is meant to be one of the important activities in the organizational life. The performance is not only measured to verify the results against the objectives of the organization but also for making changes and enhancing the performance of the organization. Although, there are a bundle of performance indicators that can be observed and studied while observing the verifying the performance of the organization but among those performance indicators there are certain indicators that are considered to be the most important and critical in the overall performance of the organization these factors are called Key performance indicators (McCabe, 2001).

When observing the performance of the organization, these key performance indicators are meant to be chosen from many of the indicators. The key performance indicators may change from organization to organization. In the service based organization, one of the most important key performance factors is the customer satisfaction, where as in production concerns the number of unit produces, the time spent in fulfilling the targets is of the key performance

indicators. Moreover, the key performance indicators are different in public and private sector organizations.

3.11. Purpose of KPIs

Before a detailed discussion on KPI's, it is important to identify a few of the purposes that are associated with the determination of the KPI's. Some are discussed as follows:

3.11.1. To communicate the status i.e. actual vs. expected

The identification and observation of the KPI's enable the organization to know their actual state where they are at present. The objectives of the organization let the organization determine the desired and expected status where they would like to be in future. The KPI's of the organization supports them in making a good comparison of now and then. This comparison allows the manager to make critical decision for the benefit of the organization (Harrington et al., 1996).

3.11.2. Improvement by fact not guesses

The most important purpose and reason for identifying the KPI's is the improvement in the processes of the organization in order to improve performance. This improvement is not based on guesses but real facts. Due to the reason that the data collected in accordance with the KPI's serves the basis of improvement, that is why the purpose served by the KPI's is that they are based on real and determined facts.

3.11.3. Priorities improvement activities

The performance indicators are priorities according to their importance in contribution to the overall performance. The indicators that are contributing a lot in this regard are given more weight and hence the KPI's enables the managers and organization to arrange the performance factors in a logical order to support a better performance improvement (Parmenter, 2007).

3.11.4. A frequent health check for business

Most of the people treat business as a lively entity and therefore they say that the investment and new employees are like fresh blood to the organization. On the same basis, they also suggest that frequent check up and controlling must be considered at regular intervals of time. Once the KPI's are identified, they are check on regular basis and ultimately respond to the business in a good verification of the organizational health.

3.11.5. Connecting customer to process

Customer is said to be king of every business as all the activities are undertaken to please and satisfy the customer. The performance indicators are also included in the study that enables the researcher to figure out the importance of the consumer in the process. That is the reason, the customer are concerned and connected to the performance and its indication. The suggested KPI's enables better to understand the performance of the business (Kelly et al., 2002).

3.12. Importance of KPI's

Following are the importance of KPIs that are considered in this research and are carefully kept in mind while dealing with the KPI's:

3.12.1. Critical for the Managers

Managers are the persons in a project who have been decided to be the key players in the performance of the project. The true identification of the KPI is also very important for the viewers or managers. A better understanding of the key performance indicator and then measure their level of achievement enables business to make favorable decisions. Therefore, managers are motivated to keep an eye on the key performance indicators.

3.12.2. Vital – Affects the Business

Nothing can be managed and maintained until it is identified. The identification of the key performance indicators affects the business as their identification and the benefits of this identification are revealed to the business; therefore they rely more on the results and level of key performance indicators. Their identification is fruitful for the organization and at the same time ignoring the performance indicators and their data also force the organization in the darkness where nothing is seen and nothing can be implemented (Steven, 2007).

3.12.3. Customer Focused

There is no restriction over the KPI's that they should be focused on a single entity or objective but most of the time it is true that the activities performed in order to check the performance and their indication are customer focused or oriented. Therefore, the best suitable KPI's are selected to have a true result.

3.12.4. Drives Improvement

The data related to the key performance indicators are found to be in two states either below the required level or up to the desired level. In both of the cases, the participants seek motivation from such identifications and studies. Therefore, it has been considered as an important factor because it is how the managers present their data of KPI to the senior managers (Bernard, 2012).

3.13. Usage of KPIs

Following are the factors that are considered while using the KPIs in this research:

3.13.1. Current and Up to Date

The collected data or facts are very important for the decision making. It is also mentionable that as recent and up to date the facts are helpful for the organization in decision making. The facts collected about different KPI's are never based upon the secondary data it is apparently a primary data, and are collected when the organization desires to measure their performance. Therefore, the data can be most up to date for a certain situation (Bernard, 2012).

3.13.2. Easy to Understand

In some of the performance measurement tools and methods related to the financial situation is quite difficult to understand, especially for a non-commerce managers. However on the other hand, the factors selected for the key performance are easy to understand by almost every level of organization. It does not require a specific knowledge of the subject to observe, elaborate and verify the data collected against these key performance indicators.

3.13.3. Important and Relevant

The Key performance indicators and the data collected about these indicators is the most important and relevant to the objectives of improved performance. If the collected data does not contribute the performance enhancement and assessment that means a problem has occurred at the time of selection of key performance indicators. The process would be revised with rather new and different performance indicators as they are recommended and needed in the process of key performance indicators and the most important and helpful factor must be selected.

3.13.4. The Viewers' Contribution

In the performance enhancement through the identification of the key performance indicators, there are many types and number of participants. Their willing contribution cannot be ignored or over ruled; they can contribute and participate in both the ways. It can be done in a positive and favourable sense as well as the negative and problematic sense. Therefore, it is also used to create an environmental situation in which the contributors of the enhanced performance through key performance indicators must contribute willingly in a constructive way (Moore, 2004).

3.14. Characteristics of Favourable KPI's

This section describes the characteristics that are considered in this research for identifying the KPIs for the data collection. The selection of the KPI's is the most critical, vital and important part of the overall process. A false selection of the KPIs can result in a poor and unfavourable result. The following criteria are used to select a favourable key performance indicator (McCabe, 2001):

3.14.1. Simple

The selected key performance indicator must be simple and straight forward so that it can serve every individual in the organization with its results. A difficult to understand key performance indicator can result in the facts which do not favor the organization as desired by the managers while initiating the improvement in process through key performance indicators.

3.14.2. Dynamic

The performance indicators are found to be of two types. One of them does not change with its situation and data, the variation in the results of such factors do not show a considerable change over a period of time; moreover they do not show any elasticity when related to the other organization factor. These are considered to be less relative to the other organizational factors. Therefore, such factors are not found favorable to be selected for the key performance indicators.

3.14.3. Engaging

The performance indicators must engage all the participants as strongly as they can. The key performance indicators must be selected in such a way that almost every group of employees and department must participate and engage in the process of managing the key performance indication and their enhancement. It is possible only if such factors are selected and organized in the process.

3.14.4. Visual

The visualization of the key performance indicator and the changes made with the help of key performance indicator must be useful for all the employees of the organization. If the results of these indicators are not visualized by the employees and participants of the process, they will not feel motivated for taking up such targets. Therefore, the performance indicators that have a clear vision and visualization for the participants must be selected.

3.14.5. Standard format

For the abovementioned targets, a standard criteria and format must be designed for the selection process. Those selection criteria may be called a standard format. The performance indicators that fail to fulfil the standard format must not be selected for the project of performance enhancement of the organization. It is also a matter of fact that the organizations that are using this tool frequently, has already developed this standard.

3.14.6. Recorded feedback and acted response

The key performance indicators must be selected keeping in view the fact that the feedback and data must be in some tangible form with evidence. As some of the factors have the data but not available in the recorded form. Therefore, it is recommended to select only such factors that are supported by some recorded data so the evidence can be provided in case of any ambiguity (Shahidur et al., 2010).

3.15. Important KPI's

Following are the important factors which are considered in this research and given more importance in the study:

3.15.1. Safety performance

One of the general performance measures is the safety of the workers, managers and team members. In some of the businesses, it is directly associated with the working environment like working in a production concern construction business. There are certain businesses as well in which security is not the primary matter of concern but considerable at secondary level. Whatever is its nature primary or secondary, the performance of the organization can be measured in terms of safety of its employees. The number of accidents at the site or the number of illness happened due to working in the business environment must be recorded and taken as the key performance factors.

3.15.2. Quality performance

The performance should be measured by the quality. In general, the quality is said to be the defect free production or services. In this way, a business can be considered working on better quality if the error free produced units are more in number. In the services concern, these products are not produced but an intangible thing is delivered than it is needed to identify the defective and defect free services. For this purpose, a feedback from the customer is quite favourable to figure out the level of performance achieved regarding the quality.

3.15.3. Cost performance

In every possible case of business, every activity results in a cost and those costs bring the return. If the returns are not up to the required level, it can be said that the cost of the product is mismanaged. In this scenario, the cost leadership is the most important consideration. The cost leadership means incurring the least cost in the development of a product or delivering a service.

3.15.4. Delivery performance

After product production, it is needed to be delivered to the consumer or buyers. The quality of delivery of services and products is also taken as among the important key performance indicators and factors. In some of the cases and businesses, the most important factor is delivery performance, especially in business where the response time is the only factor (Albert et al., 2010).

3.16. Identification of Key Performance Indicators (KPIs)

The identification of the key performance indicators is the key point in the success of the research and next chapter (Chapter Four) of this thesis specifies the KPIs for this study. The following characteristics were kept in mind while making a selection of the KPIs: (1) Realistic, (2) Related, (3) Verifiable, and (4) Mutually agreed. For the purpose of identification of the KPIs, the primary and secondary methods are adopted. In the secondary research, the literature already developed and researched in this regard is studied (see Chapter Two). The journals and research papers became the vital participants in this regard. One of the limitations with the secondary research is that it may not be the latest data; therefore the primary research is also under taken to verify and purify the identified KPIs.

3.17. Benchmarking Approach for KPIs

Whenever, a research is conducted, it is compulsory to define a set pattern in order to find a result or conclusion. The following section will help in determining the methodology that can support in performing a benchmarking for the Key Performance indicators; and then using them to guide the other organization in achieving the same or better performance. The conceptual frame work adopted to perform this research has been presented below:

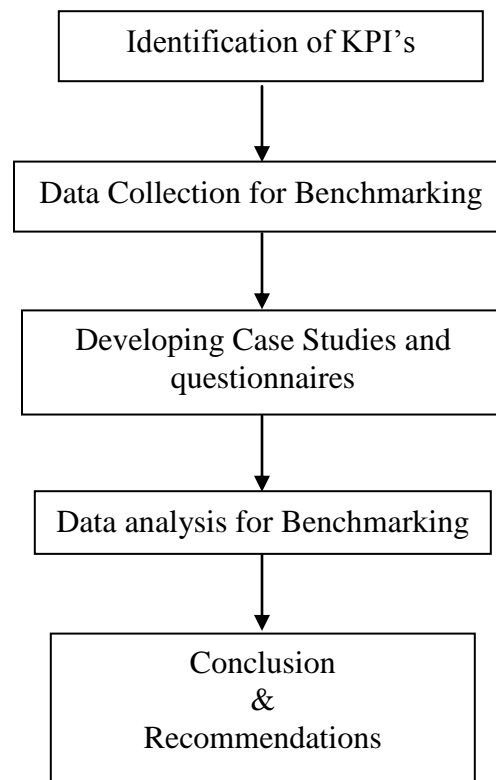


Figure 3-1: Research Process

This research focuses on the pattern defined in the figure 3.1. The primary research starts with the identification of key performance indicators to perform the benchmarking approach followed by data collection for benchmarking. Next step is to develop case studies for clarifying the problem to achieve the research objectives. Second last step is to do the data analysis for benchmarking. Last but not least step is to define the results of this research with the help of conclusion and the recommendations for the further study on this research.

3.18. Case Study Approach

This study is about the exploration of the construction project management of the two companies and to compare them mainly with respect to time management, cost management and customer satisfaction. The data has been collected for two companies in order to make comparison and to benchmark. For benchmarking, it is necessary to collect the data from two companies of the same nature and there is a need to develop the cases. Therefore case study is the approach used for this purpose.

The case study research method has the ability to provide an understanding of complex problems and objects. It can enhance experience and exposure about what is already known through past researches. The feature of case study is that it stresses on detailed investigation of a limited number of issues, events, objects or conditions or their connections. Case study research has been in practice for many years and it also has no limitations in type of fields where this research method has been applied. Specifically, social sciences field extensively used this approach to analyze contemporary social problems and offered the base for the application of concepts. Critics of the case study method argue that on the bases of small number of cases, reliability and generality of conclusions may compromise. Consequently, deep study of any single case can lead

to prejudices. Some researchers were of the view that case study method is appropriate only for exploratory researches. Researchers with all its limitations continued using this method to explore and present theories for real life issues by avoiding biasness with great care. Now extensive studies are found in literature conducted using case study method.

Gerring (2004) defined case study as “*an intensive study of a single unit with an aim to generalize across a larger set of units*”. In the view of Robson (2002), case study is the approach to investigate contemporary problems. The definition of case study is not difficult rather its application involves complexities. Detailed study of a single unit and then generalize the results for other units involve uncertainties. Case studies creates distinction between units which are studied in details are those units which are not. Gerring (2004) argued that before selection of any research methodology seven points are important which must be considered. These points elaborate research methodology’s strengths or weaknesses. Case studies have following seven points are which are its strengths: (1) Where conclusions of the study are descriptive, (2) Where research plan is extensive, (3) Where case comparability is more important, (4) Where it is more crucial to investigate underlying system than its contributory effects, (5) When contributory plan at issue cannot be changed, (6) Where research objective is explanatory, and (7) When limited number of variance are available. These seven points apply to KPI research too. This research is descriptive and research plan is extensive as all crucial aspects of the cases are considered. Specific characteristics of the cases are compared. Goal is to investigate the system of KPI and its benchmarking. Variances are difficult to develop. Changes in casual plan are not possible and research core objective is explanatory. In case studies, data collection is difficult task. According to the research onion of Saunders et al., (2012), researchers

have few other research methods i.e. ethnography, experiment, action research, grounded theory and archival research. All of these have their own strengths and weaknesses. It is the research objectives which assist in selecting most suitable research technique. Ethnography is to study of people that involve various methods to collect and interpret data. Critiques of ethnography claim that it is impossible for researcher to remain unbiased as researchers become the part of the research activities and their behaviour, attitudes and perceptions affects the research goals (Goldthorpe, 2000: Adler and Adler, 1998). As far as this research is concerned, it is not concerned with social issues it involves qualitative and quantitative data. Subsequently, biasness of researcher could not be tolerated. KPI identification and benchmarking do not involve social phenomena and also not a study of real life situation involving people therefore this methodology is not selected for this research work.

Experiment research method requires an environment in which research has control. It is mostly carried to see cause and effect relationship while keeping some variable constant and some manipulated. Advantage of this type of research method is that experiment can be repeated any number of times to observe the cause and effect relationship among variable; and disadvantage is that it generally do not involve real life situation. Sampling in experiment is very crucial as most of the psychology experiments are done by using sample of youth and generalized to USA or western population which is not so appropriate in the eye of critiques of experiment research methodology. KPI identification and its benchmarking do not involve such variable whose cause and affect relation it to be established or evaluated. Further environment is not, and cannot be controlled; therefore experiment method is not used. Archival research method, grounded research method and action research methods are not used as they have limitations of being

qualitative in nature and involves historical data which does not suits to research type and data required for findings. Due to seven characteristics mentioned by Gerring (2004), case study is selected for this research.

3.19. Questionnaire Survey

This research is quantitative and explanatory in nature. Data is collected through structured questionnaire. Interviews or focused groups are not used even though they are good in answering questions like “why” and “who” and assist in intense situation to understand the real causes of occurrence of certain issues or problems; however at the same time, it consumes lot of financial and time resources. A lot of data is collected using this method which also consume more time for filtration. Other methods of data collection for this study i.e. observation and pictures/videos are also not used as they inherit limitations of not suitable for studying people’s behaviours in certain circumstances of views about certain activity and furthermore is not easily understood until unless not explained by painter or maker.

Due to time and financial resource limitations, surveys are used for this research and structured questionnaires are used to collect data related to cases under study. It helped in collection of substantial amount of data in limited time period. Data is easily categorized, compared and analyzed which was not possible in case of interviews or non-structured questionnaire with open-ended questions. Due to the nature and limitation of ethnography, archival research, action research and experiment research methodologies with all pros and cons, case study approach is used as it allows achieving objectives of this research. Further from cases, reasonable amount of data is collected for KPI identification and their benchmarking using structured questionnaire.

3.20. Summary

This chapter has presented the research methods and techniques used in this research. The section has demonstrated the benchmarking approach, importance of benchmarking approach and reasons and characteristics for which the benchmarking approach is used in this research. This chapter has also presented the rationale for using key performance indicators in order to collect data for benchmarking. This research focused on the benchmarking approach because of the nature of this research and facts found in the literature review. The data for this study is collected through the use of case studies of Company AA and Company BB where the Company AA is used to benchmark its best practices and standards for Company BB the growing organization.

CHAPTER 4 – CASE STUDIES AND KPI IDENTIFICATION

4.1. Introduction

In this chapter, two companies are as case study discussed in order to identify the potential Key Performance Indicators (KPIs) for the company to benchmark the successful company in the same industry. This case study is the base for benchmarking and to identify and evaluate the KPIs. This chapter focuses on the features and projects of two construction companies. The case study is based on two types of primary research i.e. surveys and secondary data. Two types are used as few KPIs are evaluated by existing data related to the financial management, time management, employee turnover and change management. KPIs have been evaluated by collecting data through questionnaire surveys. The questionnaire survey has been conducted by distributing questionnaire face to face and questionnaires were filled in by the respondents. In order to omit the chances of inaccurate filling or incomplete responses, questionnaires were duly filled in the presence of survey team. In addition, a detailed study is conducted about the construction projects of the company which has been selected as a benchmark. A review of company's construction projects is conducted to see the success factors of the company.

A review of the existing documentation related to the projects, their cost, time schedules, change order costs schedules, employee turnover records and employment policies is conducted in this study. This study focused on the application of KPIs in the construction industry. This study stressed mainly on the industry approach towards designing the KPI and to measure the project performance management according to the KPIs. The data was collected for having in depth information about the practices prevailed in the industry.

Furthermore, this study extracted many key performance indicators of construction industry that are to be followed by the construction companies in order to be a successful company in the industry. These KPIs include construction cost and time performance, customer satisfaction regarding services and products, Quality Management System (QMS), team performance, change and material management, and safety factors. This determination of KPIs was much useful for companies in order to measure and manage project performance. It also helped the purpose of examining the case study companies.

4.2. Data Collection

For this research, data is collected from two case studies about their project finance, project team activities, checking and taking over the sites, and data on quality management system. Content analysis of the primary data and project documents is conducted. Subsequently, data collection questionnaire are prepared to collect information from the project personnel. For transferring the non-structured information into a format which allows analysis, information content analysis is conducted. Basic steps of this include as follows: (1) Deciding the types of material to be included in content analysis, (2) Selecting units of analysis, (3) Developing coding categories, (4) Coding the material, and (5) Analyzing and interpreting the results.

This content analysis provides KPIs that are used as a basis for designing the questionnaire for data gathering form project teams and other stakeholders. For quality research work, the case studies should be relevant, consistent, reliable and dependable and it should pass the validity tests of content, construct concurrent and predictive (Golafshani, 2003). For this study, three tests are conducted for ensuring validity. These are: Content Validity (text mentioned on

documents to be verified by the experts), Concurrent validity (documents to be verified by cross checking with other relevant document) and Construct validity (documents to be examined relationship between KPI and its measurement).

4.3. Case Studies

Two construction companies have been selected for this case study. The case studies were selected due to following factors: (1) Both are from construction industry, (2) Availability of documents, (3) Diversity in projects, (4) Diversity of geographical project locations.

The text describes the salient characteristics of the company. The following sections provide the prominent KPIs, their definition and implementation in projects in order to set a base for understanding case study results.

4.3.1 Company AA

Company AA is located in Kuwait. It is serving in both public and private sector for several years. Company AA is esteemed construction company in Kuwait. This company has won the hearts of the customers by delivering high level of specialized services in construction sector. It completed its projects in all over Kuwait. Various projects in recent years are accomplished by Company AA in UAE. Kuwait Municipality and the Central Tendering Committee rated Company AA as “Grade I” company. This rating is purely based on its excellent project execution in construction of infrastructure. Company AA is ISO 9001: 2008 certified company. Quality certification is the evidence of its commitment towards quality standards. Company AA has proved un-paralleled commitment towards timely delivery of services with cost

effectiveness. Company AA has ability to complete its project even before the scheduled time with the support of committed labour force.

4.3.2. Company BB

Company BB is one of the promising contracting firms which is on the way to be specialized in foundation civil works. Company BB has a big team of professionally qualified and highly experienced Engineers, Technicians and other Supervisory and Technical staff. In time completion of the projects are assured with the coordinated work of highly skilled employees. Company BB is financially stable and able to meet its commitments and discharge its responsibilities in the field of Civil Engineering Projects in Kuwait.

In competitive market, Company BB is struggling with various problems which are leading to delayed project completion and also causing financial losses. In order to become the first choice for project owners, Company BB needs to improve the efficiency in project design and cost by appointing a number of KPI's that have relevance to the problems.

Primary data on project specification, financials, material management, change order management, material inventory levels and employees' turnover is collected. KPI implementation is dependent on various data analysis. Questionnaires are prepared for the purpose of problem identification.

4.3.2.1. Performance Measurement in Company BB

Company BB has no formal procedures to evaluate its performance with reference to KPI or to compare actual performance with the required one. They have never been goals achievers. They evaluate only their cost of project and profit margin for the purpose of performance measurement. Now Company BB has decided to implement KPI in the organization in order to measure and compare its performance and to achieve high level of stakeholders' satisfaction.

For this purpose, benchmarking is conducted and Company BB has decided to evaluate the KPI implemented in Company AA and adopt them in order to meet the current needs of the market.

4.3.2.2. KPI in Company BB

Data to measure the current performance in Company BB is available in the system. Managers have never performed data analysis due to time and resources constraint. KPIs have not been implemented in the firm due to non-availability of the different variances of cost and time and order management. System is designed in such a manner which automatically reschedules the completion time of project which leads to cost ineffectiveness, late deliveries and mismanagement of resources.

Company BB came to know that through the implementation of KPI benchmarking, problems can be solved and it is the most relevant solution of their problems, they agreed instantly on adopting this solution. Company BB needs of defining their clear goals based not only on financials but also on customer and employees satisfaction. The logistics department of Company BB has set its goal to become the leading contractor in the industry which requires high level of efficiency and sophistication in service availability.

It also requires that policies are objectively reviewed at the strategic levels which now have been recently done and approved by the higher management of Company BB. CEO has released their vision explaining their commitment to overcome their problems in current year.

The vision statement includes performance indicators to be implemented which are related to cost and time management and customer satisfaction in terms of product and services and also relating to human resource. The only problem with Company BB is to fulfil contract undertaking and become the prioritized service provider in the industry. The way to achieve is to remain focused on customers.

4.4. KPIs identified in Company AA

The KPIs identified in Company AA are of four types:

4.4.1. Project and Company Performance

4.4.1.1. Cost Performance Indicator

There are three types of cost indicators- one for design cost, 2nd for construction cost and 3rd for project cost.

(a) Design Cost Variance

Design cost is expressed as: percentage of the anticipated cost of the design process. Design cost is obtained by subtracting the anticipated cost of the design process from Actual cost of the design process.

(b) Construction Cost Variance

Construction cost is obtained by subtracting the anticipated cost of the construction process from Actual cost of the construction process. The resulting figure is the percentage of the anticipated cost of the construction process.

(c) Project Cost Variance

Project cost is the percentage of the anticipated cost of the combined design and construction process. This is the difference of Actual cost of the combined design and construction process and the anticipated cost of the combined design and construction process.

$$\frac{\text{Actual Cost} - \text{Estimated Cost}}{\text{Estimated Cost}} * 100 = \% \text{ of Cost Variance}$$

Actual Cost is the cost incurred on the project while estimated cost is the cost projected/budgeted at the time of design. Difference of both gives the variance of cost; if the resulting figure is divided by the estimated cost and multiplied by 100 it gives the variance in percentage. This variance may be positive or negative.

If the resulting figure is positive it means actual cost incurred is more than the estimated cost, this rise may be due to inflation or change order cost or false budgeting. If this core is negative then it would mean that the project was delivered with cost effectiveness and estimation was done by keeping in mind the inflation factors and proper margins. Cost performance indicator is very crucial for the success of the Company BB projects. Company BB is facing financial issues and project completion cost remains high than the estimated cost. This indicator is used to check the cost variance and its acceptance level in projects and to set a benchmark for their further projects.

4.4.2. Construction Time Performance Indicator

There are three indicators to measure time performance which are as follows: (1) for design phase, (2) for construction phase, and (3) for whole project.

(a) Design Time Variance

Design time is expressed as a percentage of the anticipated duration of the design process. Design time is obtained by subtracting the anticipated duration of the design process from actual design duration of the design process.

(b) Construction Time Variance

Construction Time is obtained by subtracting the anticipated duration of the construction process from actual duration of the construction process. This is expressed as a percentage of the anticipated duration of the construction process.

(c) Project Time Variance

Project time is the percentage of the anticipated duration of the combined design and construction process. This is the difference of actual duration of the combined design and construction process, and the anticipated duration of the combined design and construction process.

4.4.2.1. Schedule variance

Project owners require on time completion of their projects. For this purpose, they keep their eye on project progress and time charts. Company AA makes dynamic plan to tackle the time variance issue. This time variance is wisely planned by the project team and also communicated to all subcontractors to coordinate the activities and resources of the company. This brings high quality output, and resources are utilized in efficient manner. Schedule variance planning gives Company AA an edge over other firm which usually fail to complete their projects on time.

$$\frac{\textit{Discounted Construction time}}{\textit{Revised Construction time}} * 100 = \% \textit{ of Construction time Variance}$$

Where discounted construction time = actual construction time - revised construction duration,
revised construction time = original construction duration (recorded in contract) + the extension of time (granted by the owner)

If resulting figure is positive it means that the project later than originally predicted. If this score is negative then it would mean that the project was delivered before the stated time in the project. Time is one of the crucial constraints in the completion of the projects in Company BB. For this purpose, Company BB will identify and monitor the difference in estimated completion time and actual time spent on the completion of the task. Factors should be closely monitored causing the time variance. This variance may be due to change in demand of the project owner or natural factors like weather.

4.4.3. Product Performance Indicator

To maintain competitive advantage, tracking of firm's ability to meet owner expectations, qualitative feedback is unavoidable. Qualitative feedback is to be compiled and analyzed carefully in order to maintain a high quality performance in construction industry.

Company AA maintains a qualitative feedback approach to identify customer expectations and satisfaction level.

Level of customer satisfaction about finished product/facility is measured by a 5 point Liker-type mark, using a 1 to 5 scale, where:

- 5 = totally satisfied
- 4 = Mostly satisfied
- 3 = neither satisfied nor dissatisfied
- 2 = Mostly dissatisfied
- 1 = totally dissatisfied

4.4.4. Service Performance Indicator

In the similar terms as in product performance, firm also have to maintain a qualitative feedback from the clients about its services. Company AA does so to maintain a high performance in services as well in order to identify customer expectations and satisfaction level.

How satisfied the client was with the service of the consultants and main contractor facility is measured by a 5 point Liker-type mark, using a 1 to 5 scale as above.

Company BB will conduct customer satisfaction survey on past projects to gather necessary data to identify discrepancies between actual levels achieved and actual desired level of satisfaction.

4.4.5. Quality Management System (QMS) Performance Indicator

To be consistent in the provisioning of products and services, a quality management system has adopted. This system not only ensures consistency in level of services but also enables the firm to meet the specific requirements. In this system, all the processes are made documented (UK Department of Trade & Industry, 2012). The documentation detail and processes elaboration is dependent on the needs of the organization itself, its products and services, its policies and practices and also on its sub-contractor needs and also on requirements of its human resource.

