Performance Measurement of Construction Projects in Jordanian Construction Industry

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ABSTRACT

The failure of any project is mainly related to the problems of the measurement of performance at the construction site. According to the Jordanian Association of Engineers in 2014, many construction projects failed due the absence of feasible performance measurement. This is because construction projects are often exposed to challenges like cost, time, quality, human resources (i.e., training, workshops), safety and others. The objective of this study is to analyze the performance measurement of construction projects in Jordan. The factors affecting the performance of construction projects will be identified and strategic plans will be proposed as a recommendation.

Owners, consultants and contractors were asked to rate the ten (10) key performance indicators. Data collection was conducted via online questionnaire and eighty one respondents participated in the study (n=81)c. In this study, the Correlation analysis, relative importance index and t-test were used to identify the difference in perception among stakeholders. Also, the major aspects influencing the success of projects in the Jordanian construction industry were identified.

The results suggest that, the essential factors agreed by the consultant's, contractors and owners were: delivery delays due to shortage and lack of raw material, cash flow, and the duration for site preparation, the activities and behaviors of employees at the site. These stake holders (i.e., owners, consultants, and contractors) differ in terms of perception towards the ten performance factors due to their diverse interests and views. The outcome of this study shows that construction firms must have clear and concise strategic plans, which will enable them generate, apply and assess their performance relative to others or

previous projects. This study has contributed to our understanding of the current performance challenges in the Jordanian construction industry. Managers can benefit from this study by taking into consideration the factors affecting construction projects in Jordan.

Keywords: Jordan, Construction projects, Construction industry, Performance measurement

ÖZ

Herhangi bir projenin başarısızlığı özellikle inşaat sahasında karşılaşılan performans ölçüm sorunlarına ilişkindir. Ürdün Mühendisler Birliği 2014 yılı raporuna göre, birçok inşaat projesi uygulanabilir performans ölçümü eksikliği nedeniyle başarısız olmuştur. Bunun nedeni inşaat projelerinin genellikle maliyet, zaman, kalite, insan kaynakları (eğitim, atölye çalışmaları vb.), güvenlik ve diğerleri gibi sorunlara maruz kalmasıdır. Bu çalışmanın amacı, Ürdün'deki inşaat projelerinin performans ölçümünü analiz etmektir. İnşaat projelerinin performansını etkileyen faktörler tespit edilecek ve stratejik planlar bir öneri olarak sunulacaktır.

Mal sahipleri, danışmanlar ve müteahhitlere on (10) anahtar performans göstergelerini derecelendirmeleri istenmiştir. Veri toplama çevrimiçi anket yoluyla yapılmıştır ve seksen bir katılımcı çalışmaya (n = 81) katılmıştır. Korelasyon analizi, göreceli önemi indeksi ve t-testi, paydaşlar arasındaki algıyı farkını sıralamak ve tanımlamak için bu çalışmada kullanılmıştır. Ayrıca Ürdün inşaat sektöründeki projelerin başarısını etkileyen önemli yönler tanımlanmıştır.

Sonuçlar, danışmanlar, müteahhitler ve sahipleri tarafından kabul gören temel faktörlerin hammadde, nakit akışı sıkıntısı ve eksikliği nedeniyle geç teslimler, şantiye hazırlama süresi, aktviteler ve sahada çalışanların davranışları olduğunu göstermektedir. Bu paydaşlar (yani malsahipleri, danışmanlar ve müteahhitler) farklı çıkarları ve görüşleri nedeniyle on performans faktörlerinin algısı açısından farklılıklar göstermektedir. Bu çalışmanın sonucu inşaat firmalarının, diğer firmlara veya önceki projelere göreceli olarak üretmelerini, uygulamalarını ve performanslarını değerlendirmelerini sağlayacak

açık ve anlaşılır stratejik planları olması gerektiğini göstermektedir. Bu çalışma Ürdün inşaat sektöründe yaşanan mevcut performans problemlerini anlamamıza katkıda bulunmuştur. Yöneticiler Ürdün inşaat projeleri etkileyen faktörleri dikkate alarak bu çalışmadan yararlanabilirler.

Anahtar Kelimeler: Ürdün, İnşaat projeleri, İnşaat sektörü, Performans ölçüm

To My Family

ACKNOWLEDGMENT

First, I would like to thank my supervisor Assoc. Prof. Dr. Ibrahim Yitmen for his continuous support and guidance throughout my thesis. I would like to give special thanks to my parents for tirelessly supporting, encouraging and inspiring me to reach my dreams through all the life changing events. I would like to dedicate this thesis to them as an indication of their significance in my whole life. In addition, some close friends had always been around to support, and even advised me on various aspects related to my study. I am indeed indebted to them for their kindness and concerns.

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INTRODUCTION

1.1 Background of the Study

The construction industry plays a major role in the development and betterment of the society (Butcher & Sheehan, 2010). According to Navon (2005), it is among the largest industries which is approximately 10% of the gross national product (GNP) of the developed nations. The industry has several stakeholders who make it complex namely; regulators, customers, consultants, contractors, and shareholders (Crespin-Mazet, Havenvid, & Linné, 2015). Performance improvement has been the subject of interest to researchers and practioners in the construction industry (Eccles, 1991; Egan, 1998; Kaplan, & Norton, 1996; Latham, 1994).

Navon (2005) added that national economy have significant effect (negative or positive) on the performance of the industry, besides, the performance of other sectors may also have induced effect due to the interactive relationship with all mankind activities. The arrival of refugees from the neighboring countries has led to the renewal of this sector, the presence and willingness of investors has dramatically increased. This is primarily due to favorable political climate and adequate support from the Jordanian government.

There are various sub-standard new initiatives and long-range plans for the improvements of construction industry and projects. The government has failed to

act despite acknowledging deficiency in construction project performance and the necessity to change it. Bassioni, Hassan, and Price (2008) stated that the construction industry performance can be best assessed via the reliance of performance measures. The authors developed an excellence model which is expected to serve as a benchmarked for performance is evaluation in the construction industry. Performance measurement is defined as “the process of quantifying action, where measurement is the process and method of quantification and action leads to performance” (Neely et. al., 2000).

Jordan is a "upper-middle” income country, with sparse natural resources, situated in a politically unstable region. The country utterly depends on foreign aid from developed nations, to meet its national budget. In 1962, the country implemented a five year national development plan (1962-1967), since then the sector has been for its socio-economic development (Al-Momani, 1995). In 2014, the industry signified 20% of the Jordanian GDP and existing employs 25% of the workforce (JCCA, 2015). The construction industry in Jordan has about 1,900 contracting and 1,170 architecture and engineering firms (JCCA, 2015). There are various regulatory bodies to control the performance and safety adherence of construction firms from all aspects e.g. adherence to standard material usage, site, and construction law etc. Generally speaking, these regulations are formulated by the ministry of public works and housing (MPWH), the Jordanian construction contractors association (JCCA), in conjunction with association engineers, contractors, consultants and environmentalist. All these supervisions (technical and administrative) are required to ensure that construction projects are done with the highest quality of all

engineering standards. This is because clients, investors and other stakeholders are demanding continuous improvement (Stewart, 1997; Watson, & Seng, 2001).

Regardless of the importance of the construction industry in the national economy, poor performance has hindered the overall growth (Al-Momani, 2000). A number of underlying factors and challenges exist within the Jordanian construction industry. Among others, these challenges include delays and overruns as noted in (Sweis, Sweis, Abu-Hammad, & Shboul, 2008) influential study, long legal procedures (Al-Momani, 1995) and the absence of clear indicators of productivity and growth as well as the availability of data (EnConsult, 2007). Delays in construction projects can occur from work organization between the owners, contractors and consultants, and also quality assurance due to sub-standard work processes employed by the Jordanian construction firms. Error in calculations is due to inexperienced engineers (Al-Moumani, 1995); miscalculations of material quantity (Al-Moumani, 1995). For example, a scandal happened in Amman (Project name: Tlaa Ali), the building collapsed. The scandal was due to the use a low quality material to cut costs and miscalculation of building materials. Furthermore, construction projects are not benchmarked both internally and/or externally. Perhaps, there is a significant knowledge gap pertaining to key performance indicators (KPIs). Research has shown that factors that affect the construction field include time, cost, quality, customer satisfaction, productivity and safety (Al-Momani, 1995).

1.2 Problem Statement

There are many research that focus on the common problems which face construction development, some have advocated that quality assurance is the answer while others have voted against. Other factors like methods and safety standards of

construction projects, inexperience engineers, time, cost reduction formulation and others are the causing great harm to all actors in the construction industry, in particular construction projects. Taken together all this may have negative impact on the company reputation, the country construction sector, create public distrust and pose danger to lives. In order to avoid these problems construction firms are striving hard in finding reasonable solutions to the aforementioned problems. As a solution, this study attempts to create a feasible solution for the Jordanian construction sectors which they can use to monitor their performance and avoid problems.

1.3 Research Objectives

The objective of this study is to develop the performance measurement model which focuses on the betterments of quality, sustainability and engineering performance. The objective of this research is to: firstly determine the KPIs, which affects the workflow in construction industry of the Jordan. Secondly assess the stakeholders (i.e., contractors, consultants, owners, and engineers perception regarding the relative criticality of the KPIs to evaluate the performance of the construction industry in Jordan. Then to determine the relevant and essential performance indicators in the Jordanian construction sector and also to assess the intensity of agreement and disagreement among stakeholders (i.e., consultants, contractors, owners) and to rank them based on KPIs. Lastly, to formulate and propose the recommendations to development performance of construction sector in the Jordan. Moreover, the research includes an extensive literature study and survey conducted with the industry professionals to identify and analyze the factors of performance measurement.

1.4 Research Limitations

Data collection is one of the profound problems this study has, primarily its online nature which may be subjected to the potential effect of causal inference. Secondly, the number of respondent is somewhat less and is only applicable to Jordan.

1.5 Thesis Structure

This study consists on five sections. The section introduces the background of the study, the research problem statement and limitations of the research as well as the research objectives. The second section contains the theoretical overview which describes the historical review of the critical elements affects the performance construction sector. Section three defines the methodological approach of the study and discusses the most applied methods to develop the performance measurement model in prior researches. The fourth section presents the results and analysis which explains the type of analysis conducted. The fifth and last section finally concludes the overall and study, findings and proposed recommendations for the study and the further research.

Chapter 2

LITERATURE REVIEW

According to Okuwoga (1998), performance of the construction industry is of great concern both to the public and private sector. Wegelius-Lehtonen (2001) argued that there is a new trend known as the "performance measurement", this phenomenon is a current subject and hotly debated both in business and in academia. Karim and Marosszeky (1999) added that the performance of the construction industry can be evaluated with the aid of existing KPIs as discussed earlier. These factors are time, cost, quality, client satisfaction, and business performance in other sector and occupational health safety (He et al., 2015). These factors can be used to benchmark the performance index and also to evaluate the success of a construction project (Lu, Chen, Peng, & Shen, 2015).

In their study, Samson and Lema (2002) argued that KPIs are highly appreciated, as they provide value for stakeholders. The KPIs allows stakeholders to monitor processes, both from competitive and distinctive perspective, and help to decide which area requires development or maintenance. As a general rule, benchmarking is the important step to develop engineer's efficiency, contractors' efficiency and effective construction activities, and accomplish high quality processes so its improves the construction process, and minimize the disadvantages and drawbacks that could hamper the construction process. DETR (2000) proposed five stages for

project lifetime and noted that the following KPIs should be monitored to enhance project performance.

Commit to invest stage is where the client decides whether to invest or not and also assess the profitability of the proposed investment. Commit to construct stage is where the client decides to authorize the project team to start the implementation of the business models entrusted to them in the construction industry. Available for use stage depicts the end of the project and it is the stage where the construction project ready for occupation. End-of-defect liability period is the stage where the contractor or builder is no longer liable to repair broken section of the buildings ends (Normally after 1 year from start date). End-of-Lifetime of working in the Project is the stage where the projects contactors achieved the desired goals. At this stage the full life costs can be applied as depicted in Figure 1.