Establishing and implementing a Quality Management System involves: (1) Risk evaluation in those areas where products and services are not according to the specified requirements, (2) To mitigate the risk, developing documented process which identifies the measures to be taken, (3) Resources identification and provisioning to the human resource with the delegation of responsibilities according to the documented procedures, (4) Implement the documented plan and procedures, (5) To monitor and ongoing evaluation of the plan, conduct audit to improve the procedures and implement the improved procedures which are not up to the mark, and (6) Regularly appraise and improving the Quality Management System.

In Company AA Quality Management System is integrated and documented with environmental and occupational health and safety management systems. Separate documentation is also available.

The degree of QMS performance is measured by a five-point Liker-type mark where 1 is very bad performance Very Good performance.

For the purpose of allocating resources to its personnel, extensively trained employees in their respective work area and skills development is required in ensuring quality management. Company BB should measure QMS performance indicator. Development of corporate procedures for implementing and evaluating quality management plans it is necessary to measure and compare its own performance with that of the Company AA. For maintaining the standards, these systems should be tested on regularly basis for the successful completion of the projects.

4.4.6. The project team performance Indicator

The key to success in construction industry is project team productivity. Labour productivity can raise problems like fluctuations in budgets and reduce profit margins. Variance in labour productivity is measured with calculating the difference between actual labour expenditures and estimated labour expenditures. Company AA field supervisors and managers have utilized this variance for predicting cost for completion.

The degree of project team performance at the project level is measured by a five-point Liker-type mark where 1 is very bad performance Very Good performance.

Company BB selected this indicator to evaluate the performance of project teams and their progress towards the goal achievement. Goals will be set and evaluated on daily basis. This indicator will be helpful in problems identification and solution. This variance will also benefit Company BB in estimating the cost of future projects.

4.4.7. Change Management Performance Indicator

The change management system performs the function of tracking, design and process changes and their associated cost and time schedule changes (CURT, 2005). This indicator gives the results related to companies' responses to ever changing demands of the project owners.

4.4.7.1. Unapproved Change-Order

Company AA has made their plan and procedures dynamic to meet the need of unapproved change orders. These orders bring financial risk exposure. This risk arises when project owners make changes in the requirements of the contract type.

$$\frac{\textit{Sum of Costs incurred on unapproved orders}}{\textit{Total forcasted gross margin}} * 100 = \% \textit{ of Marginat Risk}$$

This formula gives the percentage of that portion of gross margin, company have to forgo in the process of incorporating unapproved order.

4.4.7.2. Change Management Indicator

The change management performance at the project level is measured by a five-point Liker-type mark. For financial risk mitigation, Company BB will measure its performance in managing change. Procedural changes to manage change will be dependent on results of indicator.

4.4.8. Material Management Performance Indicator

Material management in construction industry involves the planning, executing and controlling site and office working. The purpose of the material management is to procure the right quality material in right quantity. The delivery channels are properly selected and their handling and delivery are done with appropriate care and on time to the authorized person. This all has to be cost effective (BRT: Business Roundtable, 2012).

Company AA has devised material management polices to ensure efficiency not only in procuring but also in delivery. Policies to procure are documented, their specification and quality standard are checked and maintained and channels for delivery from supplier to the sites are defined. Material are made available when and where requires. This is all achieved with cost effectiveness.

The material management performance at sites level is measured by a five-point Liker type mark This indicator is being selected by Company BB to bring improvements in material management policies. Minimizing material loss and overhead cost and improving the quality of material procured and its delivery at sites.

4.4.9. Labour Safety Management Indicator

A Health and Safety Management System includes the induction of processes formulated to decrease the incidence of injury and illness at work place. Management commitment is compulsory for the implementation of the health and safety management policy. On the basis of the policy, resources should be effectively allocated. Systems are not implementable without active participation of employees. System design and their complexity are dependent on the size and type of the operation area (Alberta.ca, 2012). It is pertinent to mention here that proactive way of reducing incident and illness is to implement effective health and safety management system. This system does not guarantee the non-occurrence of accidents but is an effort to reduce the number of accidents and illness at the workplace. The effective systems are helpful not only in reducing numbers but also in minimizing the severity of incidents. The safety management system follows and categorizes the data collected relating to safety incidents that take place. Typical measures include: (1) Lost-Time Incidents, (2) Recordable Incidents, (3) Doctor Cases (4) First-Aid Cases, and (5) Near-Miss Incidents

Company AA has implemented effective health and safety management system. Its management is fully committed to implement safety polices. System is so effectively designed that it identifies the hazards involved in and assesses the complexity to help in controlling them. Sites inspections are conducted regularly. Workers are extensively trained to avoid incidents. In the event of occurrence of undesirable incident proper reporting and investigations are conducted and on the basis of results of investigation, improvements are incorporated in the management system. Company AA Health and Safety Policy contain: (1) A statement declaring management's commitment, (2) Overall goals and objectives, (3) General health and safety responsibilities of

stake holders, (4) Applicable government legislation and how to comply with their requirements, and (5) Comply with the organization's own health and safety standards.

The labour safety performance at the project level is measured by a five-point Liker-type mark

Company BB selected this indicator to bring the improvement in processes of allocating resources for reducing incidence at work place. After measurement of this indicator Company BB will be able to design a safety management system. The company has the plan that survey will be conducted with the active participation of the employee. Activities will include: (1) Behaviour observation surveys, (2) Procedural audits, and (3) Techniques of predicting accidents.

4.4.10. Environmental Performance Indicators (EKPI)

Construction projects have potential to damage environment. Now this industry has a greater responsibility to protect environment and minimize damage. These indicators help in measuring the impact of projects on environment and bring improvement in the design and construction process and services offered by contractors.

Building Research Establishment (BRE) group and Construction Industry Research And Information Association (CIRIA) have developed biodiversity indicators that allow evaluating the impact of construction projects on environment (BRE, 2003).

4.4.10.1. Impact on Biodiversity – Product & Construction Process

This indicator helps in measuring performance of the projects and acceptable levels for both; the industry and environmental stakeholders.

Company AA has used these indicators not only to facilitate the design and construct eco-friendly projects but also projected the usage of framework for measuring the impact on ecology. Qualified personnel have been appointed to inspect the sites. There are two factors which indicate project performance – one for the product/design and one for the construction process.

(a) Product – Level of customer satisfaction about consideration of biodiversity impacts in the finished product/facility, using a 1 to 5 scale where:

- 5 = Thorough consideration
- 4 = Good level of consideration
- 3 = Fair consideration
- 2 = Some consideration
- 1 = No consideration

(b) Process – Level of customer satisfaction about consideration of biodiversity impacts during the construction process, using a 1 to 5 scale where:

- 5 = Very effective control
- 4 = Good control
- 3 = Fair control
- 2 = Little control
- 1 = No effective control

Company BB has decided to use this indicator to bring improvement in their design and construction process and to prove more social responsibility towards the environment and the society.

4.4.11. Respect for People Indicators (RFPI)

To judge the commitment of the organization for its human resource, these indicators have been developed. For superior performance, these RFPI are perceived to be of high importance. Successful completion of the projects requires high level of peoples' devotion. Good processes are assurance of overall improvement in the performance of the organization (<http://www.rethinkingconstruction.org/rc/respect/>, 2012). Company AA has shown high level of commitment toward its employee. These indicators are considered to be essential for improving performance (ONS, 2010).

4.4.11.1. Employee Satisfaction

It is essential for the company to be familiar with the satisfaction level of the employees. It guarantees the competitive advantage and shows the satisfaction level of the employees in respect of their authority on the jobs, salary terms, sense of achievement and the honor they receive to be the member of the project team. Company AA maintains a qualitative feedback approach to identify customer expectations and satisfaction level.

The degree of Employee Satisfaction is measured by a five-point Liker-type mark using the 1 to 5 scale.

4.4.11.2. Staff Turnover Indicator

Turnover is the quotient of the number of workers that replaces in a given time period to the average number of workers (Agnes, 1999). Turnover indicates company performance and it can exert unconstructive effects on organization progress (Glebbeck and Bax, 2004). Low wage rate and motivation level cause high turnover rate. High turnover rates leads to high costs. A certain level of turnover is important for the organization. New blood brings fresh ideas, expertise and pessimism into the labour force. Company AA has achieved low rate of employee turnover by: (1) Recruiting and selecting the right employees for the right jobs, and (2) By offering more attractive salary packages and fringe benefits as compared to local labour market

Company BB seems not to have any documented procedures for selecting skilled employees for specific jobs. Financial problems are also a hurdle in offering competitive wage rate which is causing high turnover. Company BB has decided to use staff turnover indicator to reduce not only additional recruitment costs but also bring improvements in employee training and development policies. Company BB has the plan to use this indicator to set a natural level of turnover.

4.4.11.3. Equality & Diversity

The successful organizations give importance to incorporating principles relating to equality and diversity in the culture of organization. Diversity management is considered as an important methodology in managing people and improving performance. Diverse workforce provides new and innovative ideas. People have different opinions and beliefs; their needs differ from each other. Therefore, the management practices should be consistent and fair enough for their people (PSC, 2012).

Company AA enjoys benefit of workforce equality and diversity. Improved business ideas and better sense of understanding the owners' demands led to improved services.

How effectively policies are in place and used, using a 1 to 5 scale where:

- 5 = Policy is fully enforced
- 4 = on the way to being enforced
- 3 = Partially enforced
- 2 = not implemented
- 1 = No policy in place

Company BB has decided to use this indicator for performance improvement by capitalizing the skills of diverse workforce giving them equal opportunity. Old approach of “one size fit for all” is failed in Company BB. This approach was a disastrous to offer equal opportunities to workforce.

4.4.12. Design Quality Indicators (DQI)

The design quality indicator is a tool to assess the characteristics of the design of a building. These indicators are developed by construction industry council with the support of Department of Trade and Industry, the Commission for Architecture and the Built Environment (CABE) and Revised Construction. These DQI evaluate following aspects of a building: (1) Build Quality as it speaks about engineering performance of a building inclusive of building stability, its strengths and its finishing., (2) Functionality as it is about the correlation of arrangement, space and usefulness of building design, and (3) Impact as it is related to the effect which the building has

on community and environment. The results help in setting benchmarks and allow comparison of different design.

4.4.12.1. DQI in Company AA

Along with cost and time issues in Company AA, DQI are analyzed to make sure that quality standards are met. Company AA enjoys benefits of DQI implementation some of them are: (1) At the beginning of the construction projects DQI allows project owners to clearly extract their requirements and set a workflow for assessing the significance of the quality produced. It helps in understanding the importance of better building design, setting benchmarking and also enables them to choose among different alternatives, (2) At the time of designing a building DQI allows constructors to remain focused on quality standards and let them evaluate different available options, (3) DQI helps in the understanding of the project member regarding procurement and process of construction and ensures involvement and motivate them towards achieving beyond set standards, and (4) Responses of building owners, users and client representatives on DQI can be recorded and analyzed to bring improvements in different future projects. The main functions of DQI in Company AA are: (1) As a comparator, and (2) As an indicator

Company BB respondents chose this indicator to perform both above-mentioned functions to compare different projects results and improve quality standards.

4.4.12.2. DQI questionnaire sample statements

DQI questionnaire has more than 90 statements for evaluating opinion and satisfaction level of stakeholders on building design. Few of them are related to: (1) Easy accommodation of the users' requirements, (2) Lighting is versatile for meeting users' needs (3) Building is secured in all respect, (4) Passage and common areas are pleasing, (5) Building's perspective is in accordance with its location, (6) The building is energy efficient, and (7) The building makes you think (DQI, 2012).

4.5. Identifying potential strengths

KPIs not only help in identifying strengths which enable firms to capitalize available opportunities but also help in mitigating external threats. It is pertinent to mention here that it is important that data related to KPI must be updated. Dated KPIs are based on historical data that may not be consistent with the changed external and internal requirements and old data may mislead the management. Software used for data processing may not be dynamic and manipulate the information and integration of different system for data transfer and its processing result in inaccurate KPI determination.

Implementation of sophisticated software solutions enable the firms calculating KPIs which lead to achieve financial discipline and for making necessary changes in strategic planning to achieve goals. Through the continuous evaluation of KPI, firms' responses towards the problem identification and solution implementation can be increased. Contracting firms learn from their past performances, compare them with present needs and ensures rapid growth (Hoover & Schubert, 2012).

4.6. Implementation of KPI

According to Parmenter (2007), there are four basic rules to be followed before the implementation of KPI. Every organization should follow those criteria for the successful implementation: (1) Stakeholders Collaboration (personnel, suppliers and customers), (2) Decentralization of authority from management level to operational level, (3) Integration between measurement, reporting and follow-up, and (4) Connection between KPIs and Strategy. KPI implementation requires full commitment and demands devotion from the all levels of managers and operational staff but also from suppliers and project owners. The involvement of personnel can only be achieved by transferring all the necessary information. Required data must be transmitted to right person at right time. Labour force should be considered as its capital. Motivation towards the achievement of goals is essential. Employees should be properly trained and educated in their respective field and feedback from them is compulsory. Reporting should be done timely and in efficient manner. And the focus of the reporting should remain on helping the decision maker to make quick and right decisions at right time.

4.7. Company AA KPIs in Company BB

Before the selection of Company AA KPIs as a benchmark, Company BB must analyze some important facts in Company AA which are: (1) For what purpose Company AA uses those KPIs, (2) Does selected KPI lead to improvement?, (3) Do Company BB have sufficient means available with them to evaluate KPIs and incorporate necessary changes in running projects?, (4) Are the KPIs audited externally or internally? External Audit system is considered to be credible. Audit reports will be considered having more acceptances. And company will be able to report audited KPIs in more concrete but in precise manner, (5) Are KPIs comparable for all construction projects of Company BB? There might be certain sectors in the constructions

industry where possibility of completion of projects with high performance is rare. If projects are not alike, they may give different results, and (6) what is the degree of tolerance in benchmark KPIs? This means that a minor difference in results of KPI may have negligible influence on performance where factors influencing KPIs scores are taken into consideration. Those KPIs which are not calculated scientifically may give wrong indication of performance.

4.8. Types of Benchmarking

Strategic Benchmarking: This involves long term strategies, for example new product and reengineering. This benchmarking is used to improve overall performance of business.

4.8.1. Performance and Competitive Benchmarking:

This involves benchmarking of specific performance characteristics of product or service within the same sector.

4.8.2. Process Benchmarking:

This involves improving operations and processes through comparing with the organization practicing state of the art processes and operations.

4.8.3. Functional Benchmarking:

This involves comparing business with differ partners of other sectors to find some new and improved ways of conducting business.

4.8.4. International Benchmarking:

This involves identifying and analysis of organization with best practices and then benchmark with them.

4.8.5. External Benchmarking:

This involves benchmarking outside the organization. It demands lot of time and energy

4.8.6. Internal Benchmarking:

It involves benchmarking within the organization. Less time and financial resources are required to practice internal benchmarking.

4.9. Internal Benchmarking in Company BB

Internal benchmarking is done where there is no external data to compare with. There may be certain measures which may have significant importance for them but not for other competitive companies. Companies can compare data of its own different project to measure performance despite of comparing with external projects. Where Company BB find that an important issue is not covered by selected main KPI, it may use internal indicator to benchmark its performance.

Company BB has decided not to use internal benchmarking of certain indicators due to following issues: (1) Less importance of indicator measurement as Company BB believes that measurements should only be carried out if it is important for the company itself and for its stakeholders, (2) Measurement of KPI as a definite measuring process for that indicator must be present. It must be consistent with overall process measurement of the company, easy to apply, which is required to compare different projects. If internal benchmarking require a lot of data to collect and compare which makes it non-feasible for Company BB to implement internal benchmarking, and (3) Cost of internal benchmarking is another issue for the management.

4.10. Summary

This section includes the introduction of two companies which have been selected as case studies. Product and service indicator, DQI, respect for people indicators, and environmental indicators have been defined, their formula and method of evaluation also been discussed. Furthermore, the Parameter approach to implement KPI is also included which elaborates the prerequisites of implantation of KPIs. It also involves reason of selecting external benchmarking for the improvement of performance. This chapter's facts and figures are used in the next section where available data and data collected through questionnaires data is analysed and conclusions are drawn.

Chapter 5 – KPI EVALUATION AND ANALYSIS

5.1. Introduction

The data is collected from the detailed analysis of the case study projects' agreements, projects done, and questionnaire survey with the stakeholders of the projects. This chapter evaluates the KPIs of Company BB and compares it with that of Company AA's. This is executed to benchmark the performance of Company BB with Company AA. KPIs are calculated according to the formulae and data is presented in the form of tables and graphs where necessary. The information consists of KPIs benchmarking with Company AA and performance requirements from the Company BB in their construction projects.

5.2. Selection of data

The following steps are taken for the data collection in this thesis:

5.2.1. Population and samples

In this study, interest remains on the construction projects and services delivery of Company BB. For the purpose of benchmarking, the projects selected are of less than Kuwaiti Dinar (KD) 3 Million. Purpose of selection of this project size is to keep relevance in the data and excluding the special projects having exceptional characteristics.

For the purpose of KPI calculation in Company BB, construction projects of similar nature were selected. Questionnaires were sent out to all project owners, contractors, design team and employees of Company AA and Company BB.

5.2.2.1 Collection of data

Case study research strategy demands collection of empirical data through many ways. Not only formal and structured data gathering approaches are compulsory but also internal document reviews, observations and personal communications are required. This firsthand information is used to make a foundation for the case study and personal communication is also used for increasing understanding about data.

5.2.3. Data Collection from Company BB

The variables related to KPIs calculation, data is collected from different sources.

Table 5-1 represents the data type for different KPIs.

Table 5-1: Type of data used for benchmarking

KPIs	Data Type
Construction Cost Performance Indicator	Historical
Construction Time Performance Indicator	Historical
Customer Satisfaction on Services Indicator	Current/Questionnaire
Customer Satisfaction on Products Indicator	Current/Questionnaire
Quality Management System (QMS) Indicator	Current/Questionnaire
The Project Team Performance Indicator	Current/Questionnaire
Change Management Indicator	Current/Questionnaire
Material Management Indicator	Current/Questionnaire
Labour Safety Management Indicator	Current/Questionnaire
Impact On Biodiversity Indicator	Current/Questionnaire
Employee Satisfaction Indicator	Current/Questionnaire
Staff Turnover Indicator	Historical
Equality & Diversity Indicator	Current/Questionnaire
Design Quality Indicator	Current/Questionnaire

For data collection related to six selected projects, 100 questionnaires were distributed as follows: 6 projects were selected and sample was based on 40 employees of each company. 80 questionnaires out of 100 (80%) were received and data related to Company AA is as follows: 6 (15%) from owners, 34 (85%) from employees. Further categorizing employees, it is found that from Company AA out of 34, 5 (12.5%) employees belong to design department, 6 (15%) from human resource and rest were from project construction team. Percentages are shown in Figure 5-1:

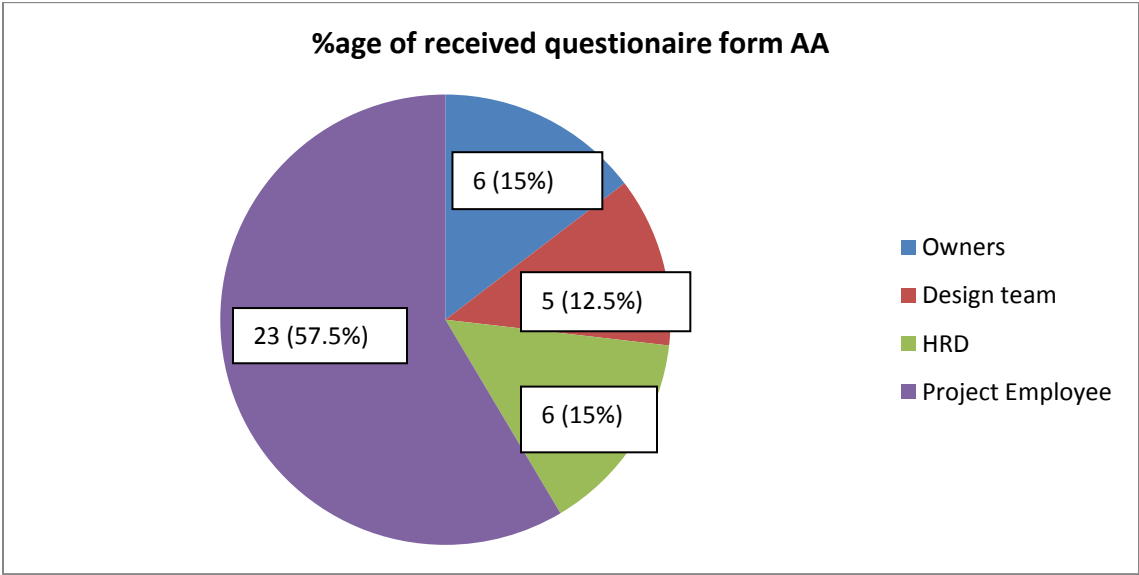


Figure 5-1: Pie Chart of questionnaire from Company AA

40 (80%) questionnaires out of 50 received were related to Company BB. Detail is as follows: 6 (15%) from owners, total of 34 (85%) from employees. Further through categorizing, employees found that from Company BB out of 34, 5 (12.5%) employees belong to design department, 8 (20%) from human resource and 21 (52.5%) were from construction project team.

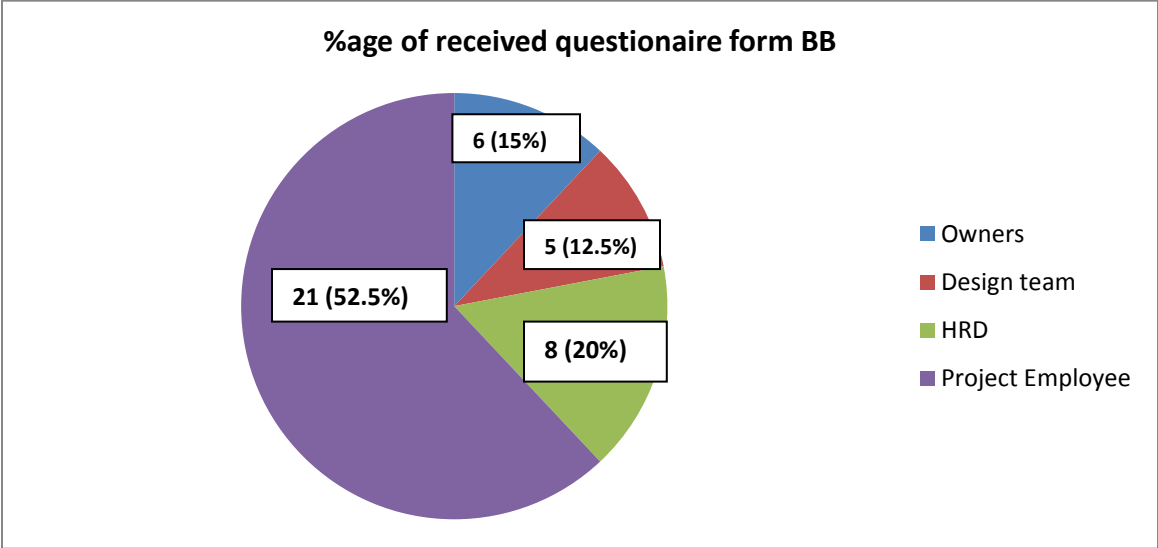


Figure 5-2: Pie Chart of questionnaire from Company BB

5.3. Data Analysis Method

In order to analyze the collected data in a symmetric manner, Statistical Package for the Social Sciences (SPSS) has been used. This software package is provided by International Business Machines (IBM). This package helps a lot in statistical analysis of data and to summarize it concisely. Version 21 of this software package has been used for the sake of current study. Descriptive statistical analysis method has been used in order to summarize the questionnaire results. Mean, Standard deviation, Percentage and frequency of each mark is calculated.

5.4. Evaluation of KPIs

5.4.1. Cost Performance Indicator

Six projects have been selected from Company AA and Company BB on the basis of their relevance in terms of type of construction and amount of contract and Data type is historical. This performance indicator describes the variance in project cost. The graphs used for benchmarking are produced below. Variance is calculated by using formula (CURT, 2005):

$$\frac{\text{Actual Cost} - \text{Estimated Cost}}{\text{Estimated Cost}} \times 100 = \text{Percentage of cost variance}$$

5.4.1.1. Construction Cost Variance

Table 5-2 shows six selected projects from both companies. Their actual cost incurred during construction and their estimated value at designing phase. Company AA project cost variance varies between 4.3% to 5.9% which show its expertise in the field of construction and management of resources. Despite of heavy pressure of global recession, Company AA did not let deviate its project cost from the estimated cost.

Table 5-2: Construction Cost Variance (Amounts KD: Millions)

Project #	Company AA Projects Value		Variance (%)	Company BB Projects Value		Variance (%)	Difference in Variances (%)
	Actual Cost	Estimated Cost		Actual Cost	Estimated Cost		
1	3.025	2.900	4.3	2.830	2.67	6.0	1.7
2	2.804	2.673	4.9	3.183	2.953	7.8	2.9
3	2.382	2.264	5.2	2.202	2.02	9.0	3.8
4	2.528	2.387	5.9	2.739	2.567	6.7	0.8
5	3.091	2.952	4.7	2.222	2.1	5.8	1.1
6	2.785	2.640	5.5	2.791	2.653	5.2	0.3

Company BB project cost variance deviate between 5.2 to 9.0 which is very high as compared to Company AA project cost variance. Further to this, data also shows that the cost management policies are not consistent and properly implemented which let the variance deviate too much.

5.4.1.2. Benchmarking with Company AA

Graph shows that Company AA has performed very well and maintained an acceptable level of variance in construction projects as compared to Company BB. For similar type of building projects and in similar economic conditions which means Company AA performed far better than Company BB. Company BB Cost performance indicator shows its incapability to manage its resources which is causing enhanced project cost.