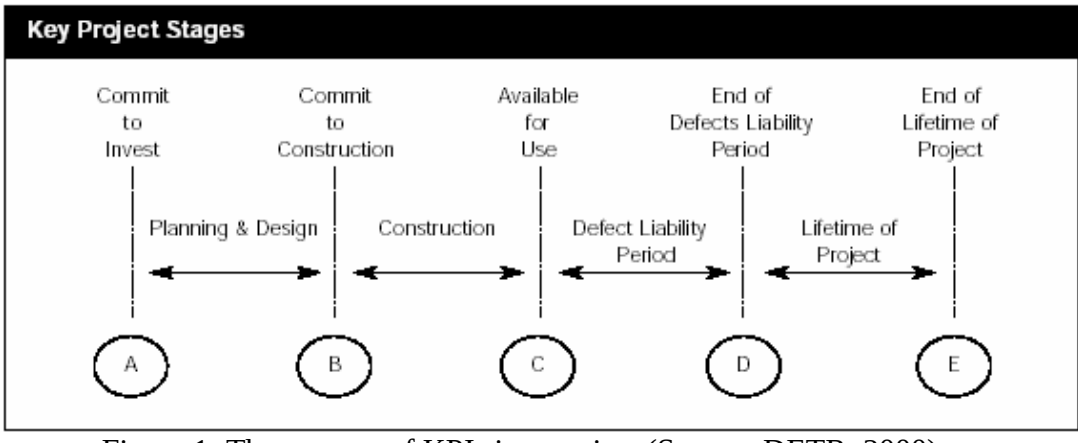

Figure 1: The process of KPIs in a project (Source: DETR, 2000)

There are several researches and definitions for performance measurement primarily due to its importance in the field of construction. For instance, Karim and Marosszeky (1999) defined "performance measurement as an operational

management accounting, consisting of both financial and non-financial performance indicators". The authors further asserted that "performance measurement is a process of re-thinking, re-evaluation of business processes", and the arrangements of important ideas to achieve significant performance in a construction projects. On another account Reichelt and Lyneis (1999) argued that performance measurement is a complex conception that entails a dynamic system structure, which is needed for substantial improvement. Al-Momani (2000) defined owners satisfaction for performance as the process by which a project is delivered on time, with the agreed attributes and qualities.

A construction project performance measurement includes several factors such as time, budget, safety, cost, quality and overall client satisfaction (Kuprenas, 2003). Navon (2005) added that although the performance measurement depends on the above factors, but the distinction that arises between the actual and the desired performance during the agreed period between the stakeholders and contractors is more important. There is a consensus and explanations that are put forth by academicians and experts related to KPIs. These KPIs are very effective and practical due to the fact that they guide decision makers in the assessment of construction project performance levels in a more quantitative and objective manner (Yang et al., 2010).

2.1 Performance Challenges in the Construction Sector

Ogunlana, Prokuntong, and Jearkjirm (1996) classified the performance challenges in the construction industry of developing economies into three parts, namely; shortages of infrastructure, lack supplies and inadequacies of sufficient construction materials for construction projects. Subsequently, Okuwoga (1998) added that problems

associated with performance are likely tied to inappropriate accounting and budgetary processes, the lack of consistent control and time management of projects. Similarly, Long, Stephen, Truong, & Chi (2004) argued that incompetent designers/contractors who do not have sufficient experience in construction sites, poor estimation and change of management, the misconception and the administration failed all construction work, social and technological issues; site related issues and improper techniques and tools are the main facets that negatively affect construction projects. In this sense the behavioral dynamics of an organization may influence its performance (Saleh, 2015).

The performance assessment procedures in the classical era is associated with drawbacks arising from huge, unsorted and distorted information; coupled with the lack of managerial guidelines to guide decision makers to be able to comprehend, sort and consume such information, which in turn allows them to organize and manage the performance of a focal firm (Samson & Lema, 2002). In addition the traditional project performance measurements are generic implying that activities monitoring and control are not accurate or update on regular basis (e.g., cost control is done once a month rather than on timely basis). For instance scholars like, Chan and Chan (2012) extended the Delphi approach to Hong Kong construction industry, and the study found that the approach is better than the traditional methods of performance measurement. The use of non-computerized data increases the risk of wrong calculations, which may have huge consequences (Navon, 2005). Nevertheless, the performance of a construction project is affected by numerous complex and dynamic factors; which encompass of external and internal actors, ranging from materials usage, untimely activities, political, economic, and social to

cultural as noted by (Kim et al., 2008). Figure 2, depicts a scheme that shows the elements and workflow processes causing drawback to construction projects. It is evident from the diagram that human related factors carries the major weight, as such it would not be wrong to say that human related factors should be monitored with extra focus.

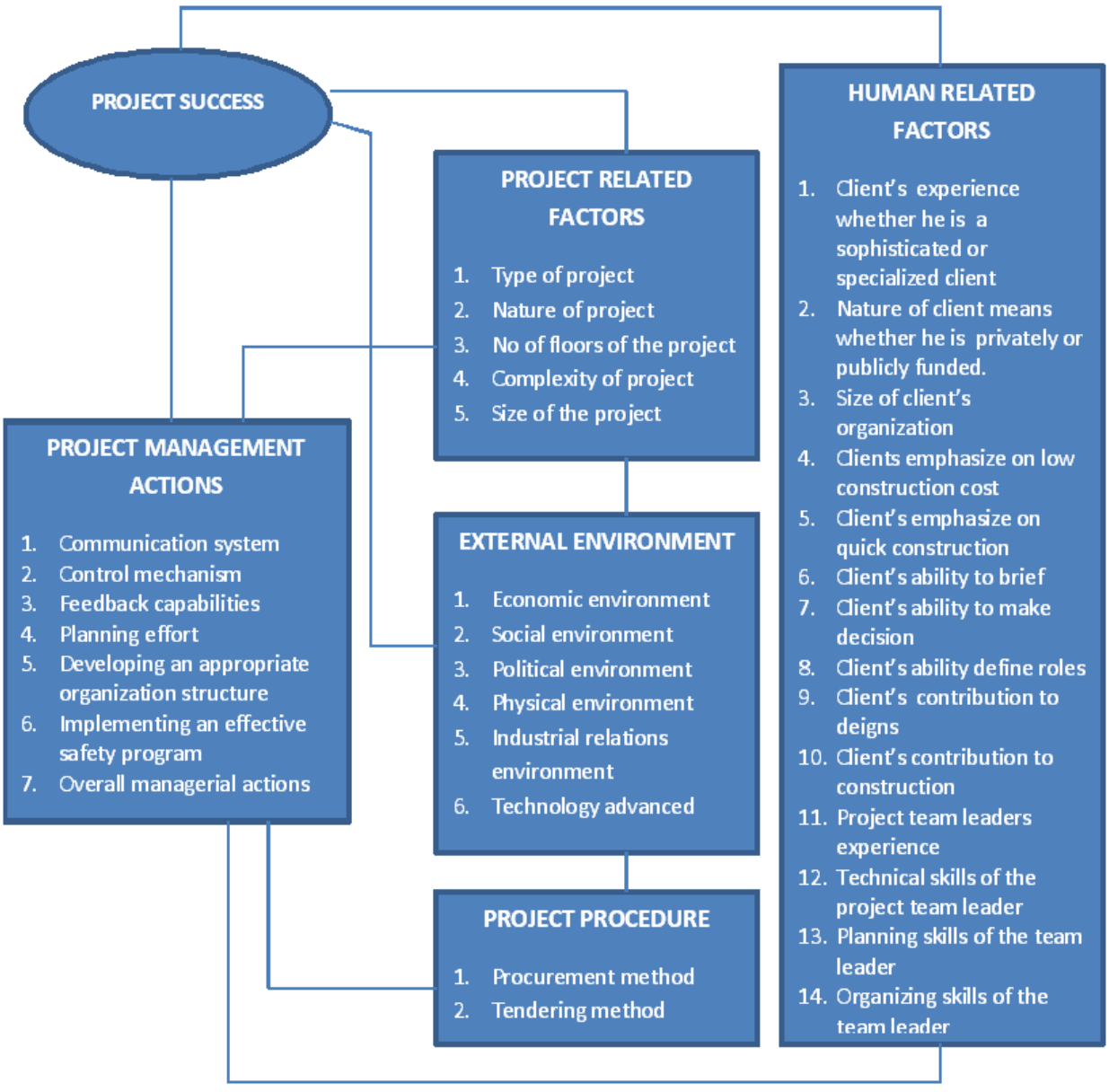

Figure 2: Conceptual framework for factors affecting project success

2.2 Relationship between Management and Performance of Construction Project

Project management and performance are known to be related to each other in a number of ways, as project management affects the project performance itself. A study by Brown and Adams (2000) employed three main KPIs in the United Kingdom namely: time, cost, and quality. The study suggests that the UK performance was not that great when tied to the tested performance factors. Wegelius-Lehtonen (2001) model shows that performance measurement can assist both operational and top managements with continuous feedback and data for operational activities. As such, they can use the data to either alter their decisions or avoid risks. He et al. (2015) proposed that the proper strategy and organization arrangements are necessary for the success of construction projects. As such it can be interpreted that management strategy and organization of resources can affect project performance. Naoum (2016) argued that such as ineffective planning and employee management, leadership and project control as well as material procurement method may have impact on project performance. El-Gohary and Aziz (2014) added that employee's management is related to productivity and performance.

Cheung, Suen and Cheung (2004) focused on the influence of project management on the project performance. The results showed that a web-based project performance monitoring system (PPMS) in construction industry could help decision makers to minimize errors and enhance success rate. Moreover, decision makers can monitor all activities simultaneously with high accuracy. Other scholars like (e.g., Pheng & Chuan, 2006; Enshassi, & El-Rayyes, & Alkilani, 2015) supported the notion the project management can enhance a project performance, in terms of time

and staff management, health measures and quality. Ugwu and Haupt (2007) added that effective decision-making, proper application of design processes, and specifications at various project-level, with the aid of appropriate decision-support tools will produce a defect free construction project. In other words the implementation of proper of human resources policy, leadership commitments and knowledge management deemed necessary (Robinson et al., 2005). Researchers (e.g., Thomas, Ekambaram, & Mohan 2002; Cheung et al., 2004) have highlighted the fact that the basic criteria's for success of a construction project include a plan for workflow, standard of quality, health and safety, resources, the strength of the socio-economic relationship between stakeholders (i.e. consultants, contractors and customers), management technical know-how, conflicts and dispute resolution mechanism, human resources, budget management, time management, environment and regulatory factors and so on. The extent literature is summarized within the Figure 3, which shows how success factors affect performance, how performance affects success rate and how success rate influences the efficiency and effectiveness of construction projects. The root of every success is determined by the planning, resource allocation, organizing and monitoring from the management. Therefore, management role in success of any project has no boundaries.

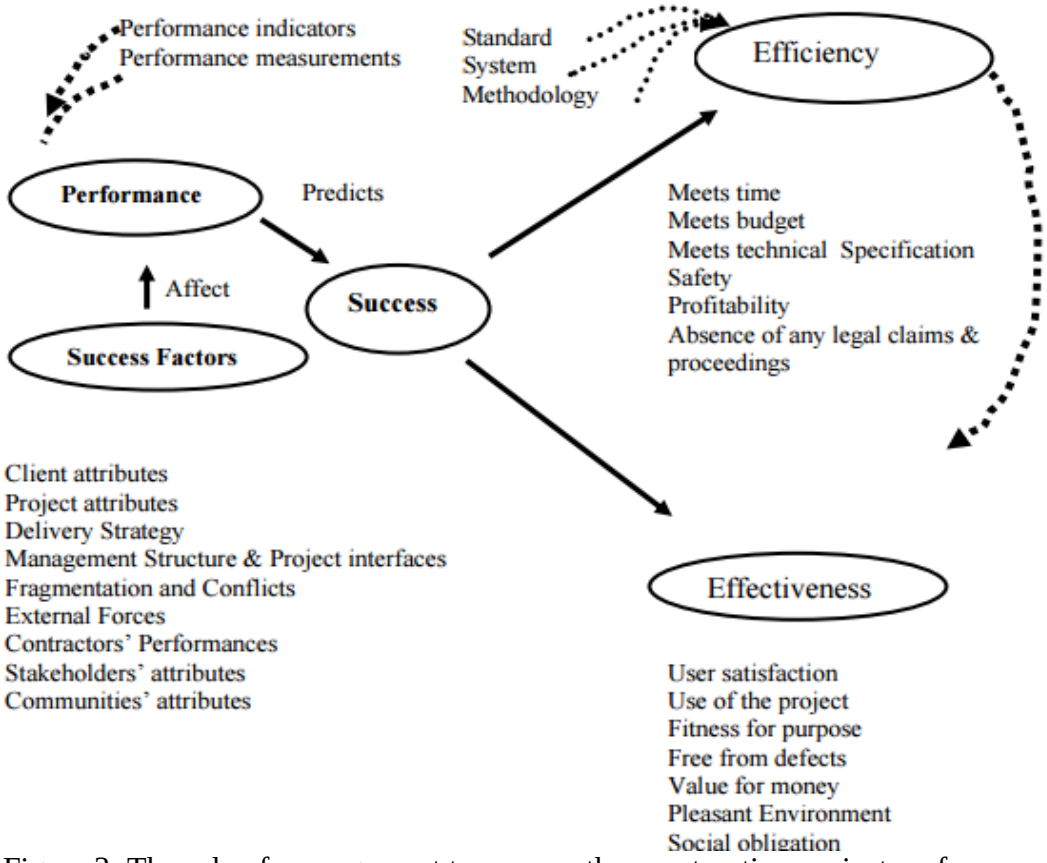

Figure 3: The role of management to success the construction project performance

2.3 Relationship between Information Technology and Project Performance

Information technology has a great role in the construction industry (Caniëls, & Bakens, 2012). It has eased the problems faced by engineers in the industry and has provided engineering programs that facilitate the engineering design and processes. Decision can be taken in a timely fashion, which eventually leads to time saving as well as increased profits for engineering firms. Client's satisfaction is enhanced because they can see blueprints and prototype before project is completed as suggested by (Ali, Al-Sulaihi, & Al-Gahtani, 2013). Information technology has created a better financial control and communications, and simpler and faster access to common data as well as a decrease in documentation errors (Dawood, & Sikka, 2009). Accordingly, performance appraisal of contractors is readily available and can

be disseminated to many actors on time and also cost-effective, which does enact effectiveness in work process (Thomas, Ekambaram, & Mohan, 2002). Nevertheless, investment of money and resources in ICT does not always enhance leading to better construction project performance but rather this should be done with a clear sense of strategy (Pérez-Méndez, & Machado-Cabezas, 2015).

2.4 Performance factors (Cost and time)

Chan and Kumaraswamy (2002) stated that numerous empirical works around the world have focused more on time and construction project performance. Their study also shows how proper time management can speed up projects. Other researchers suggested that both time and cost are important for construction project to be successful (Pheng, & Chuan, 2006). Chan and Kumaraswamy (1996) supported the notion by adding that problems that arises from the initial prototype in the development phase, may lead to performance challenges related to time or cost. Furthermore, Iyer, and Jha (2005) highlighted the existence of various indicators which can put the cost estimation of a construction project in jeopardy namely; competence of the project manager, support from the top management, the ability to coordinate, lead and execute a construction project, experience on the construction project and the presence of experienced engineers to oversee the design of the site, monitoring and feedback by the clients, coordination among project participants, current climatic, economic and social conditions. Similarly Ali, Al-Sulaihi and Al-Gahtani (2013) and Naoum (2016) supported the notion by arguing that some of the aforementioned factors of cost and time are to be given special consideration. For instance, Figure 4 shows the determinants of cost factors ranging from location, specification, tax liabilities, inflation and exchange rates, type of project, timescale

and form of procurement contract. Furthermore, Figure 5 depicts the pictorial factors influencing cost, in other words the cost changers.

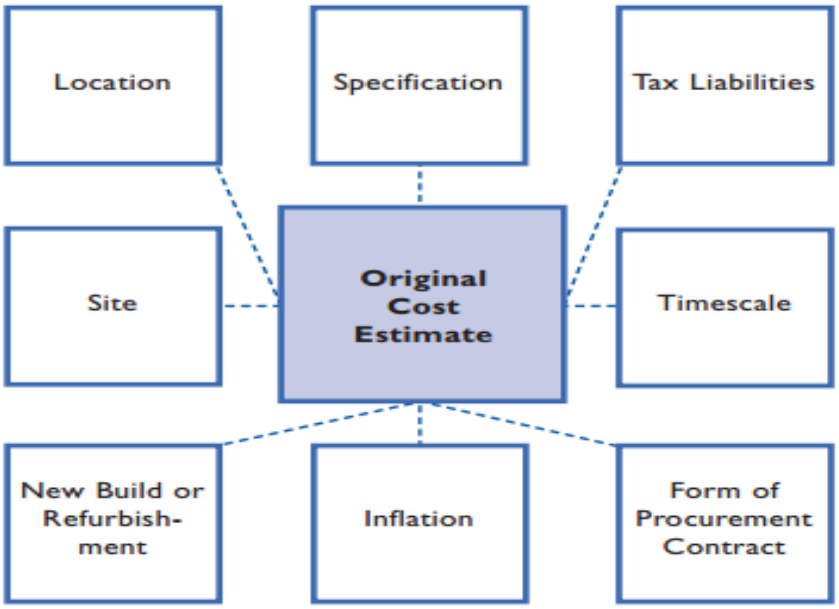

Figure 4: Key determinants of costs

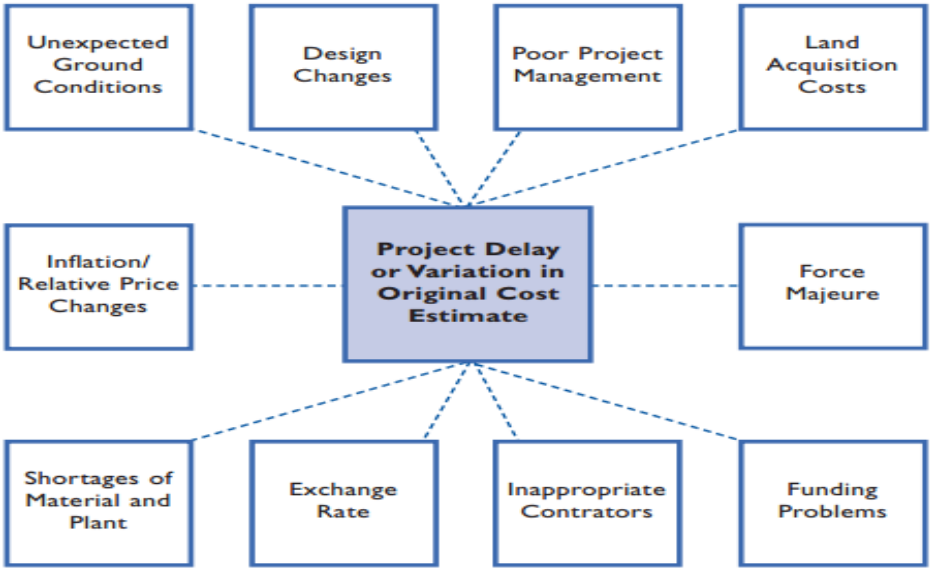

Figure 5: Cost changing factors

2.5 The Assessment of a Project Performance

A strategic plan is required for every project as if determines the success of any construction project (Lu, & Zhang, 2016). More general, strategic plans are usually crafted by consultants and supervisors of a project as the motive is to assess the performance of a construction project at all stages, and also to manage and monitor the critical factors like time, cost, quality, employees management, assurance of construction quality and conformity to the standards and quality set forth by the associations of order of engineers (Al-Momani, 2000).

Technically, performance measurement is comparison between the planned outcomes and the actual outcomes of a project. Whenever there is a mismatch then it would not be wrong to say that the performance of the project failed to meet the expectations, as there must be underlying factors that led to the current situation. According to Navon (2005), diversion of a project from the expected outcome may be as a result of two reasons namely; (a) un-realistic objectives (i.e., management and planning); (b) problems coming from the main infrastructural or building activities. Navon proposed that project managers can monitor the performance of a project by updating their database on regular basis, to use the information for future references. For example such information can be used for better planning of construction sites, such as cost control and organization of work.

Sweis et al. (2013) conducted a study about the performance of the construction industry in the Jordan. The focus was on why cost overrun or deficit may cause failure in the performance of a project. The study employed regression analysis and descriptive statistics. The driven result indicated that the cost overruns usually

resulted from change in the design, irregularities by the government and lack of experience to implement such projects. Sweis et al. (2014) attempted to Figure out the main factors affecting the performance of a contractor on public projects. The result shows that shortage of manpower, financial difficulties and owners changes are the main factors slowing down projects. The study employed a quantitative approach by ranking the factors and one way ANOVA was also utilized.

According to the Ministry of Public Works in Jordan, performance measurement framework should have certain factors. This is because the Ministry's feasibility study led them to identify a framework for project performance evaluation (PPE), in which the following factors are listed as important antecedents for performance of a construction project namely safety, cost, time, quality, communication, resolving dispute, environment and rules governing contracts. The goal of employing PPE is to expand the performance of a project is to handle all aspects of the construction project (Jordan time's journal, 2013).

Furthermore, Iyer and Jha (2005) admitted that success of a given project is indeed indebted to complicated procedures, and that all actors and entity must be involved if reliable results are to be achieved. For instance, large projects often have greater number of actors ranging from interior-designers, consultants, supervisors, contractors, sub-contractors and industry experts. As much larger the project would be, the greater the complexity and problems will be. As such the performance of each actor has to be set and benchmarked through strategic and operational plans. Consequently, Samson and Lema (2002) introduced a new performance measurement system for construction projects, which incorporates evaluations of

business and financial perspectives, innovation and learning, process analysis and stakeholders interests. Shen et al. (2005) influential work shows that a construction project performance can be enhanced by taking the necessary measures required to reduce environment pollution, as construction is the main source of environment destruction. Therein, indicators like environmental performance score (EPS) can be used to assess the activities of contractors in a construction site. Kuprenas (2003) posited that "cost performance also can be measured through a Cost Performance Index (CPI) computed by using this equation.

CPI = BCWP/ACWP

Where

BCWP = budgeted cost of the work performed.

ACWP = actual cost of the work performed.

From the equation above:

If CPI value of one means, the cost was as planned (at the budget value).

If CPI value above one means, the project was below its budget.

If CPI of less than one means, the project exceeded its budget.

As a next step, the following equation is meant for time performance, which is measured through a Schedule Performance Index (SPI):

SPI = BCWP/BCWS

Where that:

BCWP = budgeted cost of the work performed.

BCWS = budgeted cost of the work scheduled.

From the equation above:

If SPI value of one means, the time was as planned (at the time value).

If SPI value above one means, the project was ahead of schedule.

If SPI of less than one means, the project was behind schedule.

2.6 Relationship between Benchmarking and Performance

Tolosi and Lajtha (2000) defined benchmarking as the evaluations of technical and financial indicators across operating units within a company or outside the firm. It subsumes a comprehensive assessment that occurs within two parties or units to compare the present performance index and this way firms can assess their performance (Ali et al., 2013). Benchmarking refers to the process of continuous improvement by comparing organization's processes with those identified as best practice, as a method to increase the superiority of the firm. Li et al. (2001) recommended cooperative benchmarking as a potential tool that can be used to achieve partnering excellence in a construction project. The practice can be used to Figure out strengths and weakness of a particular project, as recommended by (Syuhaida, & Aminah, 2009) and can also be used to evaluate performance and competitive advantage, which leads to an increase in profits for construction companies (Chan, 2009). As the extent literature has pointed out that benchmarking has to do with monitoring ones performance against stated objectives, management need self-evaluation strategy to track and report unbiased performance as depicted in Figure 6.