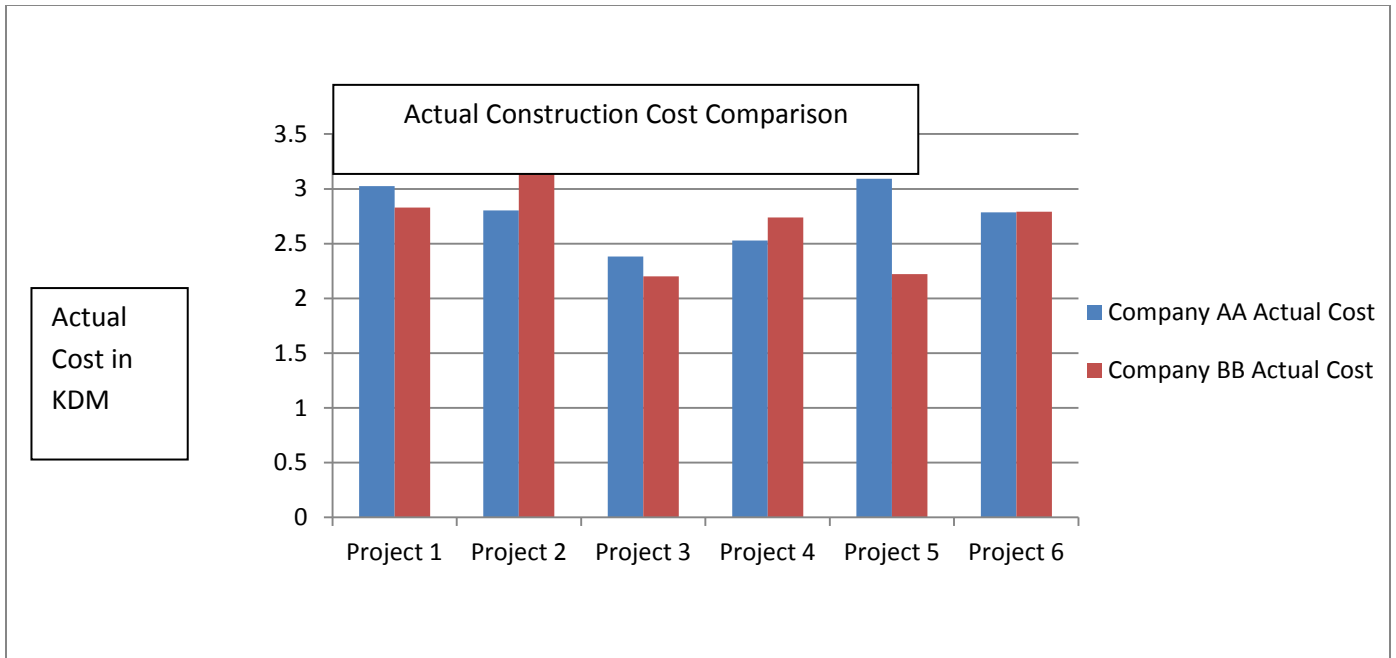


Figure 5-3: Actual Cost Comparison of 6 construction projects of both companies

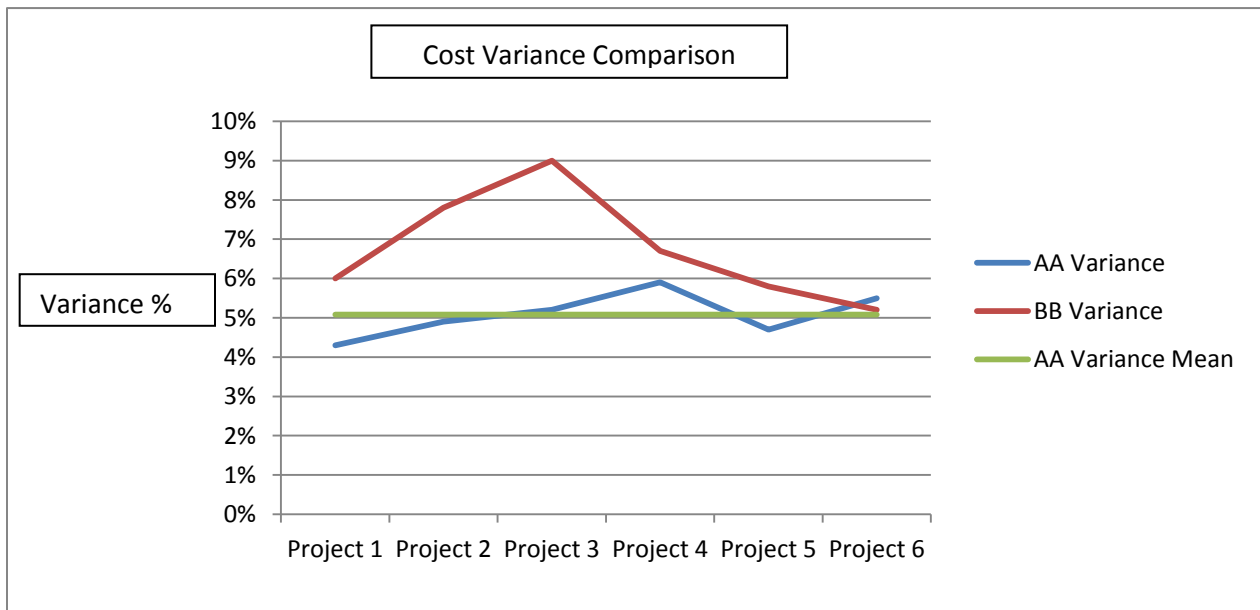


Figure 5-4: Cost variance comparison of both companies for benchmarking

Figure 5-4 demonstrates the variance of the 6 different projects completed by Company AA and Company BB. Mean of Variance of Company AA construction Projects is 5.083% and Standard deviation is .52% whereas Company BB's is 6.750% and 1.29%. Variances of both companies are plotted in the line graph. Company BB variance line intersects the Company AA project cost variance line at 5.4% which is a benchmark for Company BB. For maintaining standard in construction project, Company BB has to set its indicator for better performance between 5.08 to 5.4%

5.4.2. Construction Time Performance Indicator

For the purpose of calculating and benchmarking of this indicator, 100 projects were selected from each company. It was found that out of 100 Company AA completed 55 projects on time. In 14 projects, they completed the project before the scheduled time and in 31 projects contract were rescheduled due to non-completion of the contract assigned.

Company BB's data showed in 22 projects, job was done on time and 65 projects were completed after the revised construction time and in 13 projects Company BB succeeded to finish contract before time. Average Variance of time performance indicator of 31 projects was 8% which means Company AA were approximately 7 to 8 weeks were late than the revised construction time. However, Company BB data shows that out of 65 projects, Company BB was 10 to 12 weeks behind than the revised schedule.

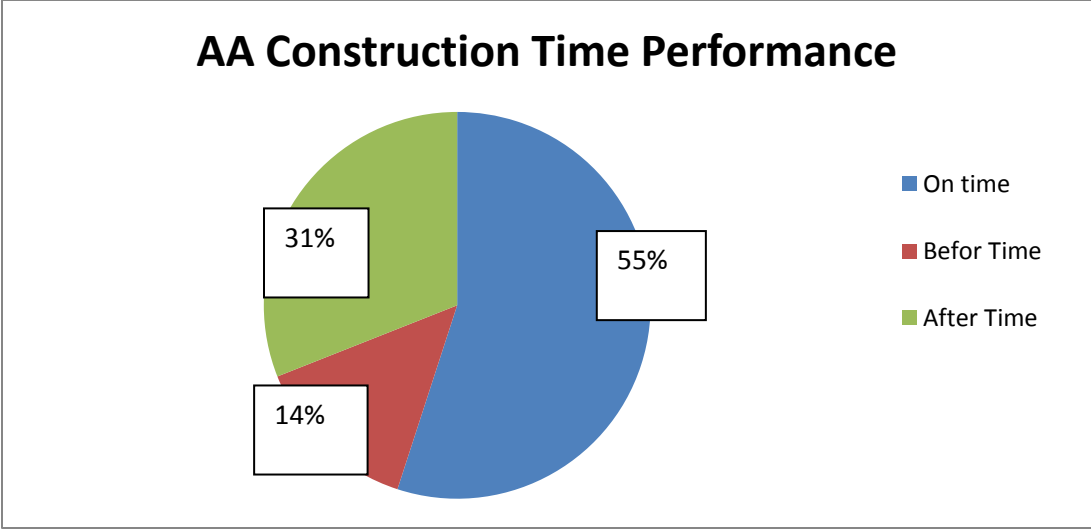


Figure 0-5: Time Management Performance of Company AA

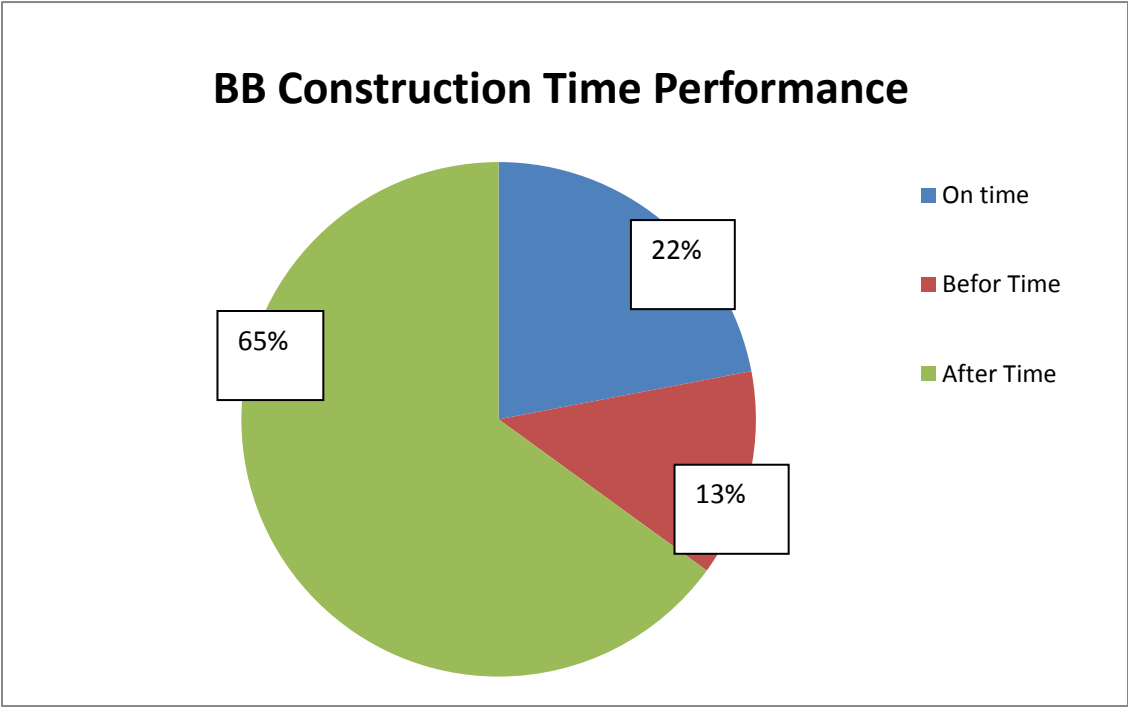


Figure 5-6: Time Management Performance of Company BB

5.4.2.1. Construction Time Variance

Following formula is used to calculate construction cost variance (CURT, 2005):

$$\frac{\text{Discounted construction time}}{\text{Revised construction time}} \times 100 = \% \text{ construction time variance}$$

Where discounted construction time = actual construction time - revised construction duration,
revised construction time = original construction duration (recorded in contract) + the extension
of time (granted by the owner).

Table 5-3 shows six selected projects from both companies. Their discounted construction time and revised construction time of construction. Company AA project construction time variance varies between 0 to 5.5%; this range shows that time management practices are dependent on many factors. Company AA has been able to mitigate risk involved in high construction time variance by adopting various time management policies and improved operational procedures. Standard deviation of Company AA construction time variance is .015 which is an indicator of Company AA employee's commitment to overcome the time constraints.

Table 5-3: Construction Time Variance (Duration in months)

Project	Company AA Time Variance			Company BB Time Variance			Difference in Variances (%)
	Discounted Construction on Time	Revised Construction on Time	Variance (%)	Discounted Construction on Time	Revised Construction on Time	Variance (%)	
1	0.97	39	2.5	2.87	41	7.0	4.5
2	3.96	72	5.5	4.28	75	5.7	0.2
3	0.49	14	3.5	0.69	16	4.3	0.8
4	0.00	13	0.0	1.00	15	6.7	6.7
5	0.91	26	3.5	0.99	26	3.8	0.3
6	0.70	26	2.7	0.81	27	3.0	0.3

Company BB project construction time variance deviates from 3% to 7.0% which is very high as compared to Company AA construction time variance. Data reveals that time management policies need to be revised from design phase to construction phase. Time calculation for the completion of each task to be calculated more accurately using operational management and also properly implement to reduce cost involved in delayed project completion.

5.4.2.2. Benchmarking with Company AA

Figure 5-7 demonstrates the actual construction time in months of six different projects completed by Company AA and Company BB. Data shows that Company AA has performed very well and maintained an acceptable level of time variance in construction projects as compared to Company BB. For similar type of building projects and in similar economic conditions, Company AA performed better than Company BB. Company BB time performance

indicator shows its incapability to manage its operations which is causing delayed project completion at higher cost.

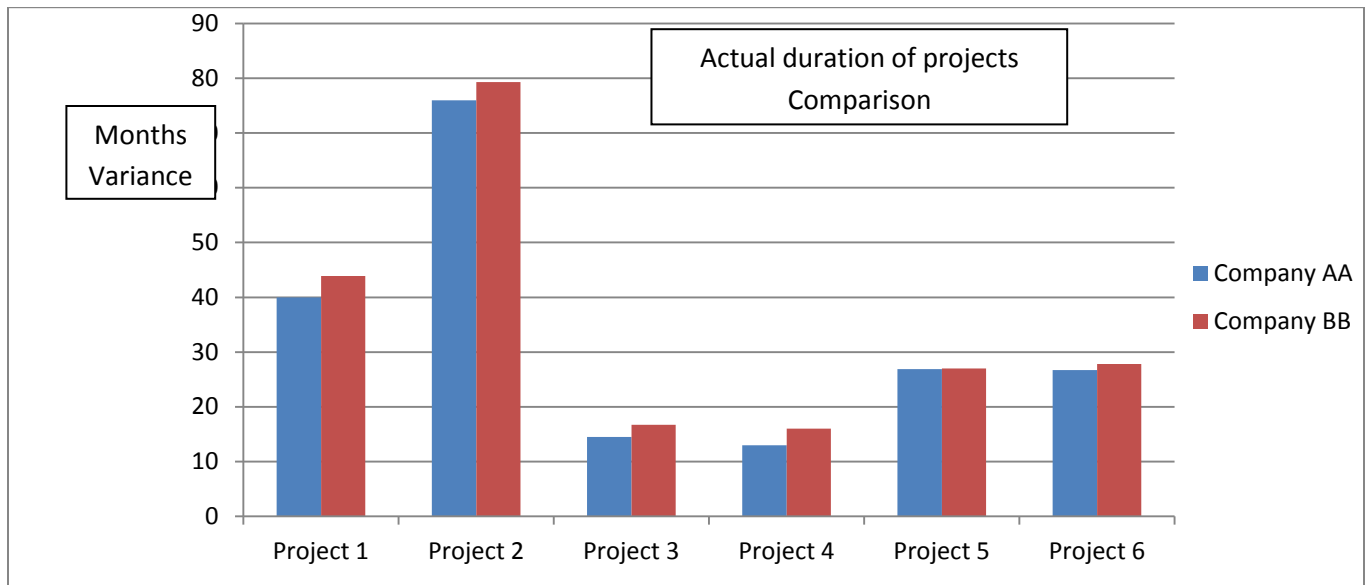


Figure 5-7: Actual Duration of Projects (in months) comparison of Company AA & Company BB



Figure 5-8: Comparison of Construction Time Variance

Figure 5-8 demonstrates the construction time variance comparison of 6 different projects completed by Company AA and Company BB. Mean of time variance of Company AA construction Projects is 3% and Standard deviation is 0.015 whereas Company BB's is 4% and .022. Variances of both companies are plotted in the line graph. Company BB variance line is always higher whereas Company AA has variance of 0% in project 4 which should be a benchmark for Company BB. For maintaining standard in construction project, Company BB has to set its indicator for better performance at 0% or maintain a negative time variance.

5.4.3. Customer Satisfaction on Products Indicator

Respondents were asked "Are you satisfied with the with the construction project". Responses are summarized in table 5-4. As it can be observed from the table, responses received from Company AA for setting benchmark, 62.5% of the respondents are "mostly satisfied" with the construction project where as 5.0% of the feedback received show that they are "mostly dissatisfied" with the project. Company BB respondents revealed that 22.5% are "mostly dissatisfied" with the project execution whereas only 35% are "mostly satisfied" with the project. Company AA has achieved higher level of satisfaction as compared to Company BB. 17.5 % respondents from Company AA and 27.5% respondents from Company BB are neither "Neither Satisfied nor Dissatisfied" from the construction project. Therefore, Company AA has total score of 155 whereas Company BB sum of scores is 129. Mean calculated for Company AA and Company BB is 3.88 and 3.23 respectively, that shows the higher level of satisfaction in Company AA and a little lower level of satisfaction by customers in Company BB. It indicates that Company AA got 155 score on Likert scale. Average score indicates that in Company AA respondent's tendency were close to "Mostly satisfied" whereas in Company BB mostly respondents were close to "neither Satisfied nor Dissatisfied".

Bar graphs show the frequency on Y-axis and responses on X-axis. There were not a single respondent in Company AA who marked “Totally Dissatisfied” whereas in Company BB there were 2 respondents who marked “Totally Dissatisfied”.

Table 5-4: Customer Satisfaction on Products

KPI-Customer Satisfaction on Products- Descriptive Statistics							Difference in percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.88	3.23	Frequency	Percent	Frequency	Percent	
Std. Deviation	.723	1.074					
Sum	155	129					
Totally Dissatisfied	0	0.0	2	5.0	5		
Mostly Dissatisfied	2	5.0	9	22.5	17.5		
Neither Satisfied Nor Dissatisfied	7	17.5	11	27.5	10		
Mostly Satisfied	25	62.5	14	35.0	27.5		
Totally Satisfied	6	15.0	4	10.0	5		
Total	40	100.0	40	100.0	0		

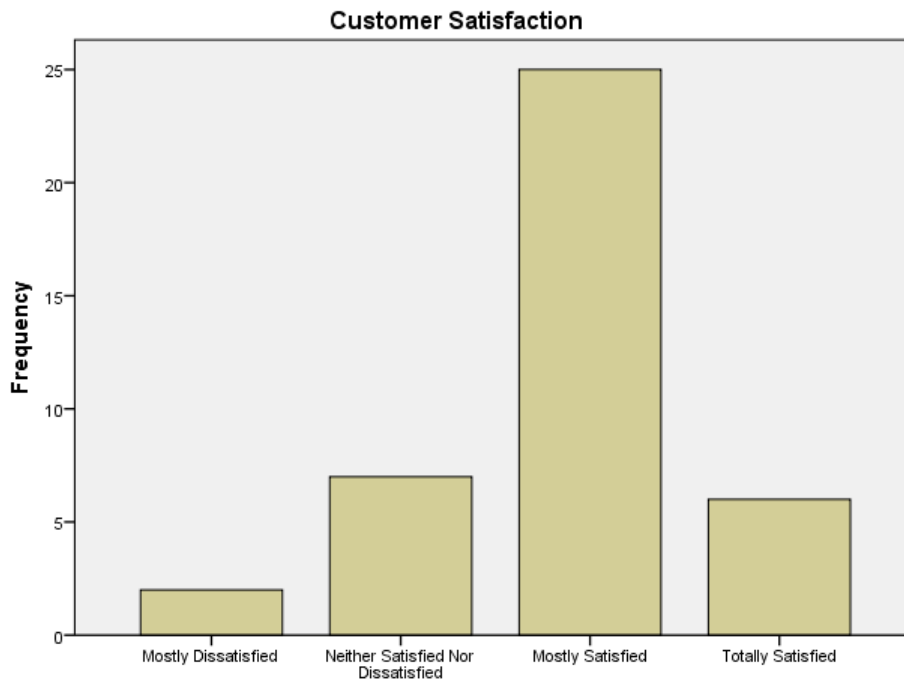


Figure 5-9: Company AA Customer Satisfaction

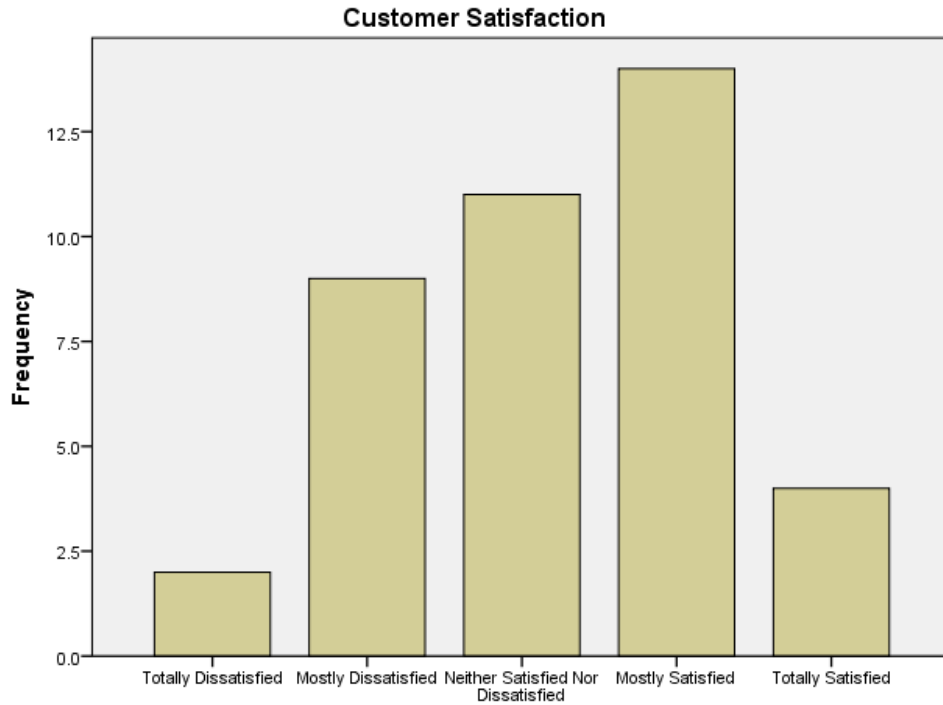


Figure 5-10: Company BB Customer satisfaction

5.4.4. Customer Satisfaction on Service Indicator

Respondents were asked “**Are you satisfied with the overall services offered by construction team**”? Responses are summarized in table 5-5. Responses received from Company AA demonstrate that 12.5% of the respondents are “mostly dissatisfied” with the construction services whereas 5.0% of the feedback received show that they are “totally dissatisfied”, 22.5% are neither “Neither Satisfied nor Dissatisfied”. Maximum percentage is for “Mostly satisfied” i.e. 40%. Company BB respondents revealed that 37.5% are “mostly dissatisfied” with the services whereas only 12.5% are “mostly satisfied” with the overall services of project and 7.5 were “totally satisfied”.

Graph 5-11 depicts that 16 respondents were “mostly satisfied” in Company AA and for Company BB it is 5. “Totally satisfied” in Company AA are 8 and in Company BB are 3.

Table 5-5: Customer Satisfaction on Service

KPI-Customer Satisfaction on Services-Descriptive Statistics						Difference in Percentages (%)
	Company AA		Company BB			
	Frequency	Percent	Frequency	Percent		
Totally Dissatisfied	2	5.0	8	20.0	15	
Mostly Dissatisfied	5	12.5	15	37.5	25	
Neither Satisfied Nor Dissatisfied	9	22.5	9	22.5	0	
Mostly Satisfied	16	40.0	5	12.5	27.5	
Totally Satisfied	8	20.0	3	7.5	12.5	
Total	40	100.0	40	100.0	0	

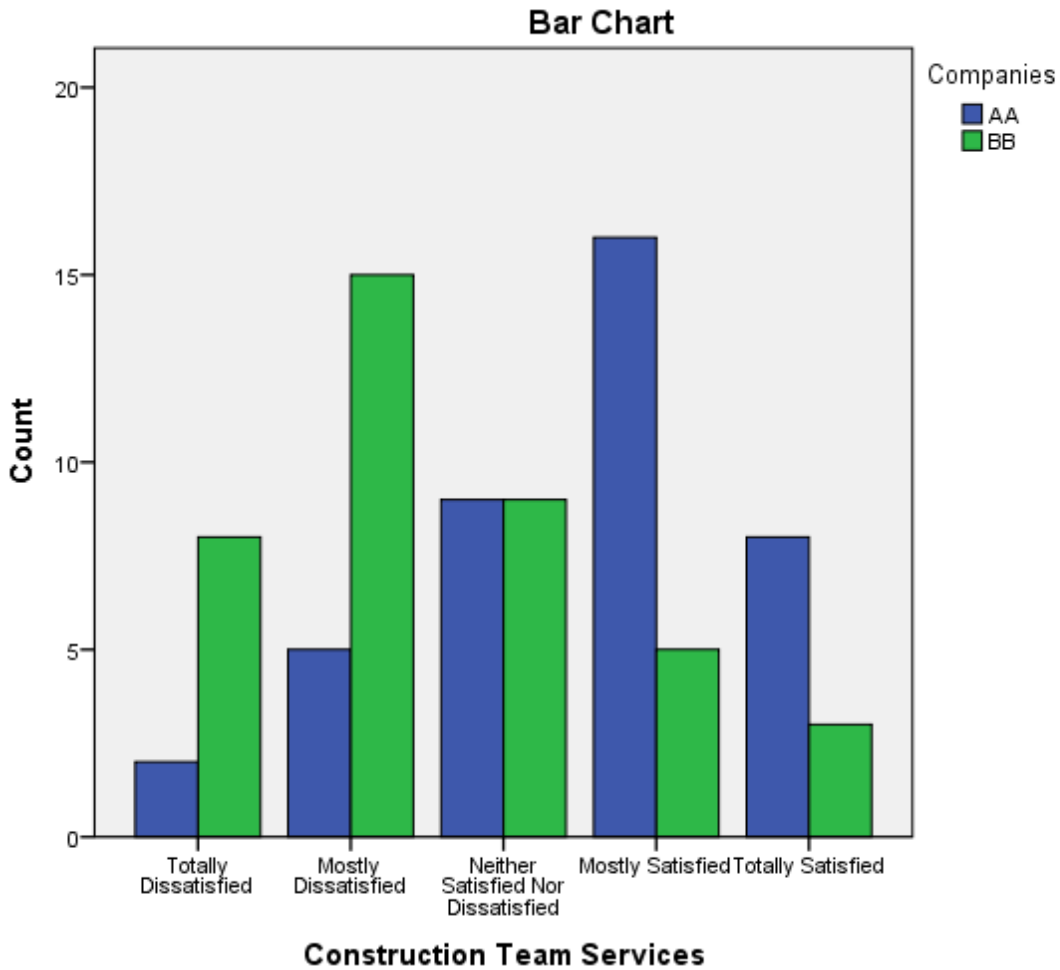


Figure 5-11: Construction Team Service

Respondents were asked “**Company completes the projects within the quoted price?**” Responses are summarized in table 5-6. Responses received from Company AA demonstrates that 32.5% of the respondents are “Disagree” with this statement. Whereas 22.5% of the feedback received show that they are “strongly Disagree” with the statement, 17.5% are “indifferent”. Percentage for “totally agree” i.e. 10. Company BB respondents revealed that 35% are “disagree” whereas only 7.5% are “mostly satisfied” with the services and 35 were “totally dissatisfied” with Company BB’s capability to remain within the quoted price. Graph 5-12 depicts that 7 respondents are “agree” in Company AA and for Company BB the number of “agree” respondent with the statement is 3. 8 in Company AA and 3 in Company BB are in strong agreement with the statement.

Table 5-6: Customer Satisfaction Price Estimation

KPI-Customer Satisfaction Price Estimation -Descriptive Statistics					Difference in Percentages (%)	
		Company AA		Company BB		
		Frequency	Percent	Frequency	Percent	
	Strongly Disagree	9	22.5	14	35.0	12.5
	Disagree	13	32.5	17	42.5	10
	Indifferent	7	17.5	3	7.5	10
	Agree	7	17.5	3	7.5	10
	Strongly Agree	4	10.0	3	7.5	2.5
	Total	40	100.0	40	100.0	0

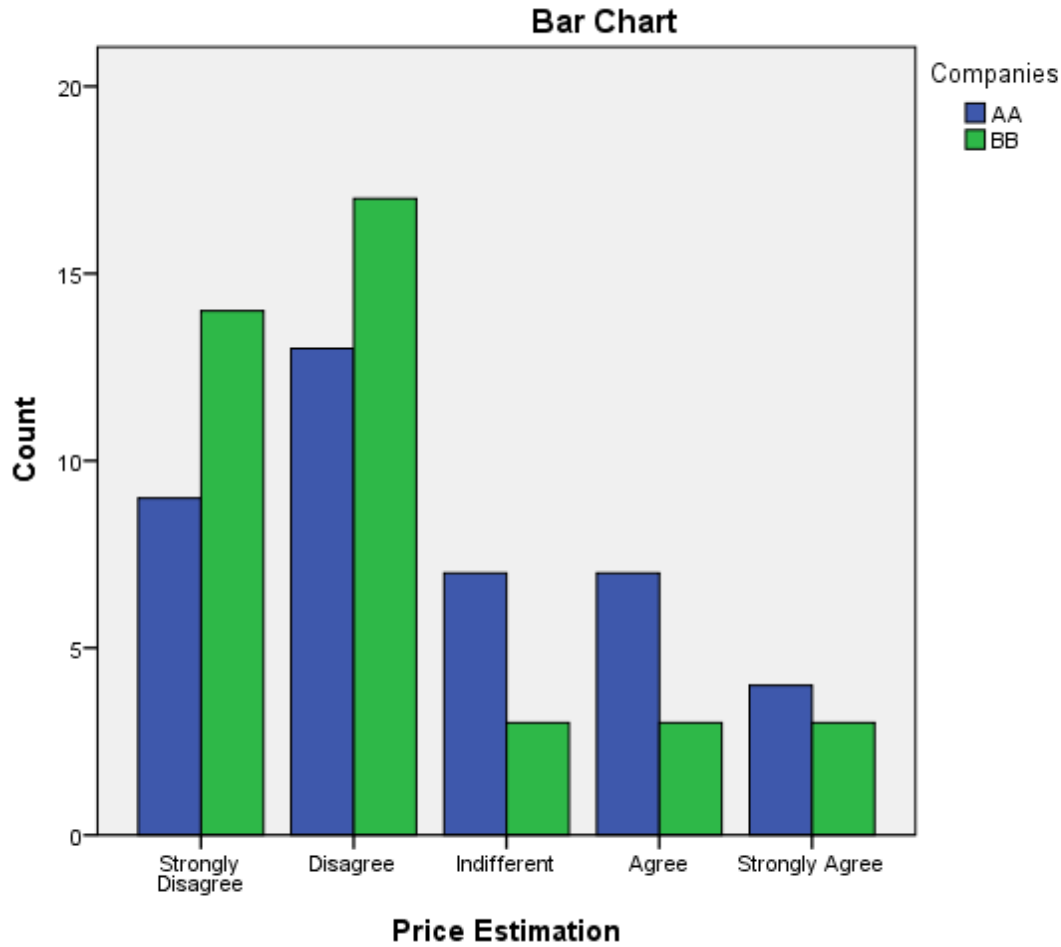


Figure 5-12: Price Estimation

Respondents were asked “**Company completes the projects within the stipulated time**”? Responses are summarized in table 5-7. Responses received from Company AA demonstrates that 25% of the respondents are in “disagreement” with the Company AA capability to manage price variance. Whereas 7.5% of the feedback received show that they “strongly disagree” with the statement, 27.5% are “indifferent”. Percentage for “strongly agree” is 25. Company BB respondents revealed that 35% “disagree” whereas only 25% are “agree” with the statement and 35% are in strong agreement about Company BB’ capability to keep to manage time variance. Graph 5-13 depicts that 10 respondents “agree” for Company AA and for Company BB the

number of respondents who marked “agree” is also 10. 6 in Company AA and 1 in Company BB are in strong agreement with the statement.