Figure 6: Diagram of Management Evaluation Project System

2.7 Key Performance Indicators

JCCA (2015) specified that owner, clients, stakeholders and the general public are from a macro viewpoint, while developers, non-operators, and the contractors are among the groups from micro viewpoint. El-mashaleh et al. (2010) study examined the relationship between factors that affect the performance of the construction industry in Jordan. They proposed cost, schedule, quality and relationship as factors that would increase the success of a construction project. Finally, the authors recommended that cooperation with multinational construction firms could improve building operations in Jordanian construction industry ranging from the development of the administrative process, selection of workers, clients satisfaction and profits.

Ibrahim, Costello, and Wilkinson (2015) proposed a framework that consists of the team formation, contractual model, teamwork principle and operational monitoring will enhance the performance of a construction project using qualitative data. Alternatively Bai and Sarkis (2014) noted that a key indicator for a construction project performance can be assessed by evaluating completed project in the neighborhood. To sum up, Cheung et al. (2004) recommended seven factors that affect performance of a construction project e.g. "time, cost, quality, client satisfaction, client changes, business performance, safety and health". Figure 7 also shows some performance indicators which are divided into objective and subjective measures. In this study, the role played by the ten (10) factors on the performance of construction projects in Jordan will be examined. Based on the extant literature, the study will focus on three (3) entities involved in construction project namely; owners, contractors and consultants.

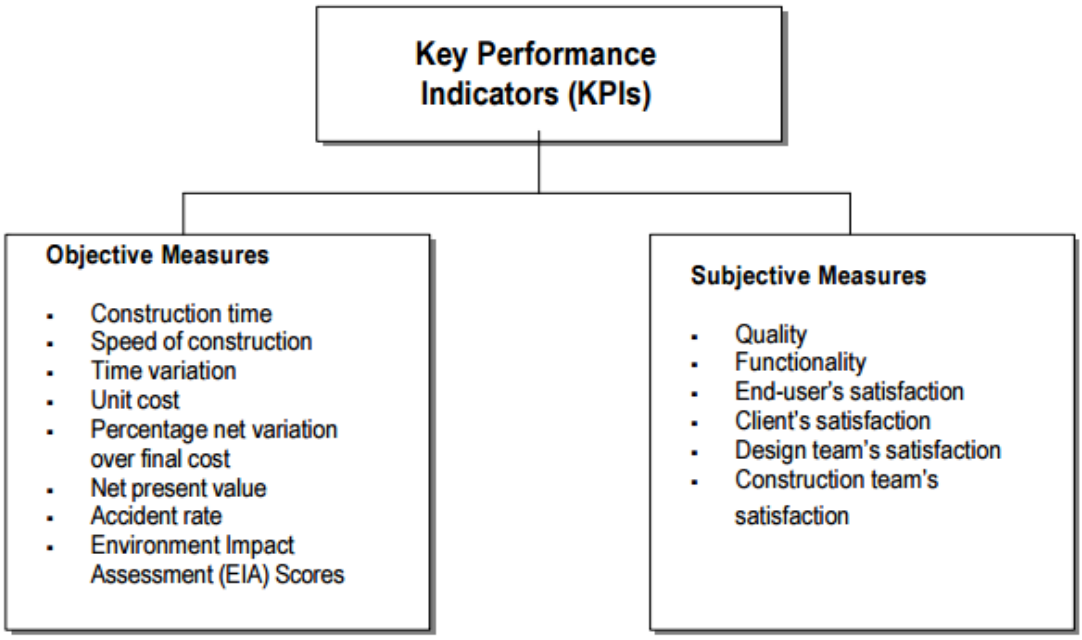

Figure 7: Key performance indicators for project success (2015)

Table 1 presents the previous studies on key performance indicators in the construction industry in chronological order.

Table 1: Summary of previous studies on performance indicators

Authors and years	Country	Performance indicators
Jastaniah (1997)	Saudi Arabia	Customer satisfaction, Safety, Claims, Payment, Budget, Profitability, Planning, Communication and Experienced Engineers.
Egan (1998)	UK	Planned Time and Cost, Defects, Customer Satisfaction, Productivity, and Construction Time.
DTI (2002)	UK	People, Customer satisfaction, and Environment
Pillai et al. (2002)	India	Stakeholders, Risk, Cost, Customer Commitments, Production, Project Management and Decision effectiveness
Ramirez et al. (2004)	Chile	Quality, Schedule variation, Efficiency of labor Safety, Training, Productivity, Cost variation and Rework
Cheung et al. (2004)	China	Staffs, Cost, Time, Environment, Quality, Communication, Safety, Client satisfaction
Wong (2004)	UK	Workers and Contractors experience, Quality, Cost, Safety, Site Management and Resources
El-Mashaleh et al. (2007)	USA	Client satisfaction, Schedule performance, Safety Profitability, and Cost performance
Nudurupati et al. (2007)	UK	Environment impact, Quality, Safety, Clients Satisfaction, Time, Employee satisfaction and Cost.
Luu et al. (2008)	Vietnam	Client satisfaction, Cost, Quality Management, Safety, Team performance, Change Management and Resource Management.
Rankin et al. (2008)	Canada	Time, Cost, Project Scope, Innovation, Customer Satisfaction, Quality Safety and Sustainability
Skibniewski and Ghosh (2009)	USA	Client satisfaction, Time, Cost and Defects
Horta et al. (2010)	Portugal	Productivity, Safety, Profitability and Customer Satisfaction.

Toor and Ogunlana (2010) Defects.	Thailand	Specifications, Time, Safety, budget, and
CII (2011) and	USA	Productivity, Schedule, Rework, Cost, Changes Accident.
Bon-Gang Hwang (2012)	Singapore	Efficiency of labor Safety, Time, Training, Site Management
Bai and Sarkis (2014)	China	Employee satisfaction, Customer Satisfaction, Innovation.
Rateb Jalil Sweis (2015)	Jordan	Time, Cost, Safety and Quality Management .

Chapter 3

METHODOLOGICAL APPROACH

3.1 Introduction

This section provides a brief explanation of the research objectives and how the research will be carried out. In addition, the chapter will discuss the prospective data analysis techniques and why they are useful.

The aim of this thesis is to diagnose the best practice on how to develop the performance for construction projects in Jordan; coupled with the factors that affect the performance of the construction sector. In addition, previous empirical works have proposed several approaches and techniques to improve the performance in the construction sector. However, few have been applied in Jordan and this provides us with additional space and research gap to fill for the construction industry.

To achieve the objective of study, a research workflow was developed using scientific procedures and recommendations to guide us, to be able to acquire realistic and accurate data as seen in Figure 8. The research is quantitative in nature as a questionnaire was used to obtain information from experts and specialists working in the construction industry in Jordan.

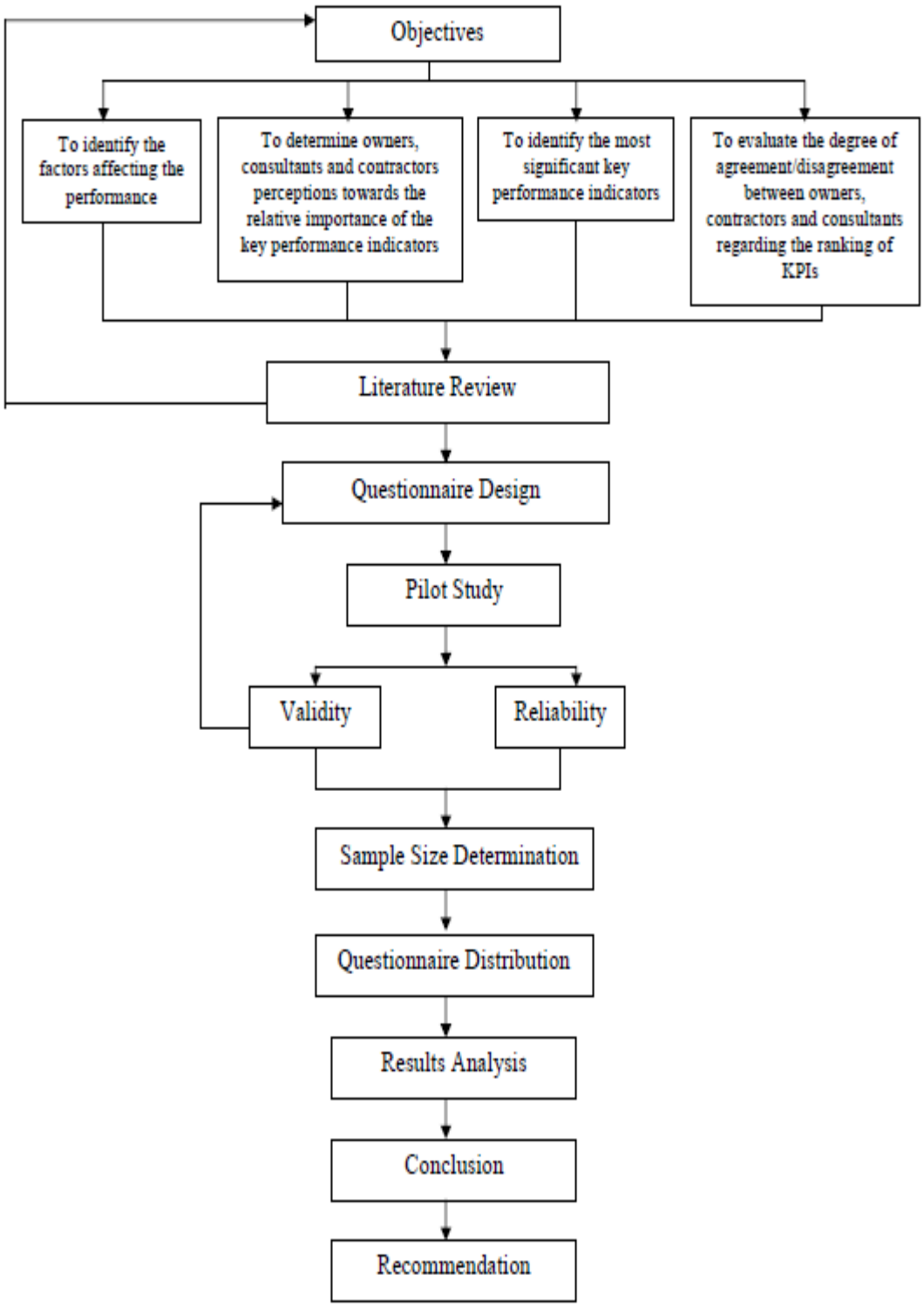

Figure 8: Summary of the methodology used in this study.

3.1.1 Research Objective 1

The first objective is to determine the elements altering the success of projects in the Jordanian construction industry. The extant literatures (e.g., Brown & Adams, 2000; Chan & Kumaraswamy, 1996; Cheung et al., 2004; El-mashaleh et al., 2010; Iyer & Jha, 2005; Kuprenas, 2003; Navon, 2005; Pheng, & Chuan, 2006; Samson & Lema, 2002; Shen et al., 2005; Sweis et al., 2013; Sweis et al., 2014; Thomas, Ekambaram, & Mohan, 2002; Ugwu & Haupt, 2007; Wegelius-Lehtonen, 2001) have highlighted various factors which will be combined in this study to provide a meaningful framework for performance measurement in the construction industry.

3.1.2 Research Objective 2

The second objective is to identify owners, consultants, and contractors perceptions towards the relative importance of the key performance indicators of construction industry in Jordan. There are many ways used in quantifying the effect of KPIs on the performance of the construction industry e.g. the relative importance index method (RII). This type of index is often desired when the explanatory aspects of regression analysis are of interest (Johnson & Lebreton, 2004). The method is of great importance in terms of determining the relative importance of key performance indicators on the construction sector. It can be calculated by the following equation:

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

Where:

W is the weight given to each factor by the respondents and ranges from 1 to 5.

A = the highest weight = 5.

N = the total number of respondents.

3.1.3 Research Objective 3

The third research objective is to identify the most important key performance indicators of construction industry in Jordan. Again RII will be used to identify the most important key performance indicators for the industry as a whole.

3.1.4 Research Objective 4

The fourth research objective is to measure the level of disagreement and agreement, between contractors, owners and consultants in terms of ranking the KPIs. This can be observed with the aid of Pearson correlation analysis.

$$\rho_{X,Y} = \frac{\operatorname{cov}(X,Y)}{\sigma_X \sigma_Y}$$

Where:

cov and σ_X are defined as above

μ_X = the mean of X

E = the expectation.

3.1.5 Research Objective 5

The fifth research objective is to compare and see if there is any relationship between the rankings and importance for the parties regarding key performance indicators. This will be evaluated via t-test.

Null Hypothesis (H_0): There is no relationship between target groups with the performance indicators.

Alternative Hypothesis (H_1): There is a relationship between target groups and performance indicators.

These hypotheses will be analyzed on individual performance factor in relation to the other factors used in this thesis.

3.1.6 Research Objective 6

The sixth research objective is to set forth useful implications and recommendations that will enable practitioner to enhance the performance of construction project in Jordan.

3.1.7 Questionnaire Administration and Pilot Study

The scale items used in this study were adopted from previous studies as noted in section 3.1 research objective 1. The questionnaire consists of three sections namely (Please see appendix I for full version):

- Part One: General information.
- Part Two: Factors which affect the performance of construction industry in Jordan.
- Part Three: The practices concerning the performance of construction industry in Jordan.

Some questions were not practical or realistic for the Jordanian construction industry, as such were amended. Further, local factors were incorporated and these factors were also approved by industry experts during the pilot survey. A scale of five Likert response option was used to avoid the tendency of being biased (Likert, 1932). A pilot survey was conducted with 3 owners, 2 contractors and 5 consultants although some surveys were conducted in English. This is because most businessmen in Jordan speaks and understand English language. Rewording of some scale items deemed necessary as they find it difficult to understand the questions (Please see appendix for a sample of the questionnaire).

3.1.8 Validity and Reliability Test

Validity test shows the level at which a measured construct or variable possess its expected properties (Pilot and Hungler, 1985). In order to evaluate the validity of measure, researchers can either adopt criterion-related validity or variable validity, or both. To ensure the validity and accuracy of a proposed questionnaire, researchers can rely on two essential statistical methods, namely; item loadings, Spearman test or Pearson test. Subsequently, reliability of any focal variable refers to the level by which the variable in question conforms to the attributes of the measures. Reliability coefficient indicates the stability and consistency of the measurement tool, popularly known as the Cronbach's coefficient or alpha (George & Mallery, 2003). The normal range of Cronbach's coefficient is between 0.0 and 1.0. The closer the Alpha is to 1, the greater the internal consistency of items in the instrument being assumed. It can be calculated with the following equation:

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K} \sigma_{Y_i}^2}{\sigma_X^2}\right)$$

Where,

σ_X^2 is the variance of the observed total test scores,

and $\sigma_{Y_i}^2$ the variance of component *i* for the current sample of persons.

Chapter 4

FINDINGS AND DISCUSSIONS

4.1 Introduction

As noted earlier this chapter presents the results and findings of this study. The results are presented according to the design of the questionnaire. The thesis questionnaire consists of three parts namely; general information, factors which affect the performance of construction industry in Jordan and the practices concerning the performance of construction industry in Jordan. Figure 9 below depicts a conceptual model of the proposed study.

The questionnaire was distributed through Google forms (Please see appendix for a sample of the questionnaire). The anonymity of the respondent was guaranteed to eliminate social desirability bias as recommended by Podsakoff et al., (2003). The association of Jordanian Engineers assisted me in contacting the target respondents. First of all, 121 questionnaires were distributed to 27 owners, 41 consultants and 53 contractors. At the end only 84 questionnaires were returned, and three had missing data. As such they were exempted from the analysis, thus only 81 responses were analyzed. SPSS and Excel programs were used for data analyses.

Figure 9: Conceptual Model

The numbers of respondents to the questionnaire are as seen in Figure 10. The Figure below depicts the demographic distribution of the research sample, sixteen (16) were owners, twenty six (26) were consultants and thirty nine (39) were contractors. The distribution shows that the sample represents the main entities in the construction industry.

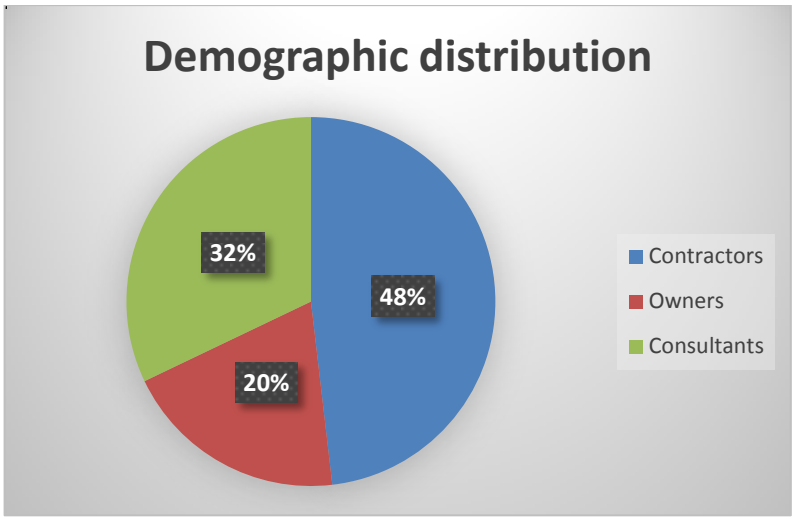

Figure 10: Demographic data

4.2 General Information Section

Table 2: Type of Organization

Type of Organization	Frequency	Percentage
Owners	16	19.75%
Consultants	26	32.09%
Contractors	39	48.16 %
Total	81	100.00 %

Table 2 presents the types of organization surveyed. As evident from the table, the majority was contracting firms (48.16%) in the construction industry, and around 32% were consultants and approximately 20% were owners. While in Table 3, the types of projects done by the entities and/or organizations in table one is highlighted and contractors have the largest share in buildings as 64.11%.

Table 3: Type of projects in the Jordanian construction industry

Type of project	Owner	Consultant	Contractor
Roads and transportation	18.75% (3)	23.07% (6)	7.69% (3)
Water and sewage	31.25% (5)	23.07% (6)	12.82% (5)
Buildings construction	50.00% (8)	46.17% (12)	64.11% (25)
Others	0.00% (0)	7.69% (2)	15.38% (6)

In terms of demographic characteristics of the construction industry employees, the number of workers in owner's firm is around 158 and the number of workers in consultants' firm is around 47. Finally the number of workers in contractors' firm is around 133. Table 4 shows the ratio and frequency for job title of the workers in construction sector based on target group.

Table 4: Staff distribution in the Jordanian construction industry

Job title of target group	Owner	Consultant	Contractor
Organization Manager	37.5% (6)	7.69% (2)	12.82% (5)
Project Manager	25.00% (4)	38.46% (10)	25.64% (4)
Site/Office Engineer	31.25% (5)	46.16% (12)	43.59% (17)
Other workers	6.25% (1)	7.69% (2)	17.95% (7)
Total	100.00% (16)	100.00% (26)	100.00% 39)

Next, the study will look at the respondent's tenure. Based on the sample surveyed, the average years of experience of the respondents in the owners category is approximately 11 years. The average years of experience for the respondents in the

consultant's category are 10 years. While for contractor is 9 years. Next, Table 5 shows the frequency and ratio of number of projects which were accomplished in the last 7 years by the target groups (i.e., owners, consultants and contractors).

Table 5: Number of projects which accomplished in the last seven years

Number of accomplished	Owner	Consultant	Contractor projects
1-8	31.25% (5)	19.23% (5)	28.21% (11)
9-16	37.50% (6)	42.31% (11)	33.34% (13)
17-25	25.00% (4)	30.77% (8)	30.76% (12)
More than 25	6.25% (1)	7.69% (2)	7.69% (3)
Total	100% (16)	100.00% (26)	100.00% (39)

The financial value of projects which was completed 7 years ago, the frequency and ratio in regard to the value of the projects that were completed 7 years ago, are categorized according to the target group in Table 6.

Table 6: Financial value of projects which accomplished in the last seven years (in million dollars)

Value of accomplished	Owners	Consultants	Contractors projects
Less than 1M	6.25% (1)	11.54% (3)	2.56% (1)
1 M to 6 M	37.50% (6)	15.38% (4)	15.39% (6)
6 M to 10 M	31.25% (5)	46.16% (12)	25.64% (10)
More than or equal 10 M	25.00% (4)	26.92% (7)	56.41% (22)
Total	100% (16)	100.00% (26)	100.00% (39)

Table 7 shows the frequency and ratio of the research entities specializations in the Jordanian construction sector. The data presented is based on categorized target groups. In similar fashion, contractors seem to have the largest share in buildings and infrastructure development having 64.10% and 23.08%.

Table 7: Company's specialization in the construction sector

Area of specialization	Owners	Consultants	Contractors
Buildings construction	50.00% (8)	50.00% (13)	64.10% (25)
Infrastructure	18.75% (3)	23.08% (6)	23.08% (9)
Others	31.25% (5)	26.92% (7)	12.82% (5)
Total	100% (16)	100.00% (26)	100.00% (39)

As a next step, a principal factor analysis was conducted with varimax rotation and Eigen value less than 1. This was done to check internal and construct validity of the measures used. The factor loadings were moderate as this is primarily due to sample size. Then the reliability of the scale items was checked. As a final step, the combination of all factors yielded a good fit for internal consistency of our scale items as presented in Table 18. As such the problem of reliability seems non-existing or being a problem with our dataset. Previous researches have noted that the overall value of alpha coefficient should be above .60 (Hair et al., 1998; Hair et al., 2006; & Nunnally, 1978).

Table 8 depicts the factor loadings and reliability analysis for cost factors. All factor loadings were moderate, reliability results were above the cutoff points.

Table 8: Factor loadings and Reliability analysis (Cost factor)

Cost factor (17 items)	Loadings	Alpha
Financial participation in the market for construction companies	0.24	0.59
Financial liquidity for companies	0.46	
Cash flow for the project	0.26	
Earnings ratio of the project	0.15	
Administrative expenses for the project	0.38	
The cost of the project design	0.48	
The cost of equipment and materials in the project	0.54	
The cost of labors in the project	0.50	
Project overtime cost	0.37	
The cost of financial incentives and rewards	0.14	
The cost of re-implementing some working	0.17	
Cost of variation orders	0.40	
The proportion of waste in material	0.65	
Regular project budget update	0.15	
Cost control system	0.67	
High prices of materials	0.32	
Change in Exchange Rates	0.17	

Table 9 shows the factor loadings, and the reliability analysis for time factor. The factor loadings were adequate. Similarly reliability analysis was above the cutoff points.

Table 9: Factor loadings and Reliability analysis (Time factor)

Time factor (9 items)	loadings	Alpha
The time required for site preparation	0 .42	0 .58
The proposed or expected duration to complete the project	0.54	
The proportion of the delay in the approval of work orders	0.50	
The time required to modify and repair the errors and the defects	0.60	
The average delay in claims approval	0.30	
The delay rate in the financial payments from the owner to the contractor	0.42	
Resource availability as planned according to duration of the project	0.35	
Delay rate due to the lack of materials	0.35	

Table 10 shows the factor loadings, and reliability analysis for quality factor. The reliability results shows internal consistency and the factor loadings were good.