Table 5-7: Customer Satisfaction Time Estimation

KPI-Customer Satisfaction Time Estimation-Descriptive Statistics						Difference in Percentages (%)
		Company AA		Company BB		
		Frequency	Percent	Frequency	Percent	
	Strongly Disagree	3	7.5	14	35.0	27.5
	Disagree	10	25.0	14	35.0	10
	Indifferent	11	27.5	1	2.5	25.0
	Agree	10	25.0	10	25.0	0
	Strongly Agree	6	15.0	1	2.5	12.5
	Total		40	100.0	40	100.0

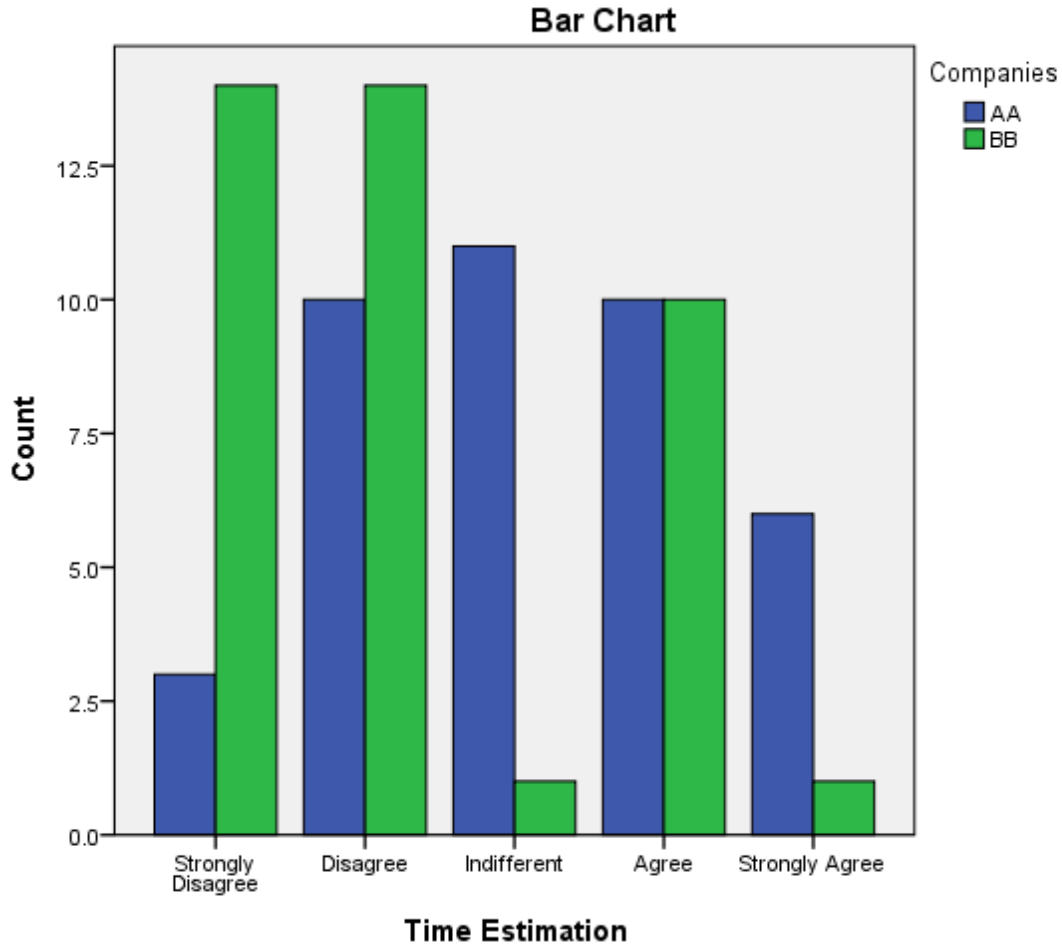


Figure 5-13: Time Estimation

Respondents were asked “**Management is fully capable of delivering the quality projects?**” Responses are summarized in table 5-8. Responses received from Company AA demonstrates that 60% of the respondents “Agree” with the statement whereas 22.5% of the feedback received show that they “strongly agree” with the statement, 17.5% are “indifferent”. Percentage of respondents who “strongly disagree” and “disagree is zero. Company BB respondents revealed that 35% are in “disagreement” whereas only 25% are “agree” with the statement and 2.5 are “Indifferent” about Company BB’ capability to deliver quality project. Figure 5-14 depict that 24 respondents were “agree” in Company AA and for Company BB, the number of “agree” respondent is 7. 9 in Company AA and 3 in Company BB are in strong agreement with the statement.

Table 5-8: Customer Satisfaction Project Quality

KPI-Customer Satisfaction Project Quality-Descriptive Statistics					Difference in Percentages (%)
	Company AA		Company BB		
	Frequency	Percent	Frequency	Percent	
Strongly Disagree	0	0.0	7	35.0	35
Disagree	0	0.0	13	35.0	35
Indifferent	7	17.5	10	2.5	15
Agree	24	60.0	7	25.0	35
Strongly Agree	9	22.5	3	2.5	20
Total	40	100.0	40	100.0	0

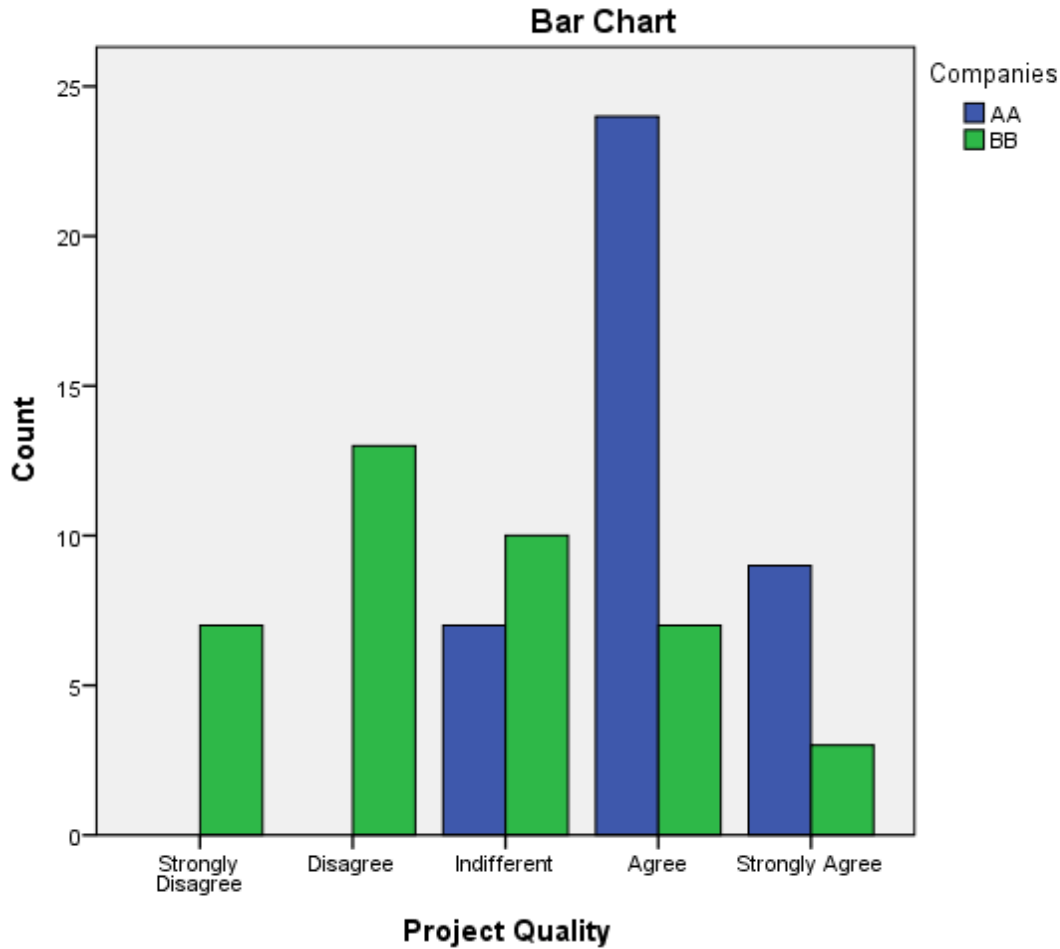


Figure 5-14: Project Quality

Respondents were asked “**Management is fully capable of resolving any defects?**” Responses are summarized in table 5-9. Responses received from Company AA demonstrates that 27.5% of the respondents “disagree” with the statement whereas 15% of the feedback received show that they “strongly disagree” with the statement, 32.5% demonstrated “indifferent” behaviour. Percentage of respondents who are in “strongly agreement” with the statement is 10. Company BB respondents revealed that 40% “disagree” whereas only 15% are “agree” with the statement and 35% are “strongly disagree” with Company BB’ capability of resolving of any defects. Figures 5-15 depict that 6 respondents from Company AA “agree” and in Company BB the

number of “agree” respondent with the statement is also 6. “strongly agreed” respondents in Company AA is 4 and in Company BB is 2.

Table 5-9: Customer satisfaction Defect Resolution

KPI-Customer satisfaction Defect Resolution-Descriptive Statistics					Difference in Percentages (%)
	Company AA		Company BB		
	Frequency	Percent	Frequency	Percent	
Strongly Disagree	6	15.0	14	35.0	20
Disagree	11	27.5	16	40.0	12.5
Indifferent	13	32.5	2	5.0	27.5
Agree	6	15.0	6	15.0	0
Strongly Agree	4	10.0	2	5.0	5
Total	40	100.0	40	100.0	0

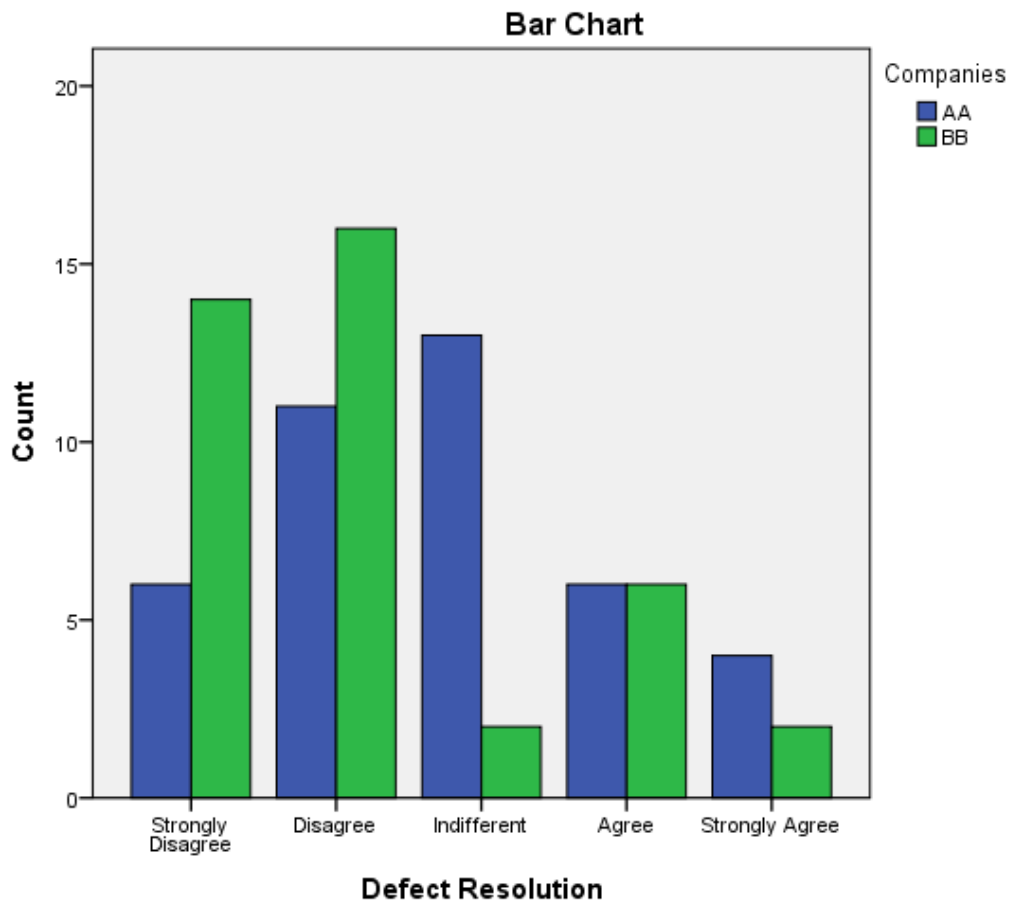


Figure 5-15: Defect Resolution

Table 5-10: Customer Satisfaction on Services Indicator

Statistics of Customer Satisfaction on Services Indicator-Descriptive Statistics						
		Customer Satisfaction	Price Estimation	Time Estimation	Quality Projects	Defects Resolution
Company AA	Mean	3.58	2.50	3.15	4.05	2.78
	Std.Deviation	1.107	1.155	1.189	.639	1.187
	Sum	143	100	126	162	111
Company BB	Mean	2.50	2.10	2.25	2.65	2.15
	Std.Deviation	1.177	1.194	1.256	1.189	1.210
	Sum	100	84	90	106	86
Difference in Std.Deviation		0.07	0.039	0.067	0.55	0.023

Table 5-10 indicates that Likert score against different questions asked from respondents. Data indicates that in average, about Company AA indicator of customer satisfaction respondent's tendency is towards "mostly satisfied" for price estimation it is towards "indifferent" about time estimation it is "indifferent" for quality projects it is "satisfied" and for defect resolution it is "indifferent. In Company BB about customer satisfaction respondent's tendency is towards "Neither satisfied nor dissatisfied" for price estimation it is towards "disagree" about time estimation it is "disagree" for quality projects it is "indifferent" and for defect resolution it is "disagree".

5.4.4. Change Management Indicator

Respondents were asked “**What do you feel about the performance of management in relation to managing “change”?**” Responses are summarized in table 5-11. Responses received from Company AA demonstrate that 0% of the respondents perceived that management showed “Very Bad performance” with respect to managing changes whereas 5% of the feedback received show that management showed “Bad Performance”. 27.5% were declared that management is “Average” in managing changes. 35% perceived management showed “Good Performance” and 32.5% perceived as “Very Good Performance”. Company BB respondents demonstrate that 5% of the respondents perceived that management showed “Very Bad Performance” with respect to managing changes whereas 22.5% of the feedback received show that management showed “Bad Performance”. 27.5% were declared that management is “Average” in managing changes. 35% perceived management showed “Good Performance” and 10% perceived as “Very Good Performance”. Company AA has total score of 158 whereas Company BB sum of scores is 129. Mean calculated for Company AA and Company BB is 3.95 and 3.23 indicating that on Likert scale respondents are on “Good Performance” in Company AA whereas in Company BB their tendency in average is towards “Average”.

Figure 5-16 depicts that 11 respondents declared management performance as “Average” in Company AA and also depicts that in Company BB 11 respondents marked “Average” that is an equal result. In Company AA 13 and on Company BB 4 respondents marked “Very Good Performance”.

Table 5-11: Change Management

KPI-Change Management-Descriptive Statistics							Differences in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.95	3.23	Frequency	Percent	Frequency	Percent	
Std. Deviation	.904	1.074					
Sum	158	129					
Very Bad Performance			0	0.0	2	5.0	5
Bad Performance			2	5.0	9	22.5	17.5
Average			11	27.5	11	27.5	0
Good Performance			14	35.0	14	35.0	0
Very Good Performance			13	32.5	4	10.0	22.5
Total			40	100.0	40	100.0	0

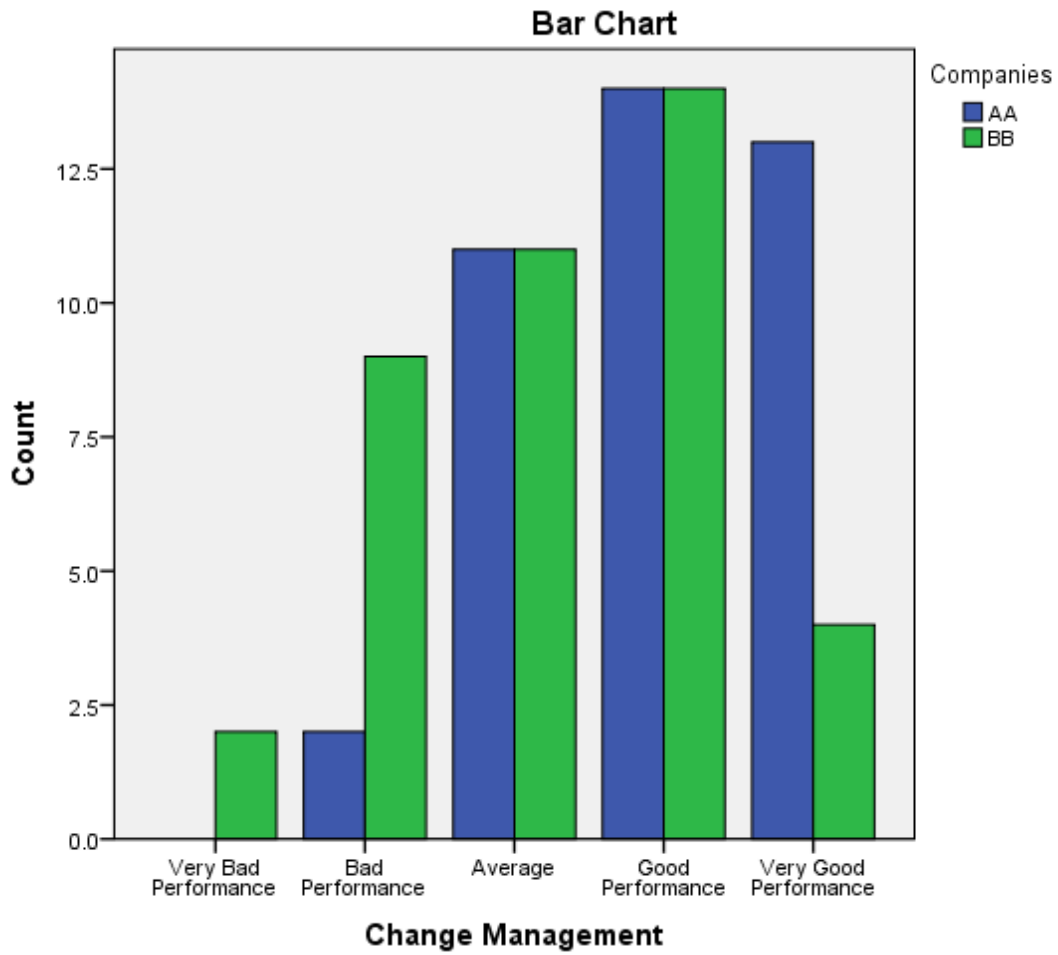


Figure 5-16: Change Management

5.4.4.1. Unapproved Change-Order Management Performance

Following formula is used to calculate the percentage of margin at risk when project owners demand changes in construction design after the giving first requirements. Changes may be demanded during construction phase or design phase. These unapproved changes raises constructor's cost and reduces forecasted profit margin. Formula of percentage of margin at risk is (CURT, 2005):

$$\frac{\textit{Sum of Costs incurred on unapproved orders}}{\textit{Total forcasted gross margin}} * 100 = \% \textit{ of Marginat Risk}$$

This formula gives the percentage of that portion of gross margin, company have to forgo in the process of incorporating unapproved order. Six projects have been selected form Company AA and Company BB on the basis of their relevance in term of type of construction and amount of contract. Data type is historical. Percentage of margin is calculated according to the formula mentioned above. This performance indicator describes the variance in gross margin. The graphs used for benchmarking are produced below.

5.4.4.2. Cost of Unapproved Order in Company AA and Company BB

Table 10 shows six selected projects form both companies. Their sum of cost incurred on unapproved order and their estimated total gross margin. Company AA project percentage of margin at risk varies between 1.0% to 3.9% which shows its expertise in the field of construction, incorporating change and dynamic procedures. Despite of heavy pressure of global recession and project owner's demands for changes Company AA did not let decline its profit margins.

Company BB projects' percentage of margin at risk ranges from 3.1 to 5.2, which is very high as compared to Company AA percentage of margin at risk. Further to this, data also shows that the management policies are not consistent and properly implemented which let the profit decline.

Table 5-12: Margin at Risk (Amounts KD: Millions)

Projects	Company AA			Company BB			Difference in Percentages (%)
	Sum of Cost Incurred on unapproved Order	Total forecasted gross margin	% of Margin at Risk	Sum of Cost Incurred on unapproved Order	Total forecasted gross margin	% of Margin at Risk	
1	0.003	0.290	1.034	0.009	0.214	4.100	3.066
2	0.006	0.267	2.245	0.007	0.236	3.100	0.855
3	0.009	0.226	3.975	0.003	0.162	2.100	1.875
4	0.008	0.239	3.351	0.007	0.205	3.500	0.149
5	0.005	0.295	1.694	0.008	0.168	5.010	3.316
6	0.006	0.264	2.273	0.009	0.212	4.200	1.927

5.4.4.3. Benchmarking of Unapproved Order Management with Company AA

Figure 5-17 shows that Company AA has performed very well and maintained an acceptable level of sum of cost incurred on unapproved order during construction projects as compared to Company BB. For similar type of building projects and; in similar economic conditions, Company AA performed better than Company BB. Company BB change order management performance shows its incapability to manage its resources which is causing enhanced project cost.

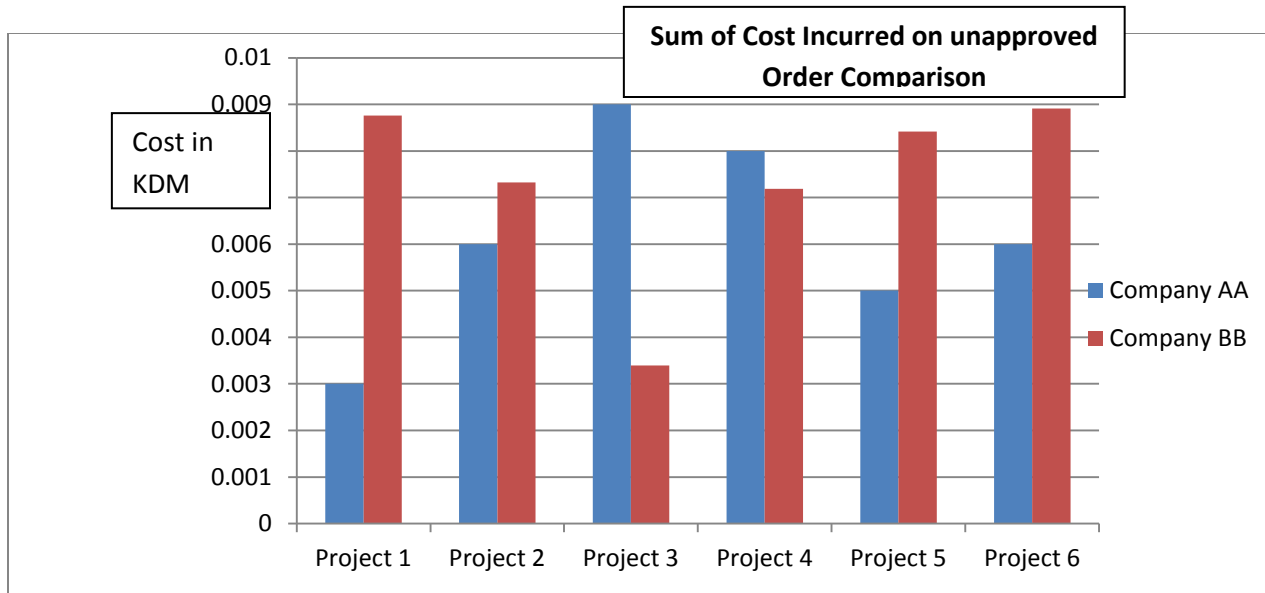


Figure 5-17: Sum of Cost Incurred on unapproved Order (KDM)

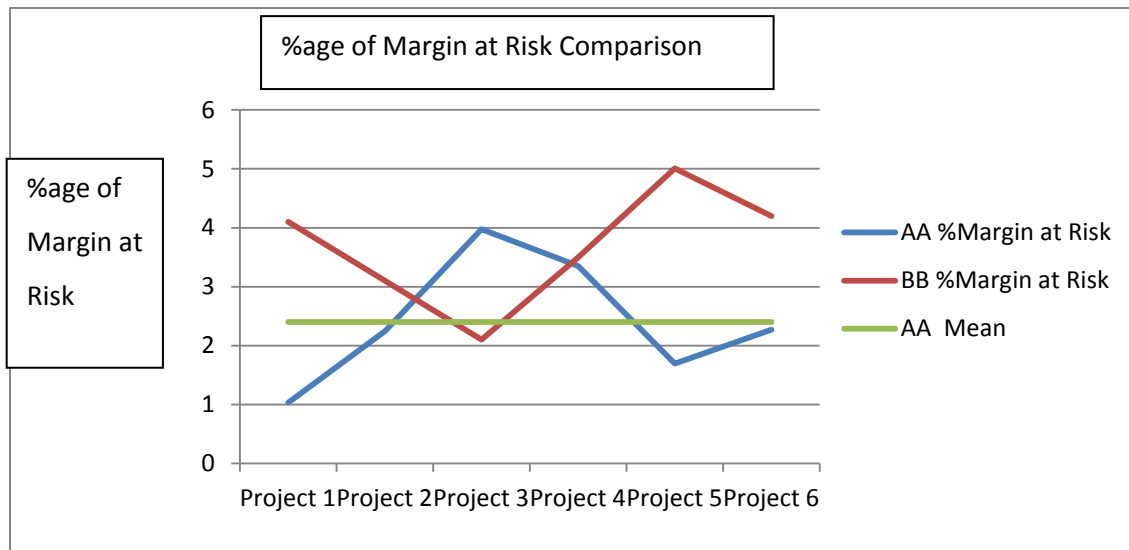


Figure 5-18: Cost variance comparison of both companies for benchmarking

Figure 5-18 demonstrates the percentage of margin at risk of the 6 different projects completed by Company AA and Company BB. Mean of percentage of margin at risk of Company AA construction Projects is 2.4% and Company BB's is 4.2%. Percentages of margin at risk of both companies are plotted in the line graph. Company BB line intersects the Company AA line at 2.8% which is a benchmark for Company BB. For maintaining standard in construction project Company BB has to set its indicator for better performance and reducing unapproved change order cost.

5.4.5. The Project Team Performance Indicator

Respondents were asked **“What do you feel about the performance of Project team?”** Responses are summarized in the table 5-13. Responses received from Company AA demonstrate that 2.5% of the respondents perceived that project teams showed “very bad performance” whereas 7.5% of the feedback received show that project teams showed “bad performance”. 27.5% were declared that performance of the teams is “Average”. 40% perceived teams showed “Good Performance” and 22.5% perceived as “Very Good Performance”.

Company BB respondents demonstrate that 22.5% of the respondents perceived that teams showed “Very Bad Performance” whereas 27.5% of the feedback received show that declared performance as “Bad Performance”. 15% declared that teams are “Average”. 17.5% perceived teams showed “Good Performance” and 17.5% perceived as “Very Good Performance”.

Company AA has total score of 158 whereas Company BB sum of scores is 112. Mean calculated for Company AA and Company BB is 3.95 and 2.80 and standard deviation is 0.904 and 1.436 respectively.

On Likert score scale in average Company AA respondents believe that management performance is “Good” whereas in Company BB they perceive it as “Average”.

Figure 5-19 depicts that 11 respondents declared management performance as “Average” in Company AA and in Company BB 6 respondents marked “Average” according to Figure 5-20. In Company AA 9 and in Company BB 7 respondents marked “Very Good Performance”.

Table 5-13: Project Team Performance

KPI Project Team Performance-Descriptive Statistics							Difference in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.95	2.80	Frequency	Percent	Frequency	Percent	
Std. Deviation	0.904	1.436					
Sum	158	112					
	Very Bad Performance	1	2.5	9	22.5	20.0	
	Bad Performance	3	7.5	11	27.5	20.0	
	Average	11	27.5	6	15.0	12.5	
	Good Performance	16	40.0	7	17.5	22.5	
	Very Good Performance	9	22.5	7	17.5	5.0	
	Total	40	100.0	40	100.0	0	

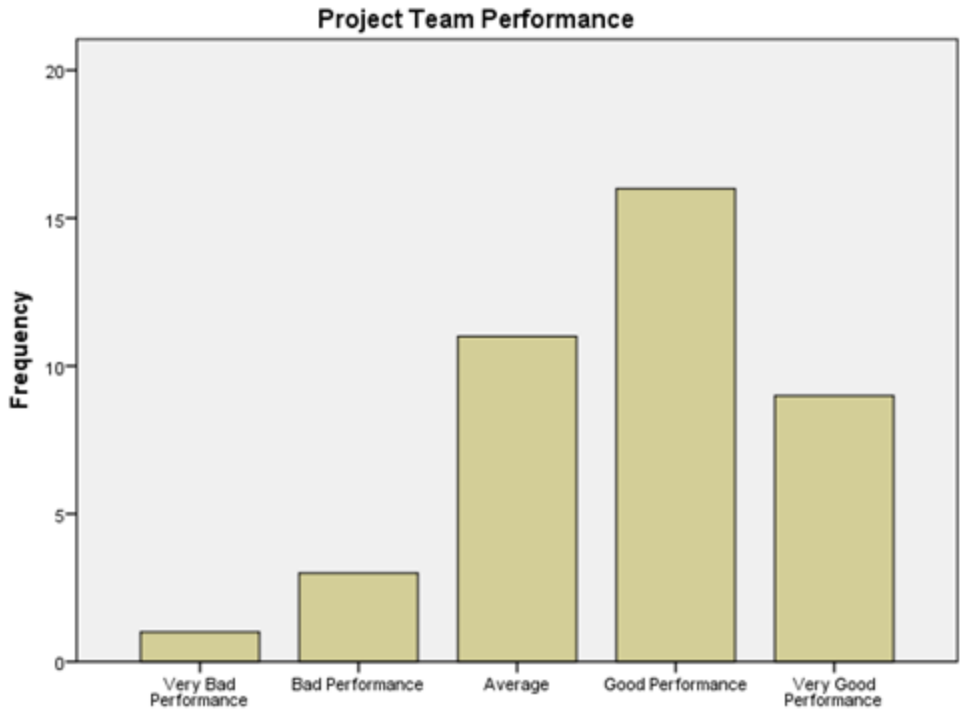


Figure 5-19: Company AA Project Team Performance



Figure 5-20: Company BB Project Team Performance

5.4.5.1. Impact on Biodiversity Indicator- during construction process

Respondents were asked “**What level of consideration company has taken about bio-diversity during construction process?**” Responses are summarized in table 5-14. Responses received from Company AA demonstrate that 0% of the respondents perceived that management has “No control” with respect to managing **bio-diversity impacts**. 2.5% of the feedback received show that management has “Little Control”. 27.5% were declared that management has “Fair Control” in managing changes. 40% perceived management have “Good Control and 30% perceived of having “Very Effective Control”.

Responses received from Company BB demonstrate that 7.5% of the respondents perceived that management have “No control” with respect to managing bio-diversity impacts. 22.5% of the feedback received show that management has “Little Control”. 42.5% were declared that management has “Fair Control” in managing changes. 10% perceived management have “Good Control and 17.5% perceived of having “Very Effective Control”. Company AA has total score of 159 whereas Company BB sum of scores is 123. Mean calculated for Company AA and Company BB is 3.98 and 3.08 Indicating on Likert scale in average respondents believe that Company AA has “Good control” whereas for Company BB they believe that management has “Fair Control”.

Figure 5-21 depicts that 11 respondents declared management have “Fair Control” in Company AA and in Company BB 17 respondents marked “Fair Control”. In Company AA 16 and in Company BB 4 respondents marked “Good Control”. 12 and 7 marked “Very Effective Control” in Company AA and Company BB respectively.

Table 5-14: Bio Diversity Impact during Construction

KPI-Bio Diversity Impact during Construction-Descriptive Statistics							Difference in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.98	3.08	Frequency	Percent	Frequency	Percent	
Std. Deviation	.832	1.163					
Sum	159	123					
	No Control		0	0.0	3	7.5	7.5
	Little Control		1	2.5	9	22.5	20.0
	Fair Control		11	27.5	17	42.5	15.0
	Good Control		16	40.0	4	10.0	30.0
	Very Effective Control		12	30.0	7	17.5	12.5
	Total		40	100.0	40	100.0	0

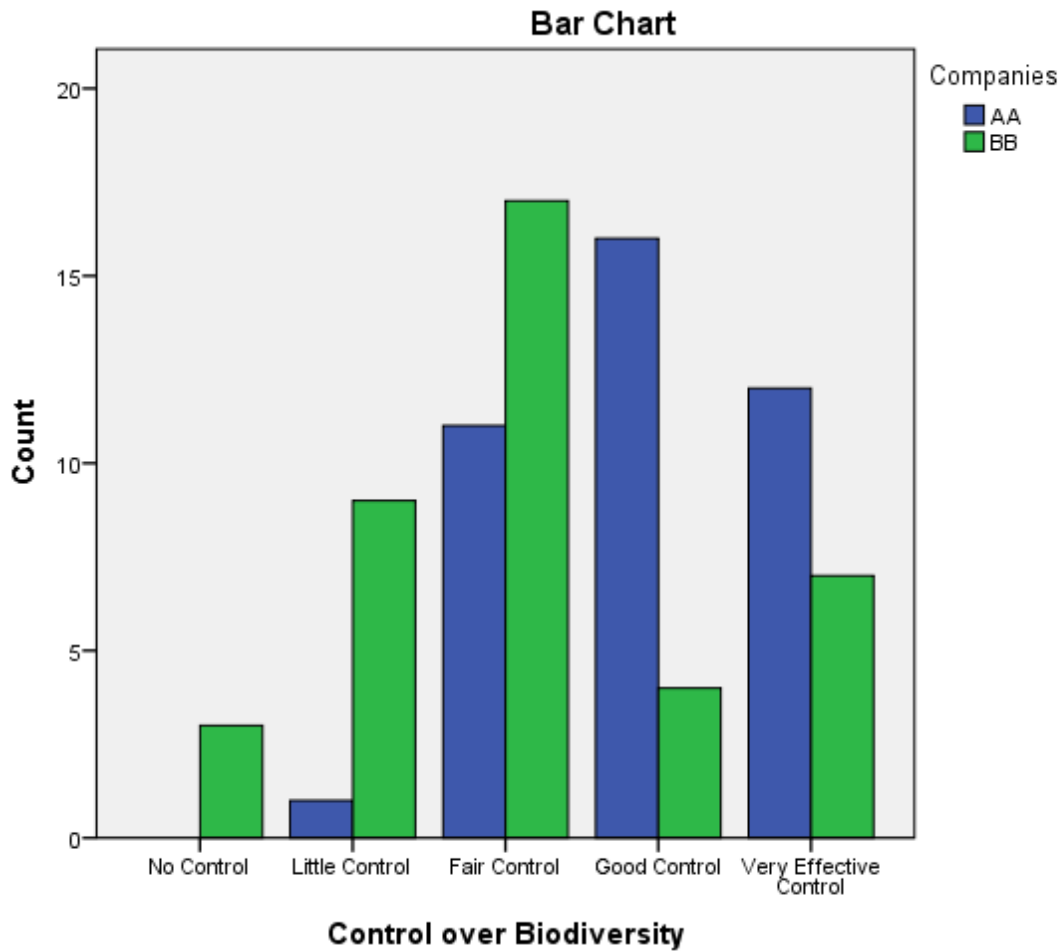


Figure 5-21: Control over Biodiversity

5.4.5.2. Impact on Biodiversity Indicator- Product

Respondents were asked “**What level of consideration company has taken about bio-diversity impacts of buildings?**” “Responses received from Company AA demonstrate that 2.5% of the respondents perceived that management have “No Consideration” with respect to managing **bio-diversity impacts**. **10%** of the feedback received show that management took “Some Consideration”. 22.5% were declared that management took “Fair Consideration” in managing changes. 45% perceived management took “Good level of Consideration” and 20% perceived of taking “Thorough Consideration”.

Responses received from Company BB demonstrate that 7.5% of the respondents perceived that management have “No Consideration” with respect to managing **bio-diversity impacts**. **22.5%** of the feedback received show that management took “Some Consideration”. 37.5% was declared that management took “Fair Consideration” in managing changes. 20% perceived management took “Good level of Consideration” and 12.5% perceived of taking “Thorough Consideration”.

Company AA has total score of 148 whereas Company BB sum of scores is 123. Mean calculated for Company AA and Company BB is 3.70 and 3.08 indicating on average Company AA’s respondents believe that management take “Good level of Consideration” whereas for Company BB respondent thinks that management take “Fair Consideration” about bio-diversity impacts of buildings.

Figure 5-22 depicts that 9 respondents declared management took “Fair Consideration” in Company AA and in Company BB 15 respondents marked “Fair Consideration”. In Company AA 18 and in Company BB 8 respondents marked “Good Level of Consideration”. 8 and 5 marked “Thorough Consideration” in Company AA and Company BB respectively.

Table 5-15: Bio Diversity Impact of Product

KPI-Bio Diversity Impact of Product-Descriptive Statistics							Difference in Percentages (%)
		Company AA		Company BB			
		Frequency	Percent	Frequency	Percent		
Mean	3.70	3.08					
St. Deviation	.992	1.118					
Sum	148	123					
	No Consideration	1	2.5	3	7.5	5.0	
	Some Consideration	4	10.0	9	22.5	12.5	
	Fair Consideration	9	22.5	15	37.5	15.0	
	Good Level of Consideration	18	45.0	8	20.0	25.0	
	Thorough Consideration	8	20.0	5	12.5	7.5	
	Total	40	100.0	40	100.0	0	

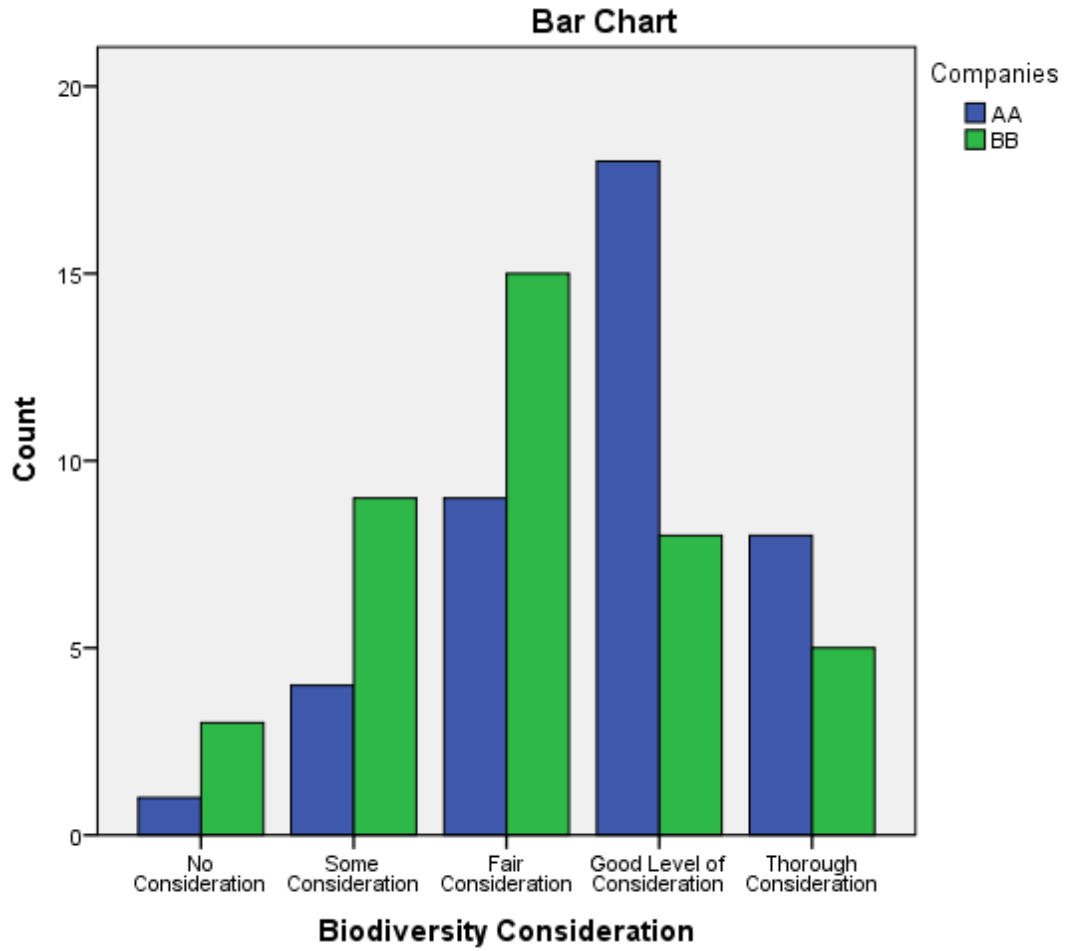


Figure 5-22: Biodiversity Consideration

5.4.6. Design Quality Indicator

Respondents were asked “Company Projects provide easy accommodation according to the users’ requirements?” Responses received from Company AA demonstrates that 17.5% of the respondents “disagree” on the statement whereas 22.5% of the feedback received show that they “agree” with the design feature. 12.5% are “indifferent”. Percentage for “strongly disagree” is 2.5 and “strongly agree” is 45%. Company BB respondents revealed that 17.5% are in “disagreement” whereas only 30% are “agree” with the statement and 12.5 are “indifferent” with Company BB’s capability of providing easy accommodation according to the user requirements. Graph 5-23 depicts that 9 respondents were “agree” with the statement in Company AA and for Company BB the number of “agree” respondent is 12. 18 in Company AA and 9 in Company BB marked “strongly agreed”.

Table 5-16: Easy Accommodation

DQI-Easy Accommodation-Descriptive Statistics						Difference in Percentages (%)
		Company AA		Company BB		
		Frequency	Percent	Frequency	Percent	
	Strongly Disagree	1	2.5	7	17.5	15.0
	Disagree	7	17.5	7	17.5	0
	Indifferent	5	12.5	5	12.5	0
	Agree	9	22.5	12	30.0	7.5
	Strongly Agree	18	45.0	9	22.5	22.5
	Total	40	100.0	40	100.0	0

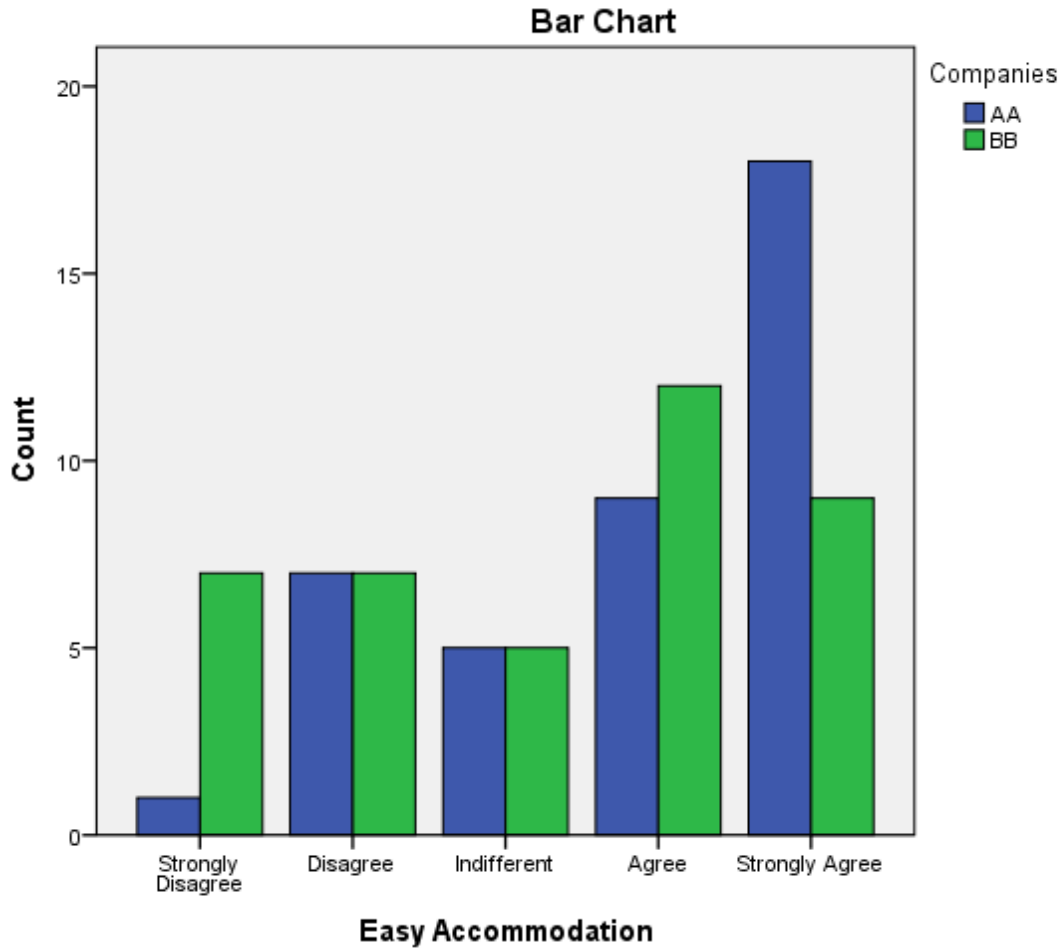


Figure 5-23: Easy Accommodation

Respondents were asked “**Company Projects provide versatile (multipurpose) lighting for meeting users’ needs**”? Responses received from Company AA demonstrate that 22.5% of the respondents “disagree” with the versatility of lighting facility offered in construction projects by Company AA whereas 20.0% of the feedback received show that they are in “strong agreement with the statement. 17.5% are “indifferent”. Percentage for “strongly disagree” is 7.5 and “disagree” is 22.5. Company BB data revealed that 30% respondents were “disagree” whereas only 25% were “agree” with the services and 17.5 are “indifferent” with Company BB’ capability of versatile lighting according to the user requirements. Graph 5-24 depict that 13 respondents “agree” for Company AA and for Company BB the number of respondent who

marked “agree” is 10. For both Company AA and Company BB, 8 respondents each marked “strongly agree”.

Table 5-17: Lighting Versatility

DQI-Lighting Versatility-Descriptive Statistics						Difference in Percentages (%)
		Company AA		Company BB		
		Frequency	Percent	Frequency	Percent	
	Strongly Disagree	3	7.5	3	7.5	0
	Disagree	9	22.5	12	30.0	7.5
	Indifferent	7	17.5	7	17.5	0
	Agree	13	32.5	10	25.0	7.5
	Strongly Agree	8	20.0	8	20.0	0
	Total	40	100.0	40	100.0	0

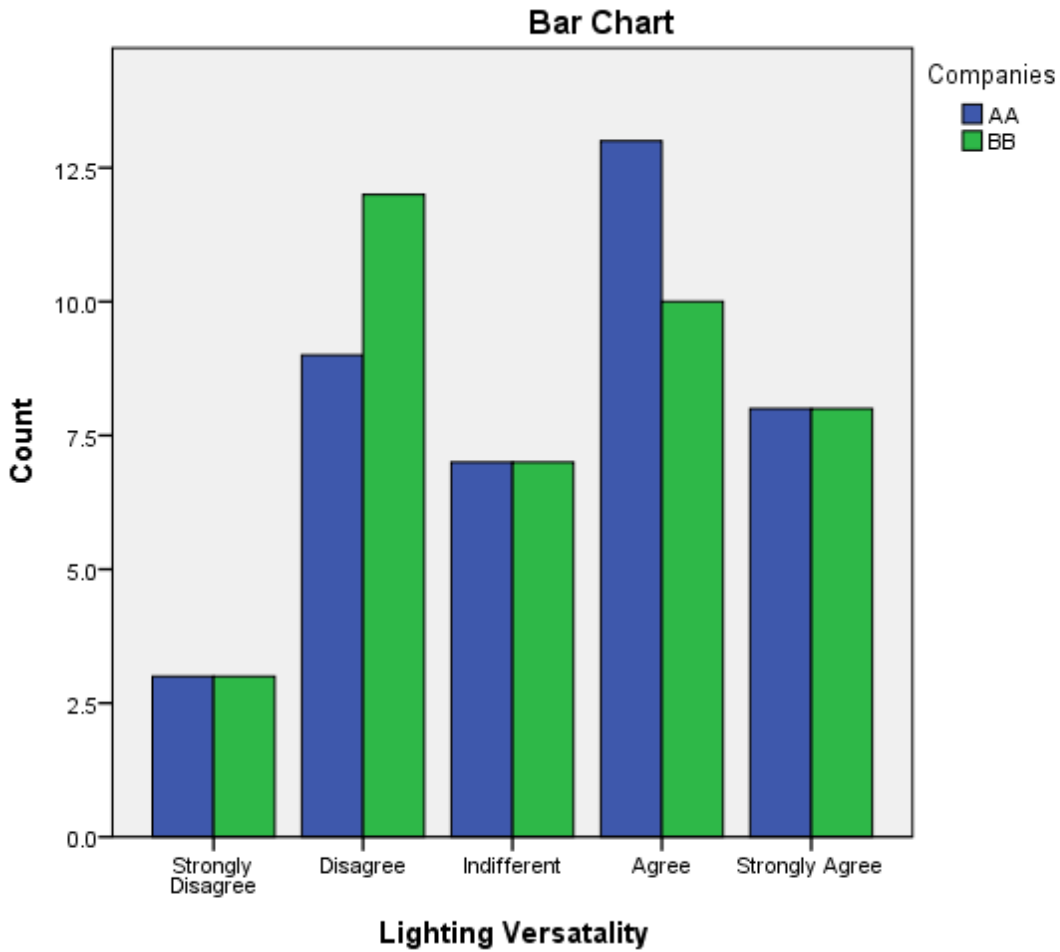


Figure 5-24: Lighting Versatility

Respondents were asked "**Building is secured in all respect**"? Responses received from Company AA demonstrates that 35% of the respondents "agree" that the Company AA buildings are secured whereas 15% of the feedback received show that they "strongly agree" on that buildings are secure. 15% are "indifferent". Percentage for "strongly disagree" is 0 and "disagree" is 35%. Company BB data revealed that 37.5% were "disagree" whereas only 22.5% are in agreement that Company BB buildings provide enough security and 15% are "indifferent" about Company BB' capability of providing security. Graph 5-25 depicts that 14 respondents "agree for Company AA and for Company BB the number of respondent who marked "agree" is 9. "strongly agree" with the statement for Company AA are 6 and for Company BB is 3.

Table 5-18: Building Security

DQI-Building Security-Descriptive Statistics					Difference in Percentages (%)	
		Company AA		Company BB		
		Frequency	Percent	Frequency	Percent	
	Strongly Disagree	0	0.0	7	17.5	17.5
	Disagree	14	35.0	15	37.5	2.5
	Indifferent	6	15.0	6	15.0	0
	Agree	14	35.0	9	22.5	12.5
	Strongly Agree	6	15.0	3	7.5	7.5
	Total	40	100.0	40	100.0	0

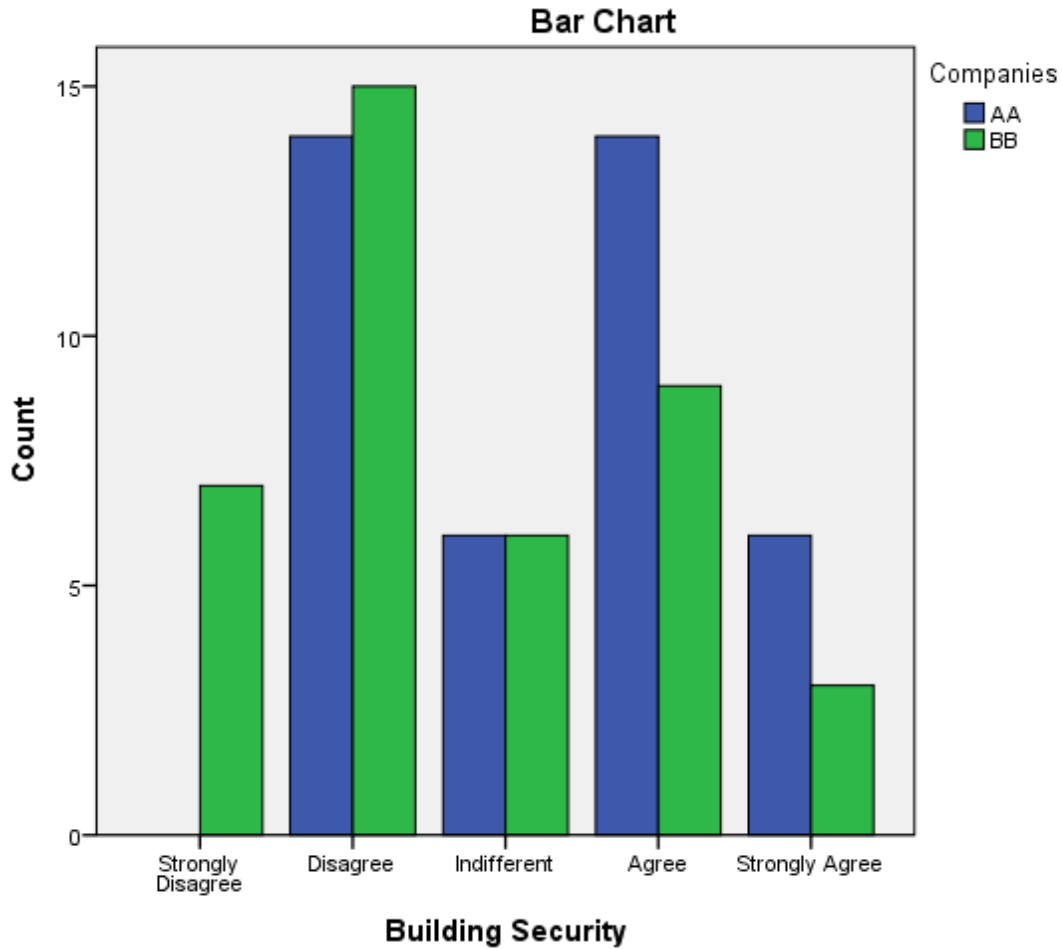


Figure 5-25: Building Security

Respondents were asked “**Company Projects provide enjoyable Passage and common areas?**” Responses received from Company AA demonstrate that 40% of the respondents “agree” on that Passage and common areas offered by Company AA in construction projects are enjoyable whereas 17.5% of the feedback received show that they are “strongly agree” with the statement. 10% are “indifferent”. Percentage for “strongly disagree” is 5 and “disagree is 27.5. Company BB responses revealed that 37.5% “disagree” whereas only 22.5% “agree” that passage and common areas of

buildings built by Company BB are enjoyable and 17.5% are “indifferent” about Company BB’ capability of providing of enjoyable passage and common areas. Figure 5-26 depicts that 16 respondents “agree” for and for Company BB the number of respondent who marked “agree” is 9. “Strongly agree” with the statement for Company AA are 7 and for Company BB is 5.