Table 10: Factor loadings and Reliability analysis (Quality factor)

Quality factor (6 items)	loadings	Alpha
Compliance with the specifications and conditions agreed	0.58	0.61
The presence of persons with competence and high experience	0.52	
Quality of raw materials and equipment used in the project	0.30	
Participation of managerial levels with decision making	0.50	
Existence the system to assessment the quality in the organization	0.55	
The existence of meetings and intensive training for		

the development of quality	0 .63

Table 11 depicts that the productivity factor loadings were moderate and acceptable. The reliability result shows that the measures were reasonable since it was above the cutoff point.

Table 11: Factor loadings and Reliability analysis (Productivity factor)

Productivity factor (5 items)	loading	Alpha
The complexity existing in project	0.20	0.57
The number of new project in the year	0.20	
The relationship between employees and project management`	0.75	
Absenteeism rate through project	0.44	
Sequencing of work according to schedule for the project	0.73	

Table 12, the reliability analysis seems good above the benchmark and the factor loadings were usually moderate and acceptable.

Table 12: Factor loadings and Reliability analysis (Client Satisfaction factor)

Client Satisfaction factor (5 items)	loadings	Alpha
Coordination in exchange of information between owner and project crew	0.60	0.56
Leadership skills for project manager	0.50	
Speed and efficiency in service delivery to the owner	0.66	
Differences and disputes between owner and project crew	0.68	

Number of works which require replay	0.41

The Table 13 shows factor loadings and reliability analysis depicted that all are in good status above the benchmark.

Table 13: Factor loadings and Reliability analysis (Regular and community satisfaction factor)

Regular and community satisfaction factor (4 items)	loadings	Alpha
The cost required for the commitment of the regulations	0.69	0.59
Number of works which infringes the law	0.70	
Quality and availability of regulatory documentation	0.51	
Problems resulting from the neighbors and the circumstances surrounding the site	0.51	

Table 14 shows the factor loadings of items in employee factor and the reliability analysis explains that outcomes are reasonable and acceptable.

Table 14: Factor loadings and Reliability analysis (Employee factor)

Employee factor (4 items)	loadings	Alpha
The behavior and performance of staff in the project	0.46	0.54
Promote the spirit of competition between employees	0.79	
Employee's motivation	0.40	
Belonging to work	0.62	

Table 15 shows the factor loadings for health and safety factor and the reliability analysis shows that the result is reasonable and all factor loadings are acceptable.

Table 15: Factor loadings and Reliability analysis (Health and safety factor)

Health and safety factor (4 items)	loadings	Alpha
Application of security and safety factors in project	0.63	0.68
Ease to reach the site (place of the project and its location	0.60	
The proportion of incidents which recorded in the project	0.75	
The proportion of compensation resulting from accidents for workers and others	0.70	

Table 16 is related to innovation and leaning factor, all factor loadings are reasonable and reliability analysis are reasonable and acceptable.

Table 16: Factor loadings and Reliability analysis (Innovation and learning factor)

Innovation and learning factor (5 items)	loadings	Alpha
Learning from own experience and past experiences	0.64	0.66
Learning the best practice of experienced	0.79	
Human resources training by new skills needed for the project	0.53	
Teamwork	0.55	
Appropriate solution	0.60	

Table 17 depicts the environment factor loadings and the reliability analysis. The results seems moderate and above cutoff point.

Table 17: Factor loadings and Reliability analysis (Environment factor)

Environment factor (4 items)	loadings	Alpha
Air quality	0.40	0.54
The level of noise and the site	0.76	
Existing waste around the site	0.60	
Climatic condition at the site	0.64	

As a final step, the combination of all factors yielded a good fit for internal consistency of our scale items as presented in Table 18. As such the problem of reliability seems not to exist or be a problem with our dataset.

Table 18: Reliability analysis for all factors

Alpha	No. of items	
All Factors	**63**	**0.84**

Table 19 presents the mean, standard deviation and correlation analysis of the research variables. The table shows that most of the performance factor is dependent on each other. For example cost and time have positive correlation, such that the longer it takes to complete a project the higher the cost will be. Similarly, the higher the quality the longer the time it takes to finalize a project. When there are health and safety measures, the level of environmental destruction will be less. The presence of health and safety measures will enable employees to be more productivity according to the data in Table 19.

Table 19: Pearson Correlation Analysis, Mean and Standard Deviation

Factors	1	2	3	4	5	6	7	8	9	10
Cost	-									
Time	.35**	-								
Quality	.36**	.40**	-							
Productivity	.34**	.32**	.57**	-						
Client satisfaction	.45**	.44**	.30**	.31**	-					
Regulatory	.22	.26**	.36**	.32**	.38**	.-				
Employees	.11	.29**	.37**	.34**	.17	35**	-			
Health and safety	.20	.19	.32**	.41**	.27**	.43**	.22**	-		
Innovation/learning	.19	.18	.14	.27*	.14	.21	.32**	.32**	-	
Environmental	.20	.19	.20	.26*	.16	.19	-.14	.29**	.01	-
Mean	3.8	3.9	3.9	3.8	3.8	3.9	3.9	3.9	3.8	3.4
Standard Deviation	.36	.39	.47	.46	.53	.57	.54	.65	.58	.69

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed)

4.3 Factors affecting the Performance of Construction Industry

The table 21 and 22 showing the relative importance index (RII) and rankings provided by the target groups (i.e., owners, consultants, contractors) for each factor**.** The Table 20 below shows the ranking and RII for cost factor based on the response provided by the stakeholders (i.e., owner, consultant and contractor). The result shows that financial participation in the market for construction companies is the most important item for all stakeholders followed by cash flow for the project and the financial liquidity of the companies.

Table 20: the relative importance index (RII) and rankings for cost factors

1- Cost factors	Owner (Stakeholder)		Consultant		**Contractor**	
	RII	Rank	RII	Rank	RII	Rank
Financial participation in the market for construction companies	0.8375	1	0.838461538	2	0.8	3
Financial liquidity for companies	0.8125	2	0.8	4	0.774358974	9
Cash flow for the project	0.8125	2	0.853846154	1	0.805128205	1
Earnings ratio of the project	0.75	7	0.746153846	8	0.779487179	8
Administrative expenses for the project	0.725	12	0.653846154	17	0.78974359	5
The cost of the project design	0.75	7	0.738461538	10	0.784615385	7
The cost of equipment and materials in the project	0.75	7	0.8	4	0.774358974	9
The cost of labors in the project	0.7	15	0.776923077	6	0.753846154	14
Project overtime cost	0.7875	5	0.715384615	15	0.769230769	12
The cost of financial incentives and rewards	0.6875	16	0.669230769	16	0.78974359	5
The cost of re-implementing some working	0.7375	10	0.738461538	10	0.753846154	14
Cost of variation orders	0.7375	10	0.730769231	12	0.671794872	17
The proportion of waste in material	0.7125	14	0.730769231	12	0.764102564	13
Regular project budget update	0.7625	6	0.730769231	12	0.774358974	9
Cost control system	0.8125	2	0.746153846	8	0.805128205	1
High prices of materials	0.725	12	0.823076923	3	0.8	3
Change in Exchange Rates	0.6625	17	0.761538462	7	0.738461538	16

In the Table 21 below ranking and RII for time factor are presented based on the response provided by the stakeholders (i.e., owner, consultant and contractor). The result shows that the time required for site preparation is the most important item for all stakeholders followed by the proposed or expected duration to complete the project and third is delay rate due to the lack of materials.

Table 21: the relative importance index (RII) and rankings for time factors

2- Time factors	Owner		Consultant		Contractor	
	RII	Rank	RII	Rank	RII	Rank
The time required for site preparation	0.8375	1	0.815384615	2	0.846153846	1
The proposed or expected duration to complete the project	0.7875	3	0.823076923	1	0.81025641	4
The proportion of the delay in the approval of work orders	0.7375	6	0.807692308	4	0.794871795	7
Time needed to implement variation orders	0.7625	4	0.784615385	7	0.8	6
The time required to modify and repair the errors and the defects	0.7	8	0.807692308	4	0.784615385	9
The average delay in claims approval	0.6875	9	0.784615385	7	0.78974359	8
The delay rate in the financial payments from the owner to the contractor	0.7375	6	0.792307692	6	0.81025641	4
Resource availability as planned according to duration of the project	0.75	5	0.776923077	9	0.825641026	2
Delay rate due to the lack of materials	0.8125	2	0.815384615	2	0.820512821	3

In Table 22 below the RII and rankings for quality factor are presented based on the response provided by the stakeholders (i.e., owner, consultant and contractor). The

outcomes delineate that existence the system to assessment the quality in the organization is the most important item for all stakeholders, followed by participation of managerial levels with decision making and quality of raw materials and equipment used in the project.

Table 22: the relative importance index (RII) and rankings for quality factors

3- Quality factors	Owner		Consultant		Contractor	
	RII	Rank	RII	ank	RII	Rank
Compliance with the specifications and conditions agreed	0.8375	1	0.769230769	4	0.78974359	5
The presence of persons with competence and high experience	0.7375	4	0.769230769	4	0.794871795	4
Quality of raw materials and equipment used in the project	0.75	3	0.792307692	1	0.779487179	6
Participation of managerial levels with decision making	0.6625	6	0.784615385	2	0.81025641	2
existence the system to assessment the quality in the organization	0.7625	2	0.776923077	3	0.805128205	3
The existence of meetings and intensive training for the development of quality	0.725	5	0.746153846	6	0.820512821	1

Table 23 below presents RII and rankings for productivity factors based on the feedback provided by the stakeholders (i.e., owner, consultant and contractor) involved in the study. The finding shows that the most important measure for productivity factor is the relationship between employees and project management followed by the complexity existing in project and the third measure is absenteeism rate through project.

Table 23: the relative importance index (RII) and rankings for productivity factors

(4) Productivity factors	Owner		Consultant		Contractor	
	RII	Rank	RII	Rank	RII	Rank
The complexity existing in project	0.7	3	0.8	1	0.764102564	2
The number of new project in the year	0.7	3	0.7	5	0.764102564	2
The relationship between employees and project management	0.775	2	0.78461538	2	0.830769231	1
Absenteeism rate through project	0.675	5	0.78461538	2	0.764102564	2
Sequencing of work according to Schedule for the project	0.825	1	0.73846153	4	0.78974359	5

Table 24 below presents RII and rankings for client satisfaction factors based on the feedback provided by the stakeholders (i.e., owner, consultant and contractor) involved in the study. The findings shows that the most important measure is leadership skills for project manager followed by the number of works which require replay and project crew and coordination in exchange of information between owner.

Table 24: the relative importance index (RII) and rankings for client satisfaction factors

(5) Client Satisfaction factors	Owner		Consultant		Contractor	
	RII	Rank	RII	Rank	RII	Rank
Coordination in exchange of information between owner and project crew	0.7625	3	0.792307692	2	0.779487179	3

Leadership skills for project manager	0.8125	1	0.792307692	2	0.78974359	2
Speed and efficiency in service delivery to the owner	0.8	2	0.746153846	5	0.764102564	4
Differences and disputes between owner and project crew	0.675	5	0.823076923	1	0.733333333	5
Number of works which require replay	0.7375	4	0.792307692	2	0.815384615	1

Table 25 below presents RII and rankings for regular and community satisfaction factors based on the feedback provided by the stakeholders (i.e., owner, consultant and contractor) involved in the study. The findings shows that the most important measure is the cost required for the commitment of the regulations followed by the quality and availability of regulatory documentation and project crew, and the third measure is problems resulting from the neighbors.