Table 5-19: Enjoyable Passage and Common Areas

DQI- Enjoyable Passage and Common Areas -Descriptive Statistics					Difference in Percentages (%)	
		Company AA		Company BB		
		Frequency	Percent	Frequency		Percent
	Strongly Disagree	2	5.0	8	20.0	15.0
	Disagree	11	27.5	11	27.5	0
	Indifferent	4	10.0	7	17.5	7.5
	Agree	16	40.0	9	22.5	17.5
	Strongly Agree	7	17.5	5	12.5	5.0
	Total	40	100.0	40	100.0	0

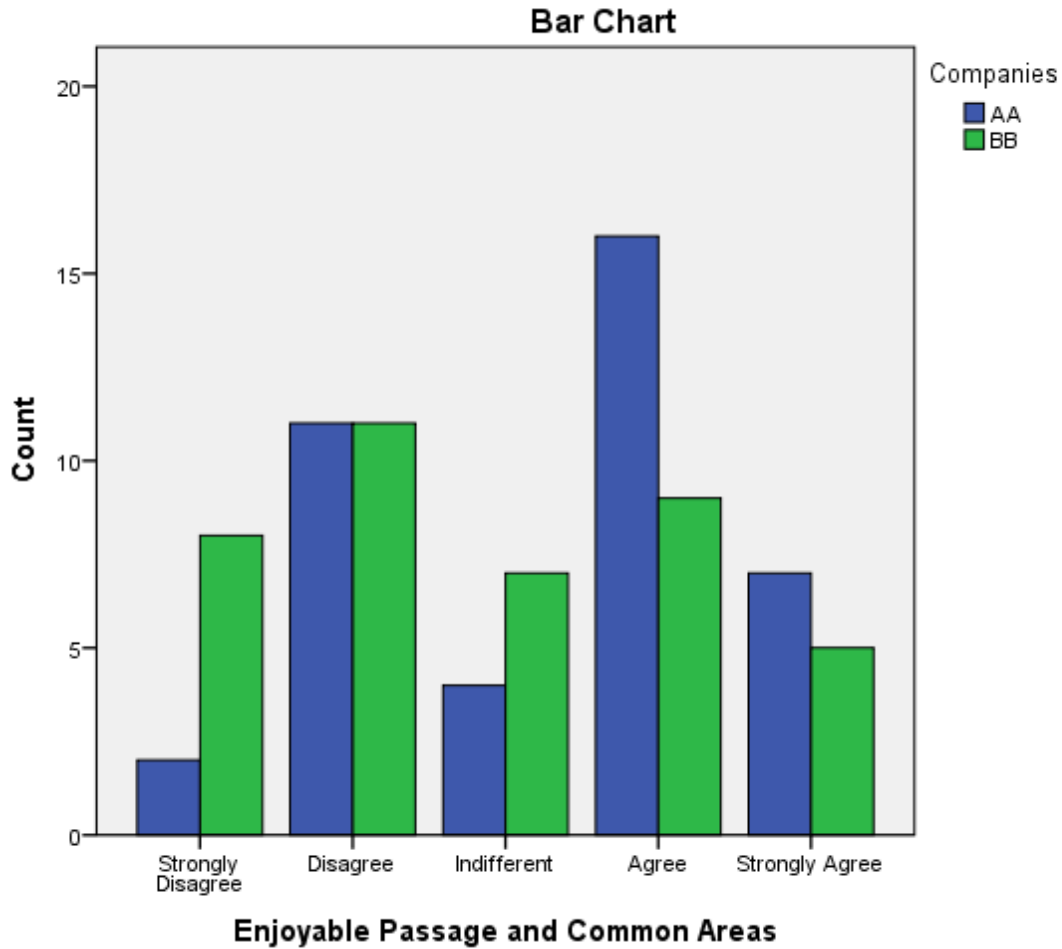


Figure 5-26: Enjoyable Passage and Common Areas

Respondents were asked **Buildings' outlook is in accordance with its location?"** Responses received from Company AA demonstrate that 30% of the respondents "Agree" with the statement whereas 12.5% of the feedback received show that they "strongly agree" with the statement. 17.5% are "indifferent". Percentage for "strongly disagree" is 17.5 and "disagree" is 22.5. Company BB responses revealed that 32.5% "disagree" whereas only 22.5% "agree" that buildings' outlook is in accordance with its location and 17.5% are "indifferent" about Company BB' capability of selecting location according to the buildings' perspective. Figure 5-27 depicts that 12 respondents were in disagreement with Company AA ability whereas for

Company BB the number of disagreed respondents is 9. “Strongly agree” with the statement for Company AA and Company BB are 5.

Table 5-20: Building’s Outlook

DQI-Building’s Outlook -Descriptive Statistics					Difference in Percentages (%)	
		Company AA		Company BB		
		Frequency	Percent	Frequency	Percent	
	Strongly Disagree	7	17.5	6	15.0	2.5
	Disagree	9	22.5	13	32.5	10.0
	Indifferent	7	17.5	7	17.5	0
	Agree	12	30.0	9	22.5	7.5
	Strongly Agree	5	12.5	5	12.5	0
	Total	40	100.0	40	100.0	0

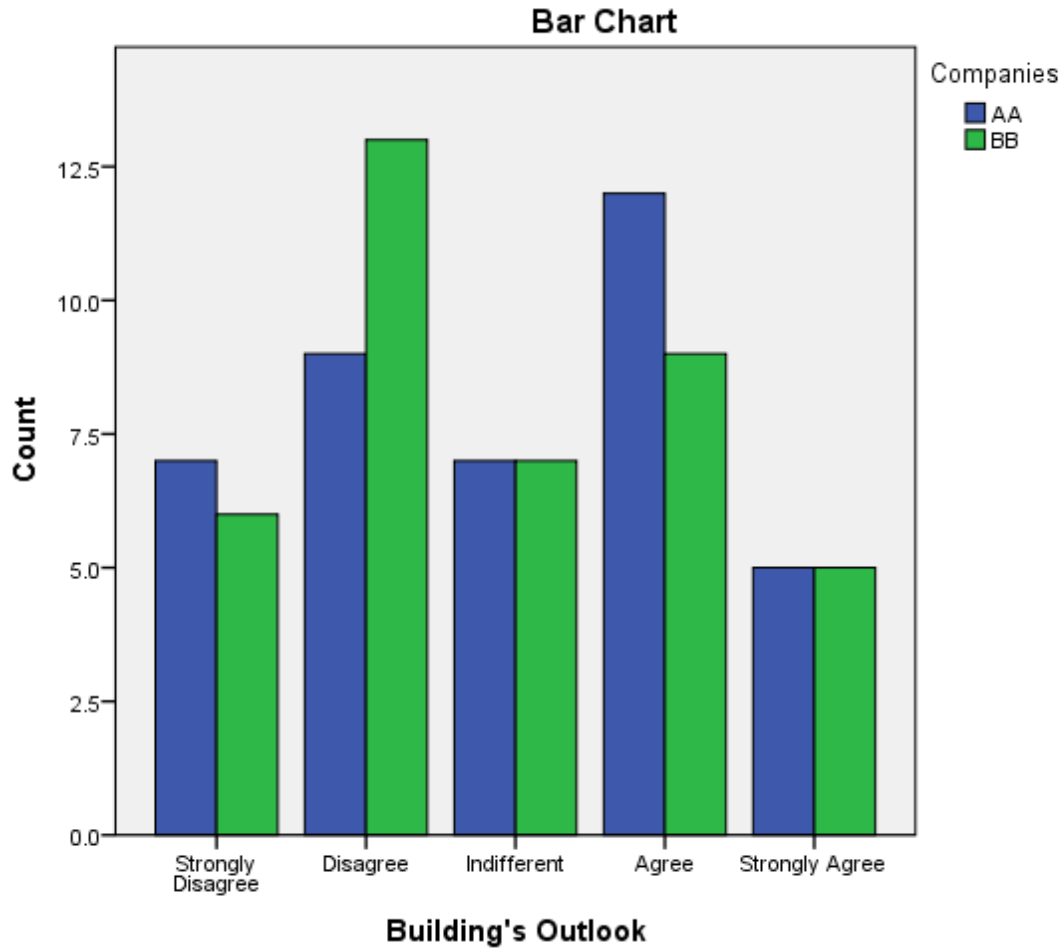


Figure 5-27: Building's Outlook

Respondents were asked “**Buildings are energy efficient?**” Responses received from Company AA demonstrates that 22.5% of the respondents “agree” that Company AA projects are energy efficient whereas 22.5% of the feedback received show that they “strongly disagree”. 15% are “indifferent”. Percentage for “strongly disagree” and “disagree” is 20. Company BB responses revealed that 15% “disagree” whereas only 17.5% “agree” that Company BB constructs energy efficient buildings and 37.5% are “indifferent” about Company BB’ capability of making building energy efficient. Figure 5-28 depicts that 9 respondents marked “agree” in Company

AA and in Company BB the number who marked “agree” is 7. “Strongly agree” with the statement for Company AA is 9 and for Company BB is 3.

Table 5-21: Energy Efficiency

DQI-Energy Efficiency -Descriptive Statistics					Difference in Percentages (%)
	Company AA		Company BB		
	Frequency	Percent	Frequency	Percent	
Strongly Disagree	8	20.0	9	22.5	2.5
Disagree	8	20.0	6	15.0	5.0
Indifferent	6	15.0	15	37.5	22.5
Agree	9	22.5	7	17.5	5.0
Strongly Agree	9	22.5	3	7.5	15.0
Total	40	100.0	40	100.0	0

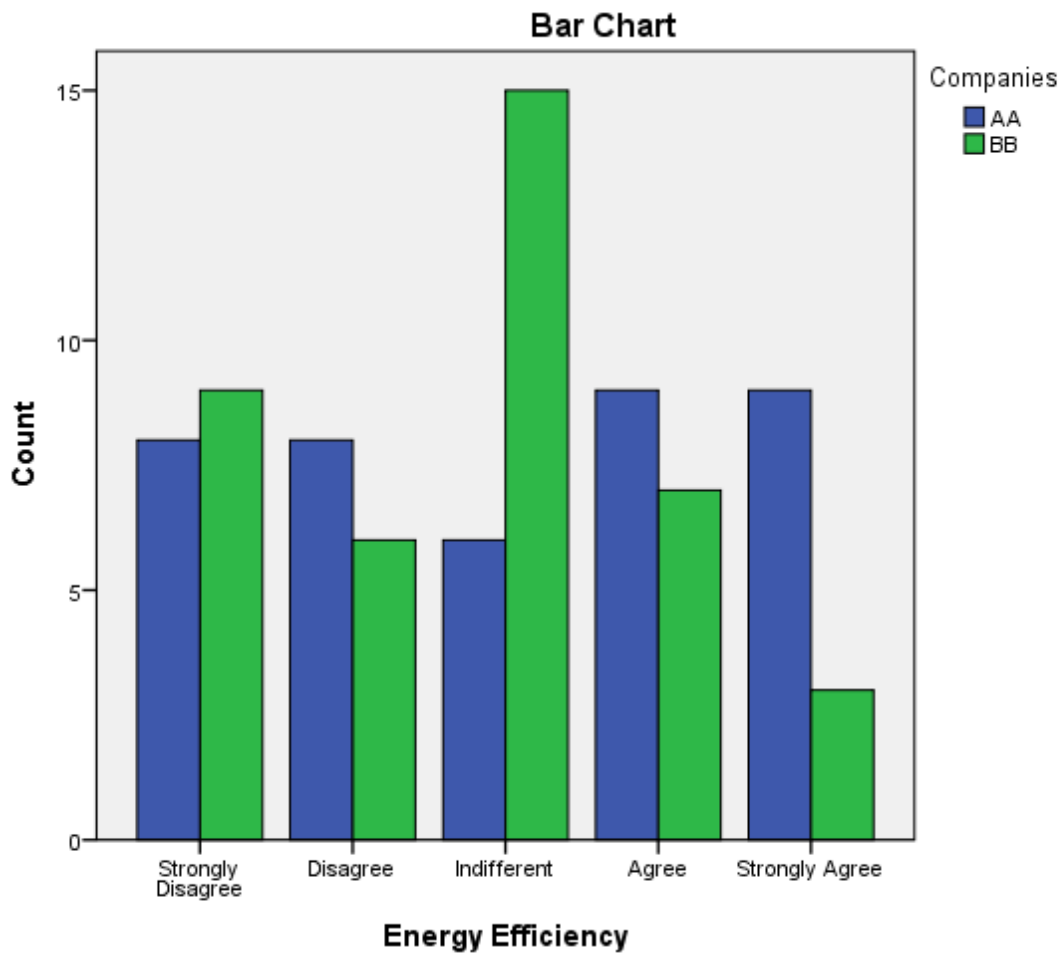


Figure 5-28: Energy Efficiency

Table 5-22: Statistics of Design Quality Indicator

Descriptive Statistics Design Quality Indicator							
N= 40		Easy accommodation	Versatile Lighting	Building Security	Enjoyable Passage and Common Areas	Buildings ' Outlook	Energy Efficiency
	Mean	3.90	3.35	3.30	3.38	2.98	3.08
Company AA	Std. Deviation	1.236	1.252	1.114	1.213	1.330	1.474
	Sum	156	134	132	135	119	123
	Mean	3.23	3.20	2.65	2.80	2.98	2.73
Company BB	Std. Deviation	1.441	1.285	1.231	1.344	1.330	1.219
	Sum	129	128	106	112	119	109
Difference in Std. Deviation		0.205	0.033	0.117	0.131	0	0.255

Table 5-22 indicates that Likert score against different questions asked from respondents regarding DQI. Data indicates that in average, about Company AA indicator of Easy accommodation respondent's tendency is towards "agree" and for remaining DQI respondents tendency on average found towards "indifferent". In Company BB for all DQI on Likert scale respondents average tendency found towards "indifferent".

5.4.7. Employee Satisfaction Indicator

Respondents were asked “**Are you satisfied with the management performance in relation to employee policies**”? Responses are summarized in Table 5-23. As it can be understood from the table, responses received from Company AA for setting benchmark, 32.5% of the respondents are “mostly satisfied” with the management performance in relation to employee policies whereas 12.5% of the feedback received show that they are “mostly dissatisfied” with the project. Company BB respondents revealed that 30% are “mostly dissatisfied” with the management performance in relation to employee policies whereas only 22.5% are “mostly satisfied” with the project. Company AA has achieved higher level of satisfaction as compared to Company BB. 17.5% respondents from Company AA and 10% respondents from Company BB are “Neither Satisfied nor Dissatisfied” from the construction project. Company AA has total score of 150 whereas Company BB sum of scores is 111. Mean calculated for Company AA and Company BB is 3.75 and 2.78 which indicates that on Likert scale on average respondents were found inclined towards “Mostly satisfied” for Company AA and for Company BB they found towards “Neither Satisfied nor Dissatisfied”.

Figure 5-29 depict that 13 respondents were “mostly satisfied” in Company AA and for Company BB the number of “mostly satisfied” respondent is 9. “Totally satisfied” in Company AA are also 13 and in Company BB are 6.

Table 5-23: Employment Policies

Employee Satisfaction Indicator-Employment Policies-Descriptive Statistics							Difference in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.75	2.78	Frequency	Percent	Frequency	Percent	
Std. Deviation	1.193	1.423					
Sum	150	111					
	Totally Dissatisfied		2	5.0	9	22.5	17.5
	Mostly Dissatisfied		5	12.5	12	30.0	17.5
	Neither Satisfied Nor Dissatisfied		7	17.5	4	10.0	7.5
	Mostly Satisfied		13	32.5	9	22.5	10.0
	Totally Satisfied		13	32.5	6	15.0	17.5
	Total		40	100.0	40	100.0	0

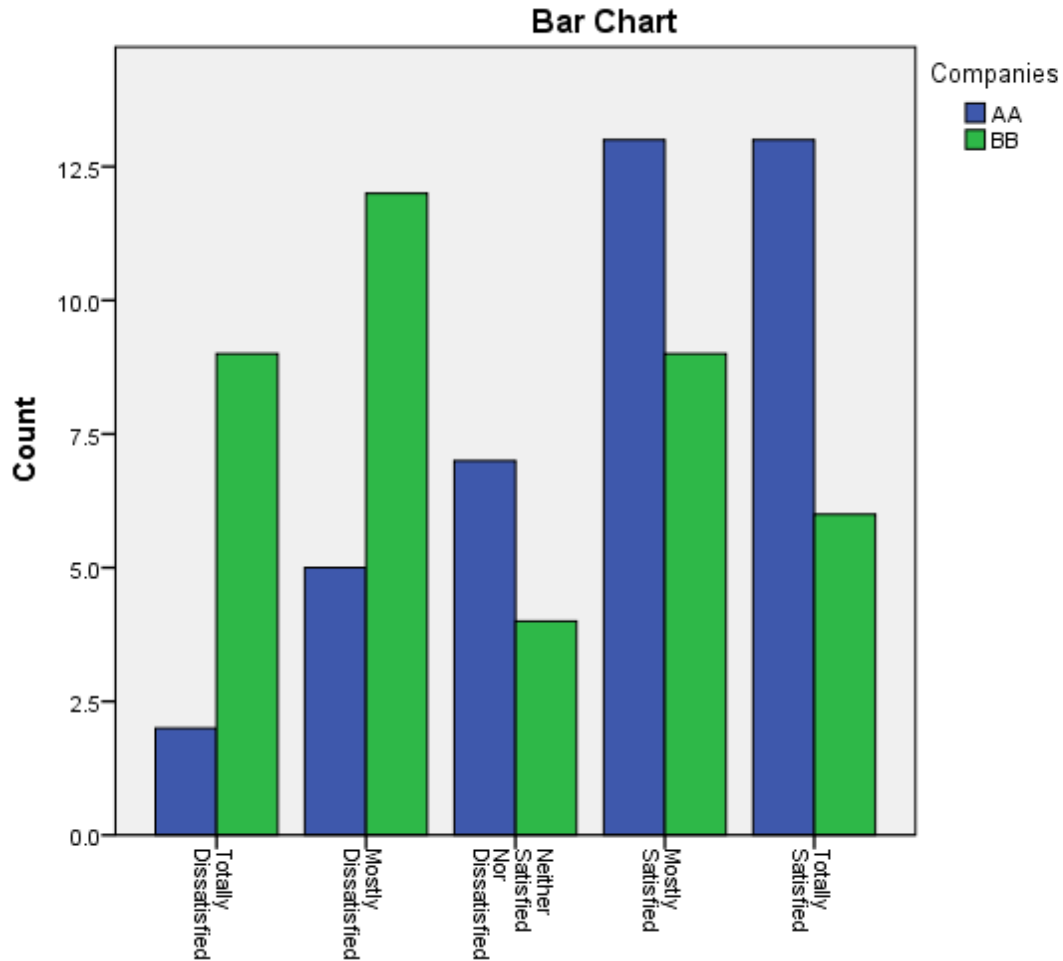


Figure 5-29: Employment Policies

5.4.8. Labour Safety Management Indicator

Respondents were asked “**Are you satisfied with the management performance in relation to labour safety measures**”? Responses are summarized in table 5-24. Responses received from Company AA demonstrate that 0% of the respondents perceived that management showed “very bad performance” whereas 15% of the feedback received show that management showed “bad performance”. 17.5% were declared that performance of the teams is “Average”. 34% perceived management showed “Good Performance” and 32.5% perceived as “Very Good Performance”.

Company BB respondents demonstrate that 17.5% of the respondents perceived that management showed “Very Bad Performance” whereas 32.5% of the respondent marked “bad performance”. 22.5% declared that management is “Average”. 17.5% perceived management showed “Good Performance” and 10% perceived as “Very Good Performance”. Company AA has total score of 155 whereas Company BB sum of scores is 108. Mean calculated for Company AA and Company BB is 3.85 and 2.70 which indicates that on Likert scale on average respondents were found inclined towards “Good Performance” for Company AA and for Company BB they found towards “Average”.

Figure 5-30 depicts that 7 respondents declared management performance as “Average” in Company AA and in Company BB 9 respondents marked “Average”. In Company AA 13 and in Company BB 4 respondents marked “Very Good Performance”.

Table 5-24: labour Safety Measures

Labour Safety Indicator-labour Safety Measures-Descriptive Statistics							Difference in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.85	2.70	1				
Std. Deviation	1.051	1.244	1				
Sum	154	108	Frequency	Percent	Frequency	Percent	
	Very Bad Performance		0	0.0	7	17.5	17.5
	Bad Performance		6	15.0	13	32.5	17.5
	Average		7	17.5	9	22.5	5
	Good Performance		14	35.0	7	17.5	17.5
	Very Good Performance		13	32.5	4	10.0	22.5
	Total		40	100.0	40	100.0	0

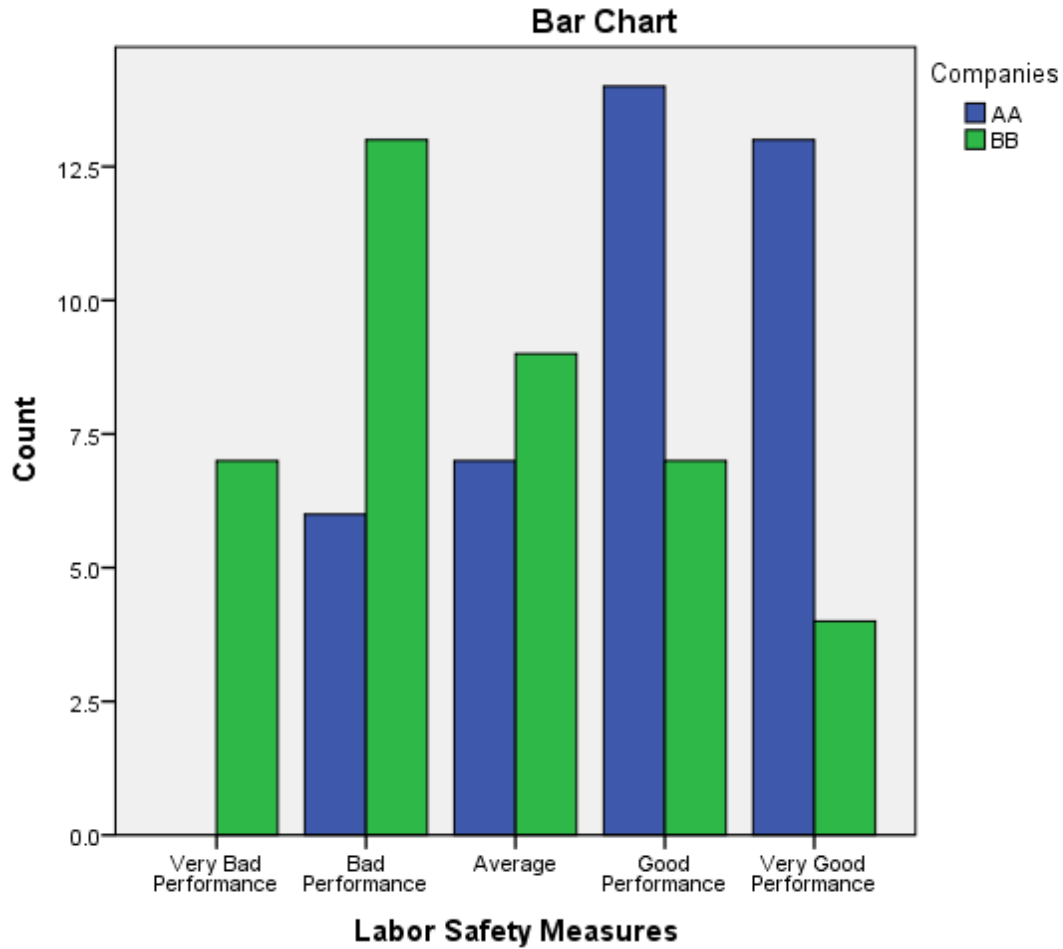


Figure 0-30: Labour Safety Measures

5.4.9. Quality Management System (QMS) Indicator

Respondents were asked “**What do you feel about the performance of management in relation to QMS**”? Responses received from Company AA demonstrate that 2.5% of the respondents perceived that management showed “very bad performance” whereas 2.5% of the feedback received show that management showed “bad performance”. 12.5% were declared that performance of the QMS is “Average”. 45% perceived management showed “Good Performance” and 37.5% perceived as “Very Good Performance”.

Company BB respondents demonstrate that 22.5% of the respondents perceived that management showed “Very Bad Performance” whereas 37.5% of the respondent marked “Bad Performance”. 10% declared that performance of management in relation to QMS is “Average”. 17.5% perceived management showed “Good Performance” and 12% perceived as “Very Good Performance”. Company AA has total score of 165 whereas Company BB sum of scores is 104. Mean calculated for Company AA is 4.13 and for Company BB, it is 2.60 which indicates that on Likert scales on average respondents were found inclined towards “Good Performance” for Company AA and for Company BB they found towards “Average”.

Figure 5-31 depicts that 5 respondents declared management performance as “Average” in Company AA and in Company BB 4 respondents marked “Average”. In Company AA 15 and in Company BB 5 respondents marked “Very Good Performance”.

Table 5-25: QMS Performance Indicator

QMS Performance Indicator-Descriptive Statistics							Difference in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	4.13	2.60	Frequency	Percent	Frequency	Percent	
Std. Deviation	.911	1.355					
Sum	165	104					
	Very Bad Performance		1	2.5	9	22.5	20.0
	Bad Performance		1	2.5	15	37.5	35.0
	Average		5	12.5	4	10.0	2.5
	Good Performance		18	45.0	7	17.5	27.5
	Very Good Performance		15	37.5	5	12.5	25.0
	Total		40	100.0	40	100.0	0

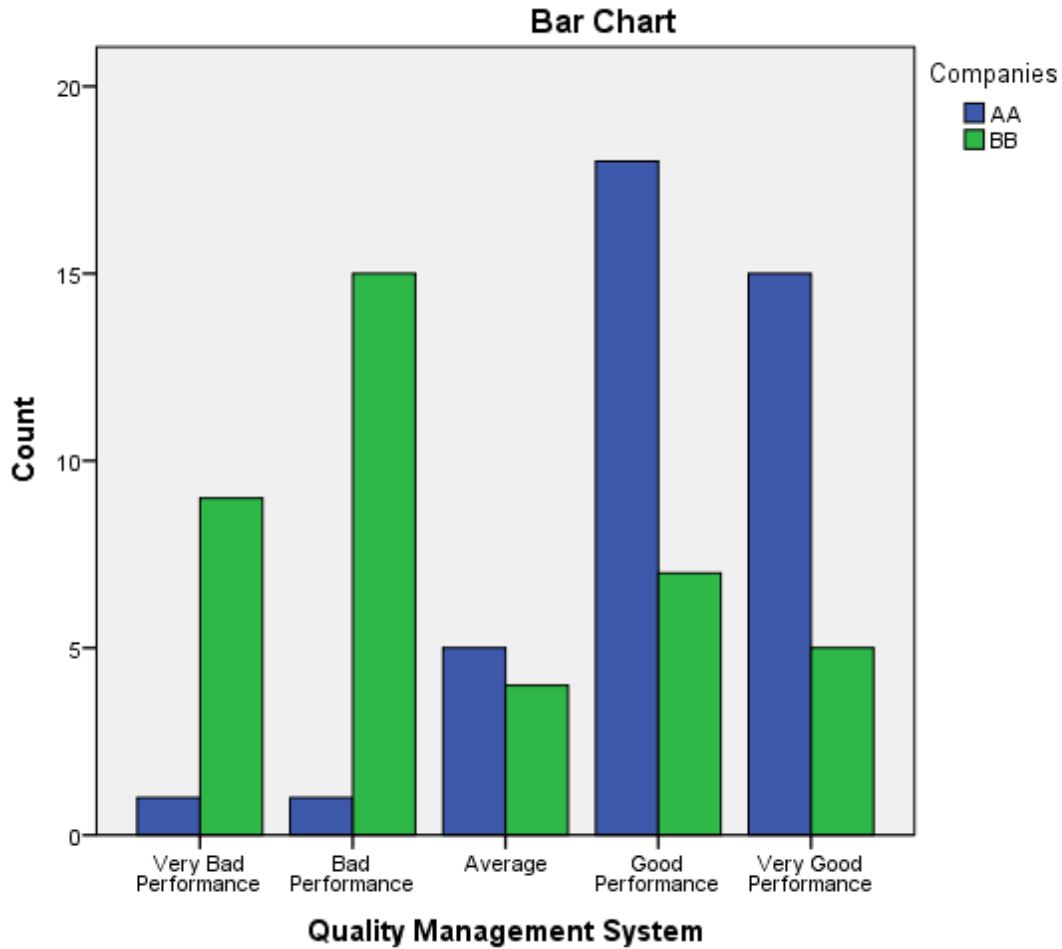


Figure 5-31: QMS Performance Indicator

5.4.10. Material Management Indicator

Respondents were asked “**What do you feel about the performance of management in relation to material management**”? Responses received from Company AA demonstrate that 7.5% of the respondents perceived that management showed “very bad performance” whereas 22.5% of the feedback received show that management showed “bad performance”. 40% were declared that management performs “Average” in managing material. 45% perceived management showed “Good Performance” and 25% perceived as “Very Good Performance”.

Company BB respondents demonstrate that 20% of the respondents perceived that management showed “very Bad Performance” whereas 27.5% of the respondent marked “bad performance”. 12.5% declared that performance of management is “Average”. 22.5% perceived management showed “Good Performance” and 17.5% perceived as “Very Good Performance”. Company AA has total score of 147 whereas Company BB sum of scores is 116. Mean calculated for Company AA and Company BB is 3.68 and 2.90 which indicates that on Likert scale on average respondents believe that in Company AA material management performance is good for Company BB respondents thinks that their material management performance is “Average”.

Figure 5-32 depicts that 4 respondents declared management performance as Average” in Company AA and in Company BB 5 respondents marked “Average”. In Company AA 10 and in Company BB 7 respondents marked “Very Good Performance”.

Table 5-26: Material Management Performance Indicator

Material Management Performance Indicator-Descriptive Statistics							Difference in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.68	2.90	Frequency	Percent	Frequency	Percent	
Std. Deviation	1.207	1.429					
Sum	147	116					
	Very Bad Performance		3	7.5	8	20.0	12.5
	Bad Performance		5	12.5	11	27.5	15.0
	Average		4	10.0	5	12.5	2.5
	Good Performance		18	45.0	9	22.5	22.5
	Very Good Performance		10	25.0	7	17.5	7.5
	Total		40	100.0	40	100.0	0

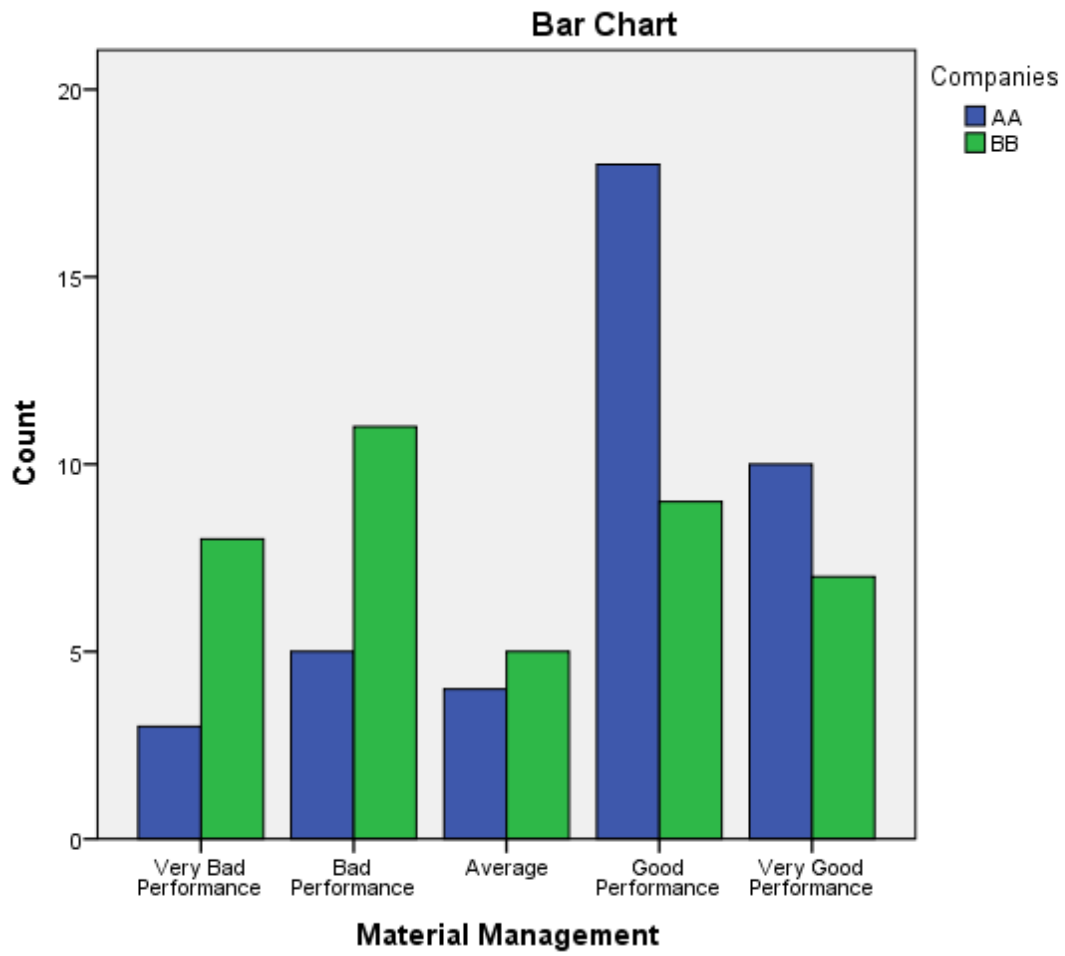


Figure 5-32: Material Management Performance Indicator

5.4.11. Employee Turnover

Employee turnover is calculated by using mentioned formula (CURT, 2005):

$$\frac{\text{No. of employees who left during period}}{\text{Average No. of employee during period}} * 100$$

The formula provides the result in percentage rate.

5.4.11.1. Employee Turnover Rates of Company AA & Company BB

Table 5-27 demonstrates the historical data of both companies. Last 6 years have been selected to calculate average turnover rate for Company AA and Company BB. Company AA Mean of employee turnover of 6 years is 4.7 and for Company BB it is 5.95 and standard deviation is .005 and .011 respectively.

Table 5-27: Employee Turnover Rates of Company AA & Company BB

Year	Company AA			Company BB			Difference in both Turnover rates
	Number of employees who left during period	Average number of employees during period	Turnover Rate	Number of employees who left during period	Number of employees who left during period	Turnover Rate	
2007	125	2725	4.6	71	900	7.9	3.3
2008	107	2500	4.3	62	928	6.7	2.4
2009	129	2500	5.2	54	968	5.6	0.4
2010	100	2500	4.0	42	950	4.4	0.4
2011	132	2750	4.8	51	935	5.5	0.7
2012	148	2750	5.4	56	1001	5.6	0.2

5.4.11.2. Benchmarking with Company AA

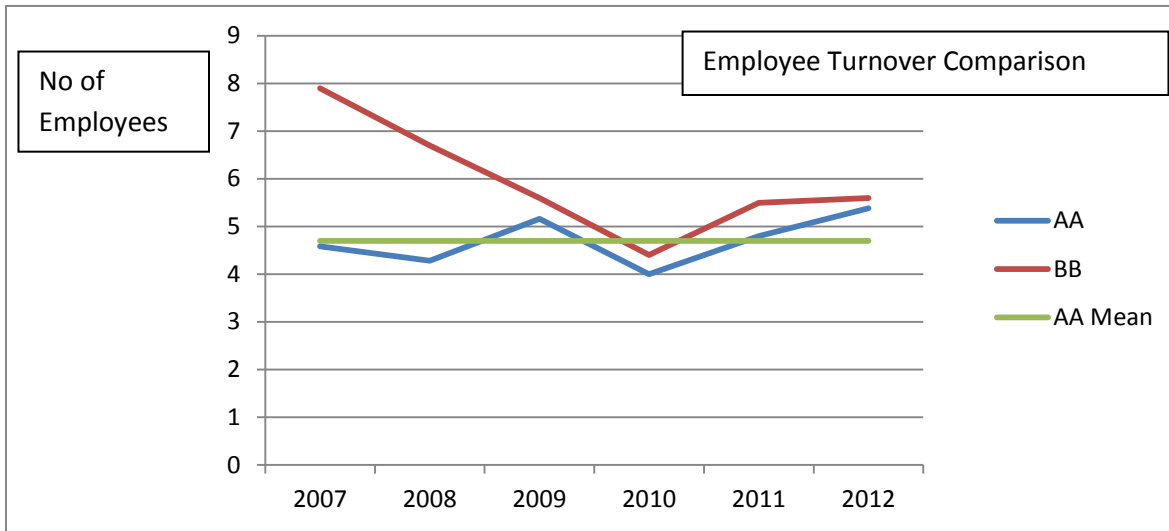


Figure 5-33: Employee Turnover for last 6 years and benchmarking

Turnover rate of both the companies are plotted in Figure 5-33. Straight line shows the average turnover rate of Company AA for last six years. Company BB average turnover rate is higher than the average turnover rate of Company AA. Company BB can benchmark its employee turnover rate at 4.7%, which is average turnover rate Company AA has achieved.

As Company BB is benchmarking Company AA for bringing improvements in its project performances therefore average of six years of turnover rate of Company AA is set as threshold for acceptable turnover rate. Turnover above 4.7% is considered as bad and below is considered as good. All organizations needs fresh blood and want to retain skilled workers therefore some percentage of turnover is always appreciated where unskilled workers are leaving and skilled workers with creative and innovative ideas are joining the workforce.

5.4.12. Equality & Diversity Indicator

Respondents were asked “**What level of Consideration Company has taken about equality and diversity measures**”? Responses are summarized in table 5-28. Responses received from Company AA demonstrate that 2.5% of the respondents perceived that management have “No policy and do not consider the subject”. **25%** of the feedback received show that “Policy is not implemented” in Company AA. 17.5% declared that “Policy is only partially implemented at present”. 35% state that “Policy is well on the way to being fully implemented” and 20% indicated that “Policy is fully implemented” in Company AA.

Responses received from Company BB demonstrate that 12.5% of the respondents perceived that management have “No policy and do not consider the subject”. 30% of the feedback received show that “Policy is not implemented” in Company BB. 17.5% declared that “Policy is only partially implemented at present”. 25% state that “Policy is well on the way to being fully implemented” and 20% indicated that “Policy is fully implemented” in Company BB.

Company AA has total score of 138 whereas Company BB sum of scores is 120. Mean calculated for Company AA and Company BB is 3.45 and 3.00 which indicates that on Likert scale on average respondents of both companies were found inclined towards “Policy is only partially implemented at present”

Figures 5-34 depict that 10 respondents declared that “Policy is not implemented” in Company AA and in Company BB 12 respondents marked “Policy is not implemented”. In Company AA 14 and in Company BB 10 respondents marked “Policy is well on the way to being fully

implemented”. 8 and 6 marked “Policy is fully implemented” in Company AA and Company BB respectively.

Table 5-28: Equality and Diversity Management Performance Indicator

Equality and Diversity Management Performance Indicator-Descriptive Statistics							Difference in Percentages (%)
	Company AA	Company BB	Company AA		Company BB		
Mean	3.45	3.00	Frequen	Percent	Frequency	Percent	
Std. Deviation	1.154	1.301	cy			t	
Sum	138	120					
Valid	No policy and do not consider the subject		1	2.5	5	12.5	10.0
	Policy is not implemented		10	25.0	12	30.0	5.0
	Policy is only partially implemented at present		7	17.5	7	17.5	0
	Policy is well on the way to being fully implemented		14	35.0	10	25.0	10.0
	Policy is fully implemented		8	20.0	6	15.0	5.0
	Total		40	100.0	40	100.0	0

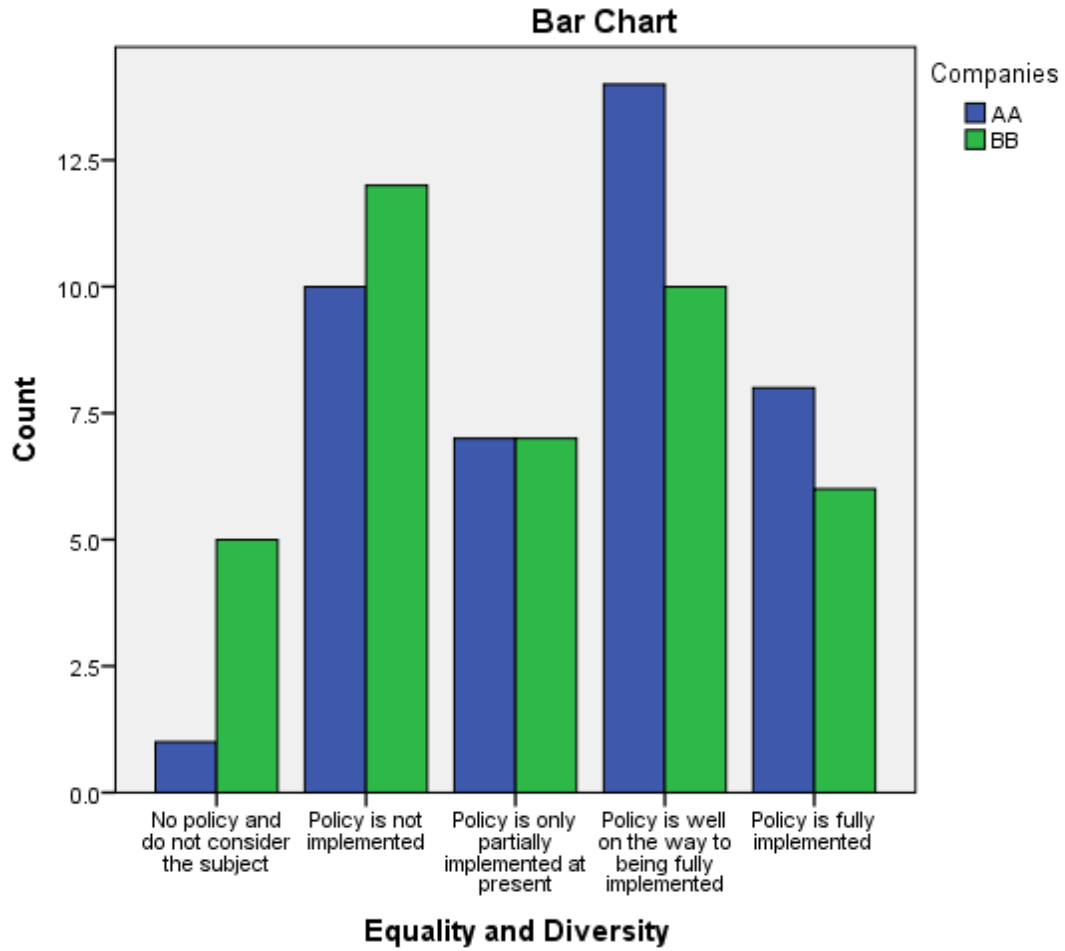


Figure 5-34: Equality and Diversity Management Performance Indicator

CHAPTER 6 – DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

The aim of this chapter is to elaborate results obtained from Chapter Five and present the conclusions regarding benchmarking in Company BB. Chapter also includes discussion on various processes of Company BB and on the basis of results of data analysis recommendations are made that how Company BB can improve its operations in order to achieve benchmarks. This Section discusses the results and makes recommendations for Company BB for benchmark its performance against Company AA's projects performances. All KPIs selected for the research are discussed separately.

Prior to this chapter objective of this research have been met in previous chapters i.e. objective of to identify the suitable KPI prevailing in the construction industry of Kuwait work has been met in Chapter 2. Develop and calculate the KPIs to assess the performance of the construction projects for this research has been discussed in chapter 3 as well as in Chapter 4 where all the formulae have been developed for the calculation of these KPIs. Objective of to develop a framework for benchmarking in the construction industry has been achieved in Chapter 4 where 2 companies have been used as case studies and medium organization needed to benchmark the big organisation. Objective of to measure the performance of large projects of construction industry has been met in Chapter 4 as well as in Chapter 5 where framework for the calculation of performance has developed in Chapter 4 and the actual calculation of some projects of two organisations has done in Chapter 5. Subsequently this chapter deals with the development of a conceptual framework for improving project management in Kuwaiti construction industry by making discussion on the results obtained in Chapter 5 and making recommendations on the

basis of these results. This will lead to the overall construction project performance improvement in Kuwaiti construction industry. The novelty of this research is that the study has revealed the useful facts related to the medium construction organizations in Kuwait as concluded below. This thesis is also important because of its distinct concerns related to the medium size construction organisations which are rarely researched or not researched at the required level. This research was a challenging decision because of its nature as no bigger organisation was ready to share their construction project data; However with the continuous efforts and importance of this research enable both the companies to give their consents.

6.1. Cost Variance

Data indicated that there is considerable difference in cost variance of both the companies. Company AA has a positive cost variance whereas Company BB is experiencing negative cost variances. It is complicated and time consuming exercise to explore the root cause for the unfavourable variances. According to the Veronika et al. (2006), corrective measures are taken against the risk after evaluating each risk factor; whether risk is high or low. Most of the projects experience variance in cost mainly due to miss-management of material.

6.2. Time Variance

There is substantial amount of negative variance in Company BB. Data reveals that variance fluctuates from 3% to 7% in the six selected projects. Standard deviation of Company AA projects is 0.015 and Company BB is 0.022 which is high. Company BB needs to review its policies and procedures from design phase to completion. Biafore (2007) suggests that discovery of variance in cost and time schedules at initial stages of project can be managed by adopting proactive approaches. Despite of various research and precautionary measures adopted by construction project managers, there is always remains possibilities to improve planning and

scheduling of time required for project completion. The importance of designing a right road map and time frame for completion project is the key to ensure effective cooperation, coordination among project stakeholders and project completion. In the large projects executed by Company AA and Company BB which involves various stakeholders, a formal preparation of time schedule is inevitable.

6.3. Integration of Cost and Time Schedule

Cost and time variances are interrelated and negative time variance is the most common cause of increased project completion cost. Project control includes control of variances. For this purpose it is necessary for Company BB to view its cost and time schedule together. Preparation of detailed documentation can help in exploring project performance in detail; and in case of variance, documentation can also provide a quick path for analysis and determination of activities which consume more financial cost and time for completion. Apparently, cost and time schedule do not possess features related to the causes of variances. Therefore, it is necessary for Company BB to prepare schedules in details to compare the budgeted and actual variables.

6.4. Customer Satisfaction on Construction Project

Data shows that in Company AA construction projects 62.5% respondents were mostly satisfied and 15% respondents were totally satisfied with the projects whereas in Company BB 35% were mostly satisfied and 10% respondents were totally satisfied. This reveals that there is immense need of improvements which Company BB has to incorporate in its projects for making its customer satisfied. Problem with the customer satisfaction is that project managers came to know about at later stages or where project owners and project users are different then it become really hard to investigate about levels of satisfaction among users of construction facilities. The organizations like Company BB have to investigate some common reasons of dissatisfaction

which were noted by Karna et al., (2004). These reasons are: (1) application and use of handover material and maintenance manual, (2) quality of construction material, and (3) repair and maintenance required during inspection. Furthermore, it is important for medium size organizations like Company BB to achieve a consistent level of satisfaction of customer as it was noted by Karna et al. (2004) that in the beginning of projects, satisfaction levels remain high but as time passes and variation occur in cost and time schedule, satisfaction level decline and if corrections are not put in place levels further decline.

6.5. Customer Satisfaction on Overall Services Offered by Construction Team

People are the greatest asset in construction industry (Jang et al, 2003); therefore they are the main source of satisfying customer needs through providing efficient services. In Company BB, only 7.5% respondents are totally satisfied 12.5% are mostly satisfied whereas in Company AA 40% are mostly satisfied and 20% are totally satisfied are with the performance of project teams. There is a need to develop criteria on which customer satisfaction can be judged. Customers select the certain contractors due to its reputation. Customers evaluates design and construction proposal on the scale of quality standards, price and details and contractors planning to execute project. Customers also have reservations about the sub-contractors and building security and defect resolution services. Mutual understanding and communication levels play vital roles in understanding each other are need and constraints involved.

6.6. Following the budget Lines

This is related to cost management of projects; Chapter 5 Table 5-6 and Figure 5-12 depict that 7 respondents from Company AA declared that Company AA follows budget lines and 3 respondents from Company BB stated that Company BB completes its projects within budgets. Total of 7.5% respondent stated that Company BB complete its project within the quoted price.

This shows that Company BB needs to improve its budget planning. Presence of cost negative variance force Company BB to enhance its quoted price. Company BB needs to review at what stage variance is present or what is causing enhanced cost consumption. Variance may start form designing phases therefore as mentioned above (see section 6.2) a network model or knowledge base system is required to keep record of cost and avoid any future deviations leading to enhance overall project cost.

6.7. Following the Time Schedules

Data revealed that total of 25% respondents stated that they are agree that Company BB completed its projects in stipulated time and also 2.5% stated that they strongly agree that projects were completed in time; Whereas only 2.5% respondents were indifferent that projects were completed in time. Situation in Company AA is quite different as Time management scope is not limited to only one activity. As mentioned in Chapter 4 (see section 4.4.2), it includes design time; construction time and sum of both i.e. project time. Customer satisfaction is influenced by timely completion of projects. Poorly interrelated activities and miss-management of operational activities give rise to delayed completion of projects. Further as it is mentioned in prior lines that time management and cost management is interrelated; therefore they both have influence on customer satisfaction. Effective financial planning would fail in case of delaying to execution of procurement decisions. Inflation always remains a threat in growing economy like Kuwait. Inflationary process with delayed functions can increase cost manifold. Sensitivity analysis must be conducted to know the increased cost of project in case of unfavourable variance rise in design and construction time. Flexible budget which can bear small cost and time pressures can play an important role. In fact, it always remains a challenge to control cost and time variances as construction project involves many suppliers, and subcontractors. Therefore,

any increase in subcontractor's price and delayed availability of material and other supplies can cause increase in project prices. An intelligently selected sub-contractors and properly designed sub-contractor's agreement including penalties in case of delaying in shipment can ensure availability of materials and supplies at right place at right time within the quoted price.

6.8. Delivering Quality Projects

Delivery of quality projects involves commitment from project management, subcontractors and project owners; and it is combination of many activities. Again in Company BB, only 25% respondents believe that management is capable enough to produce a quality project; and it can be discussed that this situation of Company BB can be existed due to less technology or less trained staff. It is also evident from the presence of negative cost and time variances in projects. These variances provide the justifiable reasons to state that management lack in delivering quality projects. Sometimes, due to anticipation of increased cost, for the purpose on further increase in cost companies compromise on purchase of quality material. Short term low cost solutions are adopted despite of long term benefits at affordable price. Establishing a quality control department evaluating that quality standards are being met is essential. Quality control starts from planning phase to implementing phase. If management is not capable of effective planning then it is hard to execute different functions of construction properly leading towards delayed and defective projects. Nothing is more required form any organisation than a sincere commitment from management for delivering quality projects through following the recommendation provided based on the results of this research.

6.9. Managing defects

Managing defects is related to how project managers are committed to resolve any gaps in required services and delivered services. Company BB's research data also shows lack in managing defects. Only 15% respondent stated that management is capable enough for resolving any defects in construction projects. In construction projects, defects occur uncontrollably and repeatedly. Defects are the main reasons of increased cost and delayed project completions. First responsibility lies with the design engineers to design a building which is defect free. Design must be in detail and well integrated. Well-designed project will reduce the chances of patent and latent defects. A specialized inspection team can observe patent defect at early stages and actions can be taken to resolve them. In case of latent design, it is hard to discover defect; however "tried and tested" standards can be supportive in avoiding defects. Gatlin et al., (2013) noted that through effective production management, peer review, owner's commitment, construction manager's skills, value engineering, and quality management and by adopting new technology in construction defects can be prevented. Company BB is now incorporate proactive, preventive and corrective measures for quality assurance and also for achieving benchmark.

6.10. Change Management

Construction industry is dynamic and changes are unpredictable. Construction industry works under uncertainties (Nahod, 2012). Main constraints faced by construction projects are project scope (analysis and approval of changes) finance and time. Rework can drastically disturb the cost and time schedules. Data analysis in under study of six projects shows that in Company AA mean of margin at risk due to unapproved change order is 2.4% and in Company BB is 4.2%. In case of performance indicator 22.5% declared Company BB performance as not up to the mark

and 27.5 % declared that performance was average. It is considerably high in Company BB. Nahod (2012) has mentioned seven major reasons of changes which can be demanded by stakeholders or project conditions. Those are as follows: (1) delayed recognitions of needs, (2) incomplete documentation, (3) changes in technology, (4) lack in availability of material, (5) delayed issuance of financial resources, (6) at times contractor request changes for saving purpose, (7) and introduction of new regulation between designing and construction phases. It is observed from the case study and questionnaire survey that Company BB lacks in management and its projects are facing delayed completion at higher cost, low level of customer satisfaction on product and services, quality standards are not being met.

Company BB needs to decide thresholds for changes. And also the company should consider what type of changes up to what extent can be made and those projects activities which cannot be modified? It is known at initial stages of projects design that change request can be entertained in better manner. Effects of changes can be measured through applying theoretical frame work but currently Company BB is not practicing it. Proactive planning and control method can be used to address change requests. Nahod (2012) has presented dynamic planning and control method (DPM) to evaluate the changes and its effects on projects. It also compares its effects with the initial project plan.

6.11. Project Team Performance

A well planned and executed project with least number of disputes among stakeholders, efficient cost and time scheduling, effective management of suppliers and well integration of all phases of construction can have effects on customer satisfaction. In Company BB, a total of 17.5% respondents declared Company BB team performance is very good and 17.5% responded as good; whereas in Company AA 22.5% declared team management performance is very good and 40% as good. Company BB needs to train their project teams and also have a plan of integration of all construction activities. Cross-functional teams which influence construction activities can ensure satisfaction of customers at each stage of construction. Hiring employees with Company AA experience or equivalent level of expertise can be tactic to take the benefit from the experience or expertise of the employees; furthermore it can also help in achieving benchmark. It is necessary to set the targets, and monitor and assisting the teams for meeting those targets. Targets must be SMART and set according to the benchmark points.