Table 25: the relative importance index (RII) and rankings for regular and community satisfaction factors

(6) Regular and community satisfaction factors	**Owner**		**Consultant**		**Contractor**	
	RII	**Rank**	**RII**	**Rank**	**RII**	**Rank**
The cost required for the commitment of the regulations	0.7875	1	0.846153846	1	0.805128205	2
Number of works which infringes the law	0.7375	2	0.753846154	4	0.774358974	4
Quality and availability of regulatory documentation	0.7375	2	0.761538462	3	0.830769231	1

Problems resulting from the neighbors and the circumstances surrounding the site	0.675	4	0.784615385	2	0.794871795	3

Table 26 below presents RII and rankings for employee's factors, this shows the ranking of each measure in the study related to the factor, technically based on the feedback provided by the stakeholders (i.e., owner, consultant and contractor) involved in the study. The finding shows that the most important measure is the behavior and performance of staff in the project, followed by the employees' motivation belonging to work.

Table 26: Relative Importance Index (RII) and rankings for employees' factors

(7) Employees factors	**Owner**		**Consultant**		**Contractor**	
	RII	**Rank**	**RII**	**Rank**	**RII**	**Rank**
The behavior and performance of staff in the project	0.775	2	0.815384615	1	0.815384615	3
Promote the spirit of competition between employees	0.7625	3	0.753846154	4	0.820512821	1
Employees motivation	0.7875	1	0.776923077	3	0.794871795	4
Belonging to work	0.7375	4	0.784615385	2	0.820512821	1

Table 27 below RII and rankings are presented for health and safety factors technically based on the feedback provided by the stakeholders (i.e., owner, consultant and contractor) involved in the study. The findings shows that the most important measure is the application of security and safety factors in project, followed by the ease to reach the site (place of the project and its location and the proportion of compensation resulting from accidents for workers and others. For more information regarding the rankings please see the table below.

Table 27: the relative importance index (RII) and rankings for health and safety factors

(8) Health and Safety factors	**Owner**		**Consultant**		**Contractor**	
	RII	**Rank**	**RII**	**Rank**	**RII**	**Rank**
Application of security and safety factors in project	0.775	1	0.807692308	1	0.825641026	1
Ease to reach the site (place of the project and its location)	0.775	1	0.784615385	3	0.774358974	3
The proportion of incidents which recorded in the project	0.7375	4	0.753846154	4	0.81025641	2
The proportion of compensation resulting from accidents for workers and others	0.75	3	0.792307692	2	0.758974359	4

Table 28 below the rankings and RII were presented for innovation and learning factors based on the responses provided by the stakeholders (i.e., owner, consultant and contractor). The results shows that the most important measure is the learning from own experience and past experiences, followed by the teamwork and its location and the appropriate solution.

Table 28: the relative importance index (RII) and rankings for innovation and learning factors

(9) Innovation and learning factors	Owner		Consultant		Contractor	
	RII	Rank	RII	Rank	RII	Rank
Learning from own experience and past experiences	0.8125	1	0.823076923	1	0.78974359	1
Learning the best practice of experienced	0.775	2	0.723076923	5	0.748717949	4
Human resources training by new skills needed for the project	0.725	5	0.776923077	3	0.738461538	5
Teamwork	0.7625	4	0.784615385	2	0.78974359	1
Appropriate solution	0.775	2	0.769230769	4	0.769230769	3

Table 29 reports the rankings and RII for environment factors based on the responses provided by the target group. The result shows that the most important measure is the level of noise and the site, followed by the air quality and the climatic condition at the site.

Table 29: the relative importance index (RII) and rankings for environment factors

(10) Environment factors	**Owner**		**Consultant**		**Contractor**	
	RII	**Rank**	**RII**	**Rank**	**RII**	**Rank**
Air quality	0.725	1	0.715384615	3	0.656410256	3
The level of noise	0.6625	3	0.730769231	1	0.717948718	1

and the site						
Existing waste around the site	0.6625	3	0.684615385	4	0.630769231	4
Climatic condition at the site	0.6875	2	0.723076923	2	0.671794872	2

Table 30 shows the relative importance index (RII) and rankings provided by the entities (i.e., owners, consultants, contractors) in the study. The Table shows the overall rankings and RII's of the performance indicators when combined as whole.

Table 30: Performance factors, RII (Ranking)

Factors	**Owners**	**Consultants**	**Contractors**
Cost factor	0.75(6)	0.75(9)	0.77(8)
Time factor	0.76(5)	0.80(1)	0.81(2)
Quality factor	0.74(7)	0.77(7)	0.80(4)
Productivity factor	0.73(8)	0.76(8)	0.78(6)
Client satisfaction factor	0.75(4)	0.79(2)	0.77(7)
Regulatory & community satisfaction factor	0.73(9)	0.79(3)	0.80(3)
Employee's factor	0.76(2)	0.78(5)	0.81(1)
Health and safety factor	0.75(3)	0.78(4)	0.79(5)

Innovation and learning factor	0.77(1)	0.77(6)	0.77(9)
Environmental factor	0.68(10)	0.71(10)	0.67(10)

Table 31: T-test for performance factors (T statistics and *p* value)

Factors	**Owners**	**Consultants**	**Contractors**
Cost factor	69.5(*p=0.00*)	44.8(*p=0.00*)	64.7(p=0.00)
Time factor	67.7(*p=0.00*)	45.0(*p=0.00*)	22.3(*p=0.00*)
Quality factor	55.1(*p=0.00*)	36.1(*p=0.00*)	17.1(*p=0.00*)
Productivity factor	54.3(*p=0.00*)	35.1(*p=0.00*)	15.9(*p=0.00*)
Client satisfaction factor	48.9(*p=0.00*)	31.9(*p=0.00*)	14.9(*p=0.00*)
Regulatory & community satisfaction factor	45.6(*p=0.00*)	29.9(*p=0.00*)	14.3(*p=0.00*)
Employee's factor	49.5(*p=0.00*)	32.8(*p=0.00*)	16.2(*p=0.00*)
Health and safety factor	.75(*p=0.00*)	26.5(*p=0.00*)	12.7(*p=0.00*)
Innovation and learning factor	40.3(*p=0.00*)	28.7(*p=0.00*)	13.2(*p=0.00*)
Environmental factor	31.6(*p=0.00*)	18.6(*p=0.00*)	5.6(*p=0.00*)

The next research objective is to see whether there is a difference between the target groups. This will be done with RII and t-test. The null hypothesis for each factor will

be tested in respect to the differences between the groups. The results above shows that cost factor is ranked six with an RII equal to 0.750 by the owners, ranked ninth an RII equal to 0.756 by the consultants and ranked eighth an RII equal to 0.772 by the consultants, as shown in Table 30. T-test for cost factor also shows that there is a difference between the groups; owners (*t=69.5, p=0.00*), consultants (*t=44.8, p=0.00*), and contractors (*t=20.1, p=0.00*). Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected. A possible explanation for this is because owners are more interested in the cash flow for a particular project than consultants and/or contractors. Their interest's ranges from earnings ratios cost of design, budget update, and cost of variation to overtime cost as shown in Table 31.

According to the findings, time factor is ranked 5th with RII value equal to 0.756 by the owners, ranked 1st by consultants with an RII equal 0.800 and by the contractors ranked 2nd with an RII equal 0.809. A possible explanation for this is because consultants are more interested in analyzing the time required to modify, repair the errors and defects of a particular project. They are also interested in meeting up the expectations for the scheduled or planned time, more than owners and/or contractors, as shown in Table 30. T-test for time factor also shows that there is a difference between the groups; owners (*t=67.8, p=0.00*), consultants (*t=45.0, p=0.00*), and contractors (*t=22.3, p=0.00*). As such the alternative hypothesis was accepted and the null hypothesis was rejected as seen in Table 31.

According to the findings, quality factor is ranked seventh with an RII equal to 0.745 by owners, ranked seventh position with an RII equal to 0.773 by consultant and finally ranked fourth position with an RII equal 0.800 by the contractors. Based on

the result, contractors are interested with competence and high experience individual, quality assessment in the organization, participation in managerial decision making, and the presence of intensive training for quality development than owners and consultants as shown in Table 30. T-test for quality factor also shows that there is a difference between the groups; owners (*t=55.1, p=0.00*), consultants (*t=36.1, p=0.00*), and contractors (*t=17.1, p=0.00*). Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected (See Table 31).

Our analysis shows that owners ranked the productivity factor in the eight position with an RII equal to 0.735, ranked eight with a RII equal to 0.761 by the consultants, and ranked sixth with a RII equal 0.782 by the contractors. As a conclusion, it is obvious that contractors in the number of new projects have relationship with employees and project managers to enhance productivity more than owners and consultants, as shown in Table 30. T-test for productivity factor also shows that there is a difference between the groups; owners (*t=54.3, p=0.00*), consultants (*t=35.1, p=0.00*), and contractors (*t=15.9, p=0.00*). Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected as seen in Table 31.

Client satisfaction factor had an RII equal to 0.757 and was ranked fourth by the owners ranked second with RII value equal to 0.789 by the consultants, ranked seventh with an RII equal to 0.776 by the contractors. The result shows that consultants are more interested than owners and contractors in activities like coordination, information sharing and exchange with clients and contractors, and other aspects like dispute resolutions, as shown in Table 20. T-test for client satisfaction factor also shows that there is a difference between the groups; owners

(*t=48.9, p=0.00*), consultants (*t=31.9, p=0.00*), and contractors (*t=14.9, p=0.00*). Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected as seen in Table 31.

According to the results, regular and community satisfaction factor was ranked ninth with an RII equal 0.734 by owners and by the consultants ranked third with an RII equal value to 0.786 and by the consultants and also ranked third with an RII equal to 0.801 by the contractors. To sum up, consultants and contractors seem to be more interested in activities like commitment to rules and regulations, availability of regulatory legislations, resolving problems resulting from neighbors, neighborhood etc. (see Table 30). T-test for regular and community satisfaction factor also shows that a difference does exist among the groups; owners (*t=45.6, p=0.00*), consultants (*t=29.9, p=0.00*), and contractors (*t=14.3, p=0.00*). Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected as seen in Table 31.

Employee's factors was ranked second with an RII equal to 0.765 by the owners, ranked fifth with an RII value equal to 0.782 by consultant, and ranked first with an RII equal to 0.812 by the contractors.. Perhaps, one can say that contractors are interested in human resource management and policies that motivates employees to work in their best form. The motive behind this is to enhance and fasten work processes and to achieve timely results (Refer to Table 30). T-test for employee factor also shows that owners (t=*49.5, p=0.00*), consultants (*t=32.8, p=0.00*), and contractors (*t=16.1, p=0.00*). Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected as seen in Table 31.

Health and safety factor ranked with an RII equal to 0.759 by the owners, ranked fourth with an RII equal to 0.784 by the consultants, while ranked fifth with an RII equal to 0.792 by the contractors. So based on results, owners are interested more in safety and health factor, implementation of security, and safety dimensions as well as compensation issues resulting from workplace accidents than contractors and consultants, as shown in Table 20. Nevertheless, all the three groups are interested in this issue, as it is very important and delicate issue, which requires continuous monitoring. T-test for health and safety factor shows that owners (t=*46.3, p=0.00*), consultants (*t=26.5, p=0.00*), and contractors (*t=12.7, p=0.00*). Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected as seen in Table 31.

The innovation and learning factor ranked first with an RII equal to 0.770 by the owners, ranked six with an RII equal to 0.775 by the consultants and ranked ninth with an RII equal to 0.767 by the contractors, as shown in Table 20. Based on the results, owners, consultant and contractors are interested more in activities like teamwork in the construction site, conflict and dispute resolutions, learning and implementing new techniques and knowledge management. T-test for innovation and learning factor also shows that the owners (t=*44.2, p=0.00*), consultants (*t=28.7, p=0.00*), and contractors (*t=13.2, p=0.00*) there is a difference between the groups. Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected as seen Table 31.

Environment factor was ranked tenth by the owners group and RII value equal to 0.684, ranked tenth with an RII equal 0.713 by the consultants and ranked tenth with

an RII equal to 0.669 by the contractors, as shown in Table 30. Based on results it seems that this factor is not relevant for the target groups, because external factors like pollution, air quality, environmental destruction and noise does not have significant effect on the performance of construction projects in Jordan. T-test for environment factor also shows that the owners (t=*31.6, p=0.00*), consultants (*t=18.6, p=0.00*), and contractors (*t=5.6, p=0.00*) there is a difference between the groups. Therefore, the alternative hypothesis was accepted and the null hypothesis was rejected (See Table 31). The next research objective is to identify the most important factors that affect the performance of the construction industry. Table 32 shows the critical facets both supported by consultants, contractors and owners that affect the construction sector in Jordan.