6.12. Control over Biodiversity

Coordination between designers, constructors and developers can result into biodiversity control during construction and during operation of building. In Company BB, a total of 37.5% respondents believe that control over diversity impact of whole project was fair. There is need to have strict control to minimize the impacts on ecosystem, natural resources destruction. Use of recycled material, enhancing quality of structure and functions of site and adding landscaping can be beneficial for the environment. Control over waste, discharge of harmful gases during construction, efficient use of earth resource, use of green technologies can reduce harmful impacts on ecosystem.

Keeping effective control over biodiversity, harmful impacts demonstrates organizations' social responsibilities towards environment (The business and Diversity Resource Centre, 2000). Nowadays, those companies which have adopted eco-friendly technologies in their operation and product development have got better image in customer's minds. Adopting eco-friendly approaches is essential to secure license for authorities and following of regulations. Bio-diversity control also can result in cost savings as resources are utilized with efficient manner and with minimum wastage. Usage of green material, having energy conservation, system and integration of HVAC systems with solar energy conservation plan will not only ensure the effective use of earth resources but also help in having good impact on environment. On construction organisations in Kuwait, government pressure, competitors and investors' involvement and demand from customers for strict following of biodiversity control methods is being increased with the passage of time. In case of non-improvement over control, company reputation, license and investment can be on stake.

6.13. Consideration of Biodiversity

This section is about to know about up to what extent Company AA and Company BB have considered Biodiversity impacts during planning and construction. In Company BB, a total of 22.5 % respondents stated that there was some control and 37.5% declared that Company BB have fair consideration over Bio-diversity impacts during projects. There is immense need for improvement in designing and construction of buildings that ecosystem not suffer. According to the Dixon (2010), construction planning, designing and construction, and their integration are complex and have deep effects around us. Sustainability is required in design and construction and it is not an easy task. It demands solid commitment form contractors, its design and

construction team, sub-contractors and procurements. Each activity is required to be carried out with the use of effective resources, with minimum waste and harmful effects. A thorough consideration of global warming which is causing climate change and assessment of useful life of a project (from designing to construction to demolition) can be a cost saving technique. Consideration of bio-diversity impacts is all about providing a healthy space to live and breathe for residents and species living around which are also economical affordable and fulfils all social needs.

6.14. Design Quality Indicator

This section presents the design quality indicator (from question 11 to 16 in questionnaire). In fact the design standards of any building are formed from client's perspective as client may give more value to cost and time schedule over design quality of respective building. Financial Budget always stands at a constraint in the way of achieving high design quality. Data analysis reveals that 30% respondents agree whereas 22.5% strongly agree that building project completed by Company BB provide easy accommodation. 30% respondents disagree that buildings does not provide versatile lighting whereas 30% disagree, 37.5% disagree that buildings are secured whereas 22.5% agree that buildings are secured.12.5% strongly agree that building offer whereas 22.5% disagree that building offers enjoyable passage and common areas. 15% strongly disagree and 12% strongly agree that buildings' outlook is in accordance with its location.15% disagree that buildings are secured whereas 17.5% agree that buildings are energy efficient. While analyzing responses data shows that in case of Company AA opinion's standard deviation fluctuates between 1.114 and 1.474 whereas in case of Company BB it is between 1.219 and 1.441. For meeting design quality standards, it is essential to understand client's needs correctly as from customer point of view quality standards can have different meaning. Company

BB and similar organisations need to have a design consultant which can define and explain design standards to stakeholders. Documentation is necessary to record design standard in details. Building owner and Company BB needs to understand what actually they require from buildings. Contributions from all the stakeholders in defining and elaborating of objectives of indicators are crucial. In setting design quality, indicators consideration of prevailing regulation related to the building construction, fundamental needs of buildings users, basic needs of stakeholders and users, view of building design and construction planning with similar kind of buildings and enforcement of local and national laws are compulsory.

6.15. Employment Policies

Data analysis demonstrates that in Company AA, 5% respondents answered they are totally dissatisfied from their work, 12.5% are mostly dissatisfied, 13% satisfied and 13% are totally satisfied. In Company BB, 22.5% respondents are found totally dissatisfied from their work, 30% are mostly dissatisfied, and 22.5% are mostly satisfied and totally satisfied. Higher percentage of employees who are dissatisfied in Company BB is an alarming sign. Human resource theories revealed that there is direct relationship between employee performance and satisfaction. Dimensions of employee satisfaction about provision of working environment can be evaluated in many ways. According to the Laryea (2010), employee's dissatisfaction has serious impacts on employee productivity and on project quality. By provisioning of basic needs like food, clean drinking water, first aid services in case of any injury, health insurance and conflict handling can ensure customers that employer is committed to their workers welfare. Detailed documentation of employee policies and procedures can ensure higher level of satisfaction as employees will be aware of their duties and rights. Ambiguous policies, miss handling of issues, non-provisions of basic needs at site can enhance dissatisfaction leading

towards lowering productivity (Danso, 2012). Tasks assignment beyond capacities can hinder in achieving objective of quality assurance. Employees must feel confidence and have faith that what they are doing, and their value in organization. It can also make them satisfied from their organization and work, and they can make them a loyal employee. Application of employee policies in respect to people toolkit can ensure evaluation of employee satisfaction about employment policies, setting benchmark, evaluating performances and taking corrective measures to review and improve policies. According to the Builder and Engineer (2010) aspects of people toolkit covers five major areas: (1) working conditions, (2) health and safety provisioning, (3) equality and diversity issues, (4) training and development plan, and (5) work in occupied sites and employee satisfaction. Toolkit provides checklist of all activities to be performed, performance measuring of employees, outcomes to different policies changes; and all data provided by tool kit can be used in setting benchmark or comparing with set benchmarks. Advantages of tool kit are evident since 2002, as improvement in construction industry indicators relating to employees is gradually being increased (Builder and Engineer, 2010).

The research results also revealed that a total of 35% employees of Company AA believe that their organization performance in relation to labour safety management is good whereas 32.5% rated it as very good. In case of Company BB, only 10% responded that Company BB's performance is very good, 17.5% declared performance as good whereas 32.5 % respondent has the deferent opinion about performer in labour safety management issues of employees. This record shows that Company BB has to work on the plans to assure labour safety which is also a major reason of employee dissatisfaction. Furthermore, employees were also asked about Equality and Diversity Management in their respective companies. In Company AA, minimum

2.5 % employees consider that their organization has no policy to handle equality and diversity problems and no consideration is paid by management. 25% believe that policy is not implemented, 17.5 % policy is in place but partially implemented, 35% has perception that policy is well on the way to being fully implemented, and 20% believed that policy is fully implemented. In Company BB, a total of 15% consider that policy is fully implemented, whereas 12.5% declared that Company BB has no policy in place and even is not considered it a crucial subject. A total 30% respondent answered employees are concerned but with no policy, 17.5% says policy is partially implemented whereas 25% believe that their organization is on the way to implement policies to handle employee's equality and diversity issues. Construction sectors have faced skill gap even in the years of recession (FMB, 2010). Therefore, it is inevitable for Company BB to develop a policy framework to manage its equality and diversity issues as employees, contractors, and subcontractors are belong to different backgrounds. Company BB has to work comparatively better in the following areas: (1) temporary workforce, (2) project delivery, (3) dependency over capital investment, (4) financial and time limitations, (5) and dependency on contractors and for sub-contractors for supplies.

The impact of dissatisfaction about human resource policies, level of performance about labour safety and consideration of equality and diversity measures can be seen on employee turnover. Data demonstrates that in Company AA employee turnover rate in the years of 2007 to 2012 remained between 4% and 5.4% whereas in Company BB it remained between 4.4% and 7.9%. Average turnover rate of six years in Company AA is 4.7 and for Company BB it is 5.95. Use of respect for people toolkit and KPI assist in ascertaining the causes of high turnover and allows the organization to change its practices to retain high performances. Link between management

practices and businesses performance can also be established with RFPT toolkit. This toolkit also offers further data needed to handle problems with a company from many years. As research results show that Company BB has not got a considerable record in human resource policies and practices. High accident rate leads to employee's dissatisfaction about policies of handling injuries at site and as a result turnover remained high. Construction industry inherits widespread risks for employee which demands full commitment of management. For any organization like Company BB, it is compulsory to collect concrete data on the employee performance, turnover, number of incidents, and all internal processes linked with employee performance and develop relationship between employee management and business performance. Measuring performance and then comparing it with Company AA can bring challenges for Company BB as it can analyze clearly where actually Company BB is and where it wish to reach.

6.16. Quality Management System (QMS)

The results show that in Company AA maximum 45% respondents consider that in their respective company performance of quality management system is good and a total 37.5% believe that it is very good; whereas in Company BB situation is different as only 12.5% believe that quality management performance is very good. Data reveals that there is a great need and potential for improvement in Company BB. Quality assurance is vital for all construction organizations, in all kind of projects and all stages of construction. Company BB is not able to afford to wastage of valuable resources as it causes cost and schedule overrun. Process quality should be the focus of the Company BB. According to Arditi and Gunaydin (1997), setting objectives is crucial in construction projects as scope of activities also depend on it; subsequently

it can guide designers, architects, engineers and owners to maintain quality controls during designing and construction process.

6.17. Material Management

Improper handling of materials at site gives rise to many problems in construction projects. Data analysis shows that in Company AA, maximum 45% respondents believe that company's performance in relation to material management is good whereas in Company BB only 22.5% participant responded the same. a total of 25% in Company AA and 17.5% in Company BB consider that performance is very good. It is noted by the Vyas and Patel (2011) in their research on "*material management on project sites*" that material and equipment may cost up to 70% in a typical construction projects. Therefore for avoiding cost and time variances, material management is important in any project. The purchase order, invoices and quotations are some of the documents with the help of which material purchase can be controlled. Best price associated with high quality material (specified by the designer/engineer); and timely deliveries are the factors which are to be considered at the time of procurement of material. When material is purchased it is called as inventory. In material management, inventory control is very important; as the various costs are associated with it for instance: (1) purchase costs (price of material), (2) order cost (administration cost associated with purchase), (3) holding costs (handling cost of storage cost etc.), and (4) unavailability costs (in case of non-availability of any material in inventory).

According to the research results, Company BB management performance needs immense improvement at all levels and in all processes. Without management commitment, it is impossible to achieve. Without material management and effective employment policies,

negative time and cost variances cannot be avoided. Consideration of DQI as per requirement of stakeholders and bio-diversity impacts, it is impossible to satisfy the internal or external stakeholders of construction projects.

6.18. Recommendations

In this section a list of recommendations are given to company BB in order to enhance their practices and performances.

6.18.1. Cost Variance Recommendations

- Company BB needs to develop a system to calculate its project cost at each phase from the initial stage of designing to completion and also include projects operation. Developing a knowledge base system which can include and compare budgeted cost with actual cost at each stage of project is essential for being aware about any cost deviations. On the basis of knowledge base system, Company BB can overcome unfavorable variance which it experienced in the past projects by taking corrective actions.
- Medium size construction organisations are also recommended to perform feasibility analysis before starting the project which can give them idea about the financial feasibility about the project.

6.18.2. Time Variance Recommendations

- Company BB needs to develop a network model which can keep record of all construction activities, estimated completion time, discounted completion time and actual time of completion. Network model can assist from the beginning of the project regarding

time variances and allow Company BB to take corrective actions to achieve desired goals and reach its benchmark. Network models which allow time scheduling also offer formation of relationship between activities and schedules.

- Medium size organization like Company BB needs to have an effective MIS for keeping records of cost and time schedules.
- Company BB and other organizations need to review its list of subcontractors, rewrite its agreement and show zero tolerance in case of delayed supplies at increased cost without compromising at quality.
- It is also recommended to use a project management system in order to perform the task management.

6.18.3. Customer Satisfaction Recommendations

- The organization like Company BB should strengthen its communication abilities with project owners for the purposes of recording of project specifications in details. Giving importance to long term satisfaction, satisfaction can increase the total value of the project.
- Company BB and the companies of same level need to develop a system to evaluate the level of satisfaction at three stages: pre-construction, construction and post construction. Detail documentation, effective communication to understand actual needs, continuous feedback from customers can shorten the gap between desired services and delivered services.
- This is recommended for the medium size Kuwaiti construction companies to provide the customers regular opportunities for the feedback. They should make available the

feedback opportunities where the customers can provide their feedbacks easily; for example, provide them opportunities on the social media as the social media is one of the easiest ways to provide feedback to the companies.

6.18.4. Delivering Quality Projects Recommendations

- It is recommended for the medium size construction industry in Kuwait that they should have a quality manual which can be used in order to deal with the quality issues.

6.18.5. Managing defects Recommendations

- For medium size construction companies in Kuwait, early discovery of defects is the better way of ensuring quality in projects and avoiding cost and time overrun
- Defects should be minimize through enhancing awareness, conducting through investigation, discovery of root cause, evaluation and examination, and taking corrective actions

6.18.6 Change Management Recommendations

- A comprehensive knowledge system having projects details with changes can assist the project managers to investigate the impact of changes on cost and time schedule. Managing change contributes to the achieving project success with benchmarking.
- Also, it is recommended for the medium size construction organisations to have a flexible policy in order to deal with change.

6.18.7. Control over Biodiversity Recommendations

- Company BB and other organisations need to design a framework integrated with core knowledge base system of organizations which can check and promote about biodiversity impacts of design and construction, use of over resources i.e. heating, lighting, water, energy etc.
- Organisations should ensure the consideration all government regulations regarding energy conservation and usage of resources.
- It is also important to use the green material and green construction techniques in the projects.

6.18.8. Design Quality Indicator Recommendations

- Medium size organisations like Company BB should set criteria to obtain feedback from stakeholders at all stages of construction to ensure that DQI are correct and according to the specifications given by stakeholders. This is the only way with which a construction company can make a building easier to live in, install versatile lighting, enhance security standards, and offer enjoyable passage and common areas, energy efficient with appropriate outlook.
- As Medium Company aims to benchmark its DQI; therefore they must visit building constructed by the high profile companies to understand the difference. For setting

benchmark and then to achieve that mark it is inevitable to adopt a formal ways to setting, recording and document DQI in formal and structured way.

- This is also necessary to have a design quality standard set by the company to improve the design to match with the best construction projects in the country

6.18.9. Employment Policies Recommendations

- A frame work is necessary to establish in order to know which aspect of employee policies and procedures makes employee dissatisfied.
- Organizations like Company BB should improve its employment policies from selection to compensation, working conditions, motivations and availability of health and safety facilities; as satisfied customers can satisfy customers.
- Respect for people toolkit (RFPT) can be used to highlight grey areas related to employee dissatisfaction. This toolkit can ensure that employees are not paid less than minimum wage rate as it is one the major reason of creating dissatisfaction among employees. Therefore, policies related to the minimum wage rate, over time payments, bonuses, rewards and promotions must be clearly stated and communicated.
- Medium size construction companies have to incorporate a culture of continuous improvement in human resource management and achieving benchmark.
- A policy should be in place within the medium size organisation like Company BB about the employees training to handle work pressure so that quality of work remains satisfactory.

- Also employee policy is recommended for training employees in order to handle any danger or risk attached to work, and jobs must be assigned according to the skills possessed by employees.

6.18.10. Quality Management System (QMS) Recommendations

- Company BB management for implementation of QMS in all processes of construction projects is most important. Management participation, contribution and commitment are the ways to successful implementation and operations of QMS.
- Management of organizations like Company BB must be aware about the training of designers, architects, engineers and operational staff working at site. All level of employees must be made aware about the quality management system. Knowledge sharing of QMS, its implantations in all process of construction and its outcomes must be clear to all stakeholders.
- Management must ensure close collaboration and corporation between team members. Teamwork is successful when it allows all individuals to perform their tasks effectively and also collectively in teams. As construction industry is project oriented; therefore for the quality assurance tasks must be defined in context of projects and assigned to project teams. Corporation between team members and integration between different teams can improve project quality.
- The most important documents in constructions are the drawings by the designers. The more in detail and concise the drawing can lead less chances of rework.
- For monitoring and evaluation of project performance statistical tool are very important. Statistical tools also help in solving problems; however Company BB management and similar organizations need to aware of them as they are not using them frequently. For

Company BB, it is essential to introduce a feedback system to know the existing quality levels and improve it.

- Implementation of quality management system consumes management financial budget. As QMS advantages can be obtained for many years; therefore it should not be considered as expense rather an investment. Company BB must not consider financial budget as a constraint in implementing QMS as it can also guarantee competitiveness and enhance opportunities.
- Company BB and similar construction companies must consider a project as a process where at all stages achievement of stakeholder satisfaction is inevitable. Not only internal stakeholders (employees) but also all external stakeholders (Owners, subcontractors, final users, government, other outsourced agencies).
- It is essential to record all the need of customers at initial level of planning. Any ambiguity in customers mind must be made clear. It can also assist in reducing number of changes and cost related to changes. Final requirement must be communicated and agreed upon by the customers, designers and management. The effective planning with detailed documentation of project allows smooth working of project.

6.18.11. Material Management Recommendation

- Company BB and similar construction companies' procurement manager should become proactive in purchasing material; and also suppliers must be selected with consciousness.
- Quality of material must not be compromised; as may be a low priced material cause a big cost at later stage of construction.

- Economic order quantity should be managed to avoid unavailability cost and holding cost. Timely delivery of material should be made confirmed as it assists in controlling overrun of time schedule.
- Procurement manager can initiate material purchase before awarding contract to constructor to avoid any delay.
- Documentation related to the material specifications and standard for usage must be communicated to labour at site; as in wastage can be controlled in this way.
- A Management Information System (MIS) must be in placed to record all the material required, their pricing, material issued at site, and inventory with economic order quantity. Historical data helps construction companies to award future purchase orders to reliable suppliers and with the information held in system benchmarks can be achieved.

6.19. An Approach for Medium Size Construction Organisations in Kuwait to Benchmark

Medium Size construction companies in Kuwait should follow the following approach in order to improve the quality:

Step 1- Understanding current business process

- Medium size organisation documentation about the performance studied to understand the current situation and process of business
- Company projects were overseen to understand the company performance
- Company's weak areas were identified to be benchmarked

Step 2- Analyzing the business processes of others:

- The businesses with high profile in the same field were identified
- Analysis of each business was done based on their performance in the past and with the expert's view
- After the analysis, benchmark company was found to be suitable for benchmark

Step 3- KPIs identification and development:

- After analyzing the medium size company and its weaknesses, the following KPIs were identified and developed:

KPIs	Data Type
Construction Cost Performance Indicator	Historical
Construction Time Performance Indicator	Historical
Customer Satisfaction on Services Indicator	Current/Questionnaire
Customer Satisfaction on Products Indicator	Current/Questionnaire
Quality Management System (QMS) Indicator	Current/Questionnaire
The Project Team Performance Indicator	Current/Questionnaire
Change Management Indicator	Current/Questionnaire
Material Management Indicator	Current/Questionnaire
Labour Safety Management Indicator	Current/Questionnaire
Impact On Biodiversity Indicator	Current/Questionnaire
Employee Satisfaction Indicator	Current/Questionnaire
Staff Turnover Indicator	Historical
Equality & Diversity Indicator	Current/Questionnaire

KPIs	Data Type
Design Quality Indicator	Current/Questionnaire

Step 4- Designing Questionnaire based on the KPIs:

- Considering the KPIs from the previous step, the following questionnaire was designed to collect data for benchmarking:

Questionnaire:

Organization Name	Organization Name				
Designation					
Experience	Years	Department			
Gender	Male		Female		
Age group	26-30	31-35	36-40	41-45	46-50

Are you satisfied with the construction project?
Totally dissatisfied (b) Mostly dissatisfied (c) Neither satisfied nor dissatisfied (d) Mostly satisfied (e) Totally satisfied
Are you satisfied with the overall services offered by construction team?
Totally dissatisfied (b) Mostly dissatisfied (c) Neither satisfied nor dissatisfied (d) Mostly satisfied (e) Totally satisfied
Company completes the projects within the quoted price.
Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree

Company completes the projects within the stipulated time.
Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
Management is fully capable of delivering the quality projects?
Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
Management is fully capable of resolving any defects?
Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
Management is fully capable of managing “Change”?
Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
What do you feel about the performance of Project team?
Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
What level of control company has achieved over bio-diversity (variety of life in the world) during construction process?
Very effective control (b) Good control (c) Fair control (d) Little control (e) No control
What level of Consideration Company has kept about the buildings’ bio-diversity (variety of life in the world) impacts?
Thorough consideration (b) Good Level of Consideration (c) Fair consideration(d) Some consideration (e) No consideration
Company Projects provide easy accommodation according to the users’ requirements.

(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree

Company Projects provide versatile (multipurpose) lighting for meeting users' needs.

(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree

Building is secured in all aspects.

Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree

Company Projects provide enjoyable Passage and common areas.

Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree

Buildings' outlook is in accordance with its location.

Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree

Buildings are energy efficient.

Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree

Are you satisfied with the management's performance in relation to employment policies?

Totally dissatisfied (b) Mostly dissatisfied (c) Neither satisfied nor dissatisfied (d) Mostly satisfied (e) Totally satisfied

What do you feel about the performance of management in relation to labor safety measures?

Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance

What do you feel about the performance of management in relation to QMS (Quality Management System)?

Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
What do you feel about the performance of management in relation to material management?
Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
What level of Consideration Company has taken about equality and diversity measures?
No policy and do not consider the subject (b) Policy is not implemented (c) Policy is only partially implemented at present (d) Policy is well on the way to being fully implemented (e) Policy is fully implemented

Step 5- Comparing both:

- Medium Size Company and Benchmark Company were compared based on their performances in the past and the current data collected through the questionnaire survey
- KPIs of each company were compared and evaluated to find out the gap as benchmark point
- After comparing both companies, a big gap found between these two companies

Step 6- Necessary step to bridge the Gap:

- Necessary gap was identified to cover the company weaknesses
- Recommendations were designed to bridge the gap between the companies

6.20. Limitations

This study has various limitations as data relating to benchmarking in construction industry was very limited. Substantial amount of literature was available about project performance but not in relation to benchmarking. There are hundreds of KPI; however selection of most relevant KPIs was made after thorough study and Key KPIs were selected. Therefore, it is not possible for any organization to measure and improve their performances on KPIs selected in this research. Each company has to determine its own KPI and then evaluate it. In other words, results of this research cannot be generalized; although these can be used as guideline for same kind of companies.

Most difficult task was to select case studies from Kuwait. People are reluctant here in sharing their business information. After meeting many companies' executives Company AA and Company BB management agreed to share their business information for this research and allowed us to conduct surveys with their teams. Thereafter, selecting such projects about which data can be gathered from owners as well was tough. Employees of Human Resource Department (HRD) were also reluctant in giving their feedback about human resource policies of their companies.

Furthermore, questionnaire required the closed responses of project owners, design teams, employees and project employees. This was done to collect a standardized data and avoid collecting any extra data which make analysis difficult. Further data was collected from limited respondents which was 40 respondents from each company. Questions were very basic to make general assessment of project performance therefore cannot be used to make critical claims. Due to nature of this study, it is important to evaluate each construction companies KPI application in Kuwaiti construction industry in order to apply this study on any company.

6.21. Future research work

For future research work, it is recommended to develop a more suitable KPI suite to help in assessing Construction Company's performance in details and can be suggestive in improving performance of those areas where the root cause exists. KPI suits should be appropriate in the sense that it could be compared with the other organizations KPI suits for benchmarking. For enhancing ability to generalization of the research sample size for collecting data can be increased. Number of projects of which performance is measured can also be increased. Number of construction companies can be increased and cross benchmarking can be done. That means, measuring of performance of more than two companies and benchmarking will be done with that company's KPIs of which performance is high among all. Furthermore, sample size for collecting data can be increased from 40 in order to increase the ability to generalize results. For this research, projects were selected from the amount of KD 3.0 Million or less. This cap limit can also be lift and projects of different amount can be selected. Other method of data collection like interviews can be selected for knowing the rationales behind certain responses of respondents.

Furthermore, similar studies can also be conducted with other construction companies working in Kuwait. It is the company's choice to select its own KPIs and benchmark it internally or externally. Benchmarking and its impact on construction industry must be evaluated with the goal of improving overall performance of construction industry.

Future research can be conducted to find a general framework to develop a systematic method to measure the performance in order to accommodate different size organisations in different fields. Researchers can create a flexible formula for measuring the performance, which can be changed, based on the size and type of the organisation. Moreover, work can be done with the greater sample size of customers and employees (300 or more) for revealing the broader results and maintain the certainty of these KPIs. Furthermore, the use of these KPIs would gain more certainty through testing their validity with the Construct validity (documents to be examined to find relationship between KPI and its measurement). Internal and external benchmarking can be considered for multiple organisations and with different international organisations in the same field.

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Appendix 1 – Questionnaire

KPI Benchmarking in Construction Projects – Questionnaire for Project Owners, Owners’ representatives and Users

Purpose

1. To ascertain the satisfied project owners with the construction projects
2. To ascertain the satisfied project owners with the services offered by constructors
3. To ascertain that how much management is concerned about biodiversity impacts of construction projects
4. To ascertain the level of change management by the constructors and designers of the buildings
5. To ascertain the level of satisfaction of project owners about project team performance
6. To ascertain the employee’s perspective about material management, labor safety management and quality management systems
7. To ascertain the overall satisfaction about their job
8. To ascertain that how much management is concerned about implementing equality and diversity management

This questionnaire contains statements about project owners’ satisfaction for its project, services, change management, biodiversity impacts and team performance employee’ perceptions about management, safety measures and policies relating to equality and diversity and management of employees. Next to each statement, mark the statement which is most suitable.

You are requested to be honest in marking as there is no wrong and correct answer. This is just an assessment of project performance. Thank you for your valuable contribution and time.

To be filled by project owners:

Project Name	
Project Value	
Constructor Name	

To be filled by employees:

Organization Name	Organization Name				
Designation					
Experience	Years	Department			
Gender	Male			Female	
Age group	26-30	31-35	36-40	41-45	46-50

1. Are you satisfied with the construction project?

- (a) Totally dissatisfied (b) Mostly dissatisfied (c) Neither satisfied nor dissatisfied
 (d) Mostly satisfied (e) Totally satisfied

2. Are you satisfied with the overall services offered by construction team?

(a) Totally dissatisfied (b) Mostly dissatisfied (c) Neither satisfied nor dissatisfied (d) Mostly satisfied (e) Totally satisfied
3. Company completes the projects within the quoted price.
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
4. Company completes the projects within the stipulated time.
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
5. Management is fully capable of delivering the quality projects?
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
6. Management is fully capable of resolving any defects?
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
7. Management is fully capable of managing “Change”?
(a) Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
8. What do you feel about the performance of Project team?
(a) Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
9. What level of control company has achieved over bio-diversity (variety of life in the world) during construction process?
(a) Very effective control (b) Good control (c) Fair control (d) Little control (e) No control
10. What level of Consideration Company has kept about the buildings’ bio-diversity (variety of life in the world) impacts?
(a) Thorough consideration (b) Good Level of Consideration (c) Fair consideration(d) Some consideration (e) No consideration
11. Company Projects provide easy accommodation according to the users’ requirements.
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
12. Company Projects provide versatile (multipurpose) lighting for meeting users’ needs.
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
13. Building is secured in all aspects.

(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
14. Company Projects provide enjoyable Passage and common areas.
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
15. Buildings' outlook is in accordance with its location.
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
16. Buildings are energy efficient.
(a) Strongly disagree (b) Disagree (c) Indifferent (d) Agree (e) Strongly agree
17. Are you satisfied with the management's performance in relation to employment policies?
(a) Totally dissatisfied (b) Mostly dissatisfied (c) Neither satisfied nor dissatisfied (d) Mostly satisfied (e) Totally satisfied
18. What do you feel about the performance of management in relation to labor safety measures?
(a) Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
19. What do you feel about the performance of management in relation to QMS (Quality Management System)?
(a) Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
20. What do you feel about the performance of management in relation to material management?
(a) Very Bad performance (b) Bad performance (c) Average (d) Good performance (e) Very good performance
21. What level of Consideration Company has taken about equality and diversity measures?
(a) No policy and do not consider the subject (b) Policy is not implemented (c) Policy is only partially implemented at present (d) Policy is well on the way to being fully implemented (e) Policy is fully implemented