Table 32: Critical performance factors, RII (Ranking)

Most Important Factor	Owners	Consultants	Contractors
Delay rate due to the lack of materials	.81(5)	.81(8)	.82(6)
Cash flow for the project	.81(5)	.85(1)	.81(16)
The time required for site preparation	.83(1)	.82(8)	.84(1)
The behavior and performance of staff in the project	.78(16)	.82(8)	.82(10)

Based on the results obtained, "the time required for site preparation" is the most critical issue supported by owners, consultants and contractors. Perhaps, this factor requires special attention in Jordan. First, in any construction project, the first step is site identification and then preparation e.g., removing and clearing of scrubs, plantation clearing or the destruction and bombardment of old buildings. Second

step, involves the digging of foundation, filling it with concrete and cement to the required level as directed by the competent authority (e.g., engineers or site managers). Third, the installation of moveable offices, guards and labor shed, coupled with environment precautions and material transfer and delivery access point.

Owners, consultants and contractors all agreed that ‘delay rate due to lack of material’ tends to influence the performance of a project. This is primarily due to arrangements with suppliers, high cost of transportation and taxation as well as the political climates in the neighboring countries surrounding Jordan.

Owners, consultants and contractors all agreed that ‘cash flow of the project’ is an important antecedent for the success of a construction project, and that this factor affects the performance of the construction industry in Jordan. For every project, a clear and conscience financial evaluation is required, cash flow is very important for activities like material procurement, equipment purchase or rent, wages, penalties and taxes as well as crisis financial plans.

All the target groups supported the notion that ‘the behavior and performance of staff in the project has a significant influence on the success of a project in Jordan. Therefore, workers are required to resume to work on time, be well committed to their jobs and to be responsible and also take responsibility if in the managerial position. A proper performance appraisal and incentive systems should be established to motivate employees do their job with full motivations. Issues like

overtime pay, health and family related supports should not be ignored and this should be a core managerial human resource policy.

Table 33 delineates the ten important dimensions impacting the performance of a project in the Jordanian construction industry and this notion is empirically supported by all target groups. As mentioned earlier, the results in Table 12 depict that 'the time required to prepare the site' is again the most important factor among all other factors in the construction sector in Jordan with an RII equal to 0.833 and ranked first. Thus, it is considered as the first pillar of the success for a construction projects. The second factor was financial participation in the market for construction companies with an RII equal to 0.825. This factor plays a leading role in the evolution of the construction industry, due to the fact that such activities increase the flow of cash into the sector. This tends to boost the financial capabilities of construction firms to take on new projects, purchase new equipment, hire professionals, and have sufficient number of workers.

Table 33: Ten significant factors affecting the performance, RII (Ranking)

Significant factors	All responses RII (Ranking)
The time required for site preparation	0.83(1)
Financial participation in the market for construction companies	0.83(2)
Cash flow for the project	0.82(3)
Delay rate due to the lack of materials	0.81(4)
The cost required for the commitment of the regulations	0.81(5)
Learning from own experience and past experiences	0.80(6)
The proposed or expected duration to complete the project	0.80(7)

Application of security and safety factors in project	0.80(8)
The behavior and performance of staff in the project	0.80(9)
Compliance with the specifications and conditions agreed	0.79(10)

Third, cash flow of the project is another important factor which significant impact on the industry in Jordan, ranked third by all respondents with an RII equal to 0.82. This suggests that a non-stop flow of cash is required for construction activities to be done from beginning to the end. Without a stable cash flow the success of a project can be jeopardized. Furthermore, 'delay rate due to lack of material' may have profound effect on the success of a construction project and ranked fourth by the target groups in this study with an RII to equal 0.816. This is primarily due to the political situation in the Middle East and all other countries that share borders with Jordan.

The cost required for the commitment of the regulations was ranked fifth by the respondents with an RII equal to 0.812. Associations of Engineers and the Ministry of Urban Development in Jordan, sets several laws in order to increase safety and security in the construction sector. This was done to ensure the rights of workers and engineers, penalties have been imposed on all irregularities in the workplace or construction site.

Learning from own experience and past experiences was ranked sixth by the survey respondents and this factor plays an important role in the development of Jordan's construction sector within the RII value equal to 0.808. This aspect is essential for all

units in the construction industry for a sustainable development. Managers and site supervisors must learn from their own or past experience, so as not to repeat the same mistake. For instance there is a need for engineers and site designers to conduct a pilot study by analyzing previous buildings, projects and developing a prototype or simulation. Further, these feasibility studies can provide useful information for engineers regarding engineering problems faced by previous engineers in terms of suitable work design as well as logical and error-free implementations.

The item 'the proposed or expected duration to complete the project' was ranked seventh with an RII equal to 0.806. For instance, scheduling of a project determines the relative budget that would be allocated for the project. Nonetheless, unforeseen factors or natural disaster like earthquake, flood, bad weather condition, and licenses or approvals from the authorities often cause delays. This in turn increases the expected cost that would be spent on the project. Therefore proper scheduling with forecasting must be taken into consideration by the project planners before the project kick off.

The application of security and safety issue is an important segment of any construction project. Based on the findings the issue was ranked in the eighth position with an RII equal to 0.803. This factor has a significant impact on construction projects in Jordan, and to mitigate the negative causes of this factor. Project managers must:

1. Put up appropriately wall around the site,
2. Put up big and clear sign to indicate the presence of heavy equipment and danger within the site.

3. Ensure proper entrance and exit and the possibility of easy access in case of crisis e.g. fire or earthquake.
4. Store hazardous and/or flammable materials stored in safe and private places, with signs to indicate the type of materials.
5. Supplies of construction materials to the site appropriately and in proportion to the work.
6. Require waste containers are required to remove construction waste.
7. Provide fire extinguisher must be in perfect and working condition in the workplace.
8. Provide a first aid box and the required materials must be in place.
9. Do not allow visitors or non-staffs into the site without supervision of professionals.
10. Use necessary traffic signs should be used to avoid accidents and guidance for workers.

The behavior and performance of staff in a project was ranked ninth by the target group with an RII value equal to 0.802. This factor seems to influence the performance construction firms in Jordan. Thus, responsible and moral behaviors of staff is required, engineers must not be careless. They should take charge of their units and ensure that staffs exhibit civil and moral attitudes on sites.

Compliance with the specifications and conditions, has been ranked by all respondents in the tenth position with an RII equal to 0.798. This factor has an effect on the construction sector in Jordan in terms of compliance with the specifications and conditions laid down by the competent authority. Ranging from the used

equipment, materials, the presence of engineers, the presence of competent officer to monitor the performance of workers, the sufficient number of workers and their commitments to all laws laid down by the Ministry of Urban Development in Jordan.

4.4 The third section: Factors influencing the performance of construction industry in Jordan in terms of practices

4.4.1 Types of methods employed by stakeholders for scheduling and planning in the construction industry

The RII and ranking will show which method is more important and for whom the method is useful.

Table 34: Planning methods, ratio (Ranking)

Planning Methods	Owners	Consultants	Contractors
Bar Chart method	62.50% (10)	34.62% (9)	56.41% (22)
Critical path method	12.50% (2)	46.15% (12)	25.64% (10)
S-Curve method	18.75% (3)	11.54% (3)	12.82% (5)
Others	6.25% (1)	7.69% (2)	5.13% (2)
Total	100% (16)	100% (26)	100% (39)

Based on the results, Bar Chart method seems to be one of the most significant planning and timing method for contractors and owners, due to the fact that Bar Chart method can simplify time performance monitoring for every planned activity through project deployment and application as seen in Table 34.

Critical Path Method (CPM) is designated as a vital method for consultants, CPM technique aid in identifying essential procedures related to a particular project; which

will then facilitate consultants abilities to assess overall time performance in respect to start date and finish date. In addition they can assess the effectiveness of certain factors in the project.

The third technique is the S-Curve Method, which is employed by the target groups. One reason this method is widely used is because of its ability to compare the actual and estimated time for a particular activity at any given stage in a project. Generally speaking, monitoring performance with regard to time is difficult, especially when the firm uses other methods. This gives the method an upper hand in terms of time estimation and forecasting.

4.4.2 Regular meetings to discuss and follow up different activities in the project

Table 35 shows that the majority of meetings in the owner companies, consulting companies and contracting companies are held weekly to assess the performance of the project and resolve problems that hinder the project. Daily meetings are held only for emergency events or delicate problems facing the project. Finally, monthly meetings are not effective for monitoring and reviving of activities related to a project.

Table 35: Regular meetings between work team, ratio (Ranking)

Meeting Activities	Owners	Consultants	Contractors
Daily	6.25% (1)	3.85% (1)	15.39% (6)
Weekly	56.25% (9)	61.54% (16)	61.53% (24)
Monthly	37.50% (6)	34.61% (9)	23.08% (9)
No	0.00% (0)	0.00% (0)	0.00% (0)
Total	100% (16)	100% (26)	100%

4.4.3 The computer programs the target group used for planning and scheduling purposes in their projects

Table 36: Project management programs, ratio (Ranking)

Programs	Owners	Consultants	Contractors
Primavera	31.25% (5)	19.23% (5)	46.15% (18)
Microsoft project	56.25% (9)	57.69% (15)	38.47% (15)
Excel sheet	12.50% (2)	23.08% (6)	12.82% (5)
Others	0.00% (0)	0.00% (0)	2.56% (1)
Total	100% (16)	100% (26)	100% (39)

Table 36 shows that Microsoft Project program is the most widely used by owners and consultants, because users can draw a plan of action and represent it on a network planned coupled with the allocation and management of resources for each activity. Users can also follow-up to the project's progress and project budget management. It is more user friendly with online support and training. Whereas, Primavera program is widely used by contractors due to the fact that it is mainly used for the preparation of schedules for projects, costing and control managements, progress report monitoring and delays. The program also allows users to calculate the duration of the project and the resources to be used and determine the optimal way to use these resources. In addition, users can review previous projects, compare and contrast it with the current or prospective projects. Thus, decision making duration can be shortened which is what contractors want to know.

Primavera and Microsoft Project both are similar but does have their differences, in terms of usage, data the input techniques, and activities screening. Microsoft Project software is much easier to use, since it supports all existing techniques (e.g., copy, cut and paste). While, primavera is very complex, each activity must be done separately and reports, display and data management seems to be difficult. Finally, in relation to information accuracy and project size, Primavera is better than Microsoft Project.

4.4.4 Engineers responsible for the project cost

Table 37 shows that most owner companies, consultant companies and contractor companies have engineers whose responsibility is cost calculation and estimation, related to the ongoing activities and processes on site. Hence, looking at the overall outcome cost performance of a project might be monitored through flexible feedback mechanism. Feedback loops enables the firms to make necessary changes on time, to enhance quality and reduce wastage, which will increase productivity and save cost.

Table 37: Cost engineering usage, ratio (Ranking)

Items	Owners	Consultants	Contractors
Yes	56.25% (9)	50.00% (13)	61.5% (24)
No	6.25% (1)	3.85% (1)	7.69% (3)
Sometimes	37.50% (6)	46.15% (12)	30.77% (12)
Total	100% (16)	100% (26)	100% (39)

4.4.5 Application of the actual value and earned value concept in controlling cost for the project

Table 38: Actual value and earned value concept in controlling cost, ratio (Ranking)

Items	Owners	Consultants	Contractors
Yes	56.25% (9)	50.00% (13)	53.85% (21)
No	0.00% (0)	3.85% (1)	2.57% (1)
Sometimes	43.75% (7)	46.15% (12)	43.58% (17)
Total	100% (16)	100% (26)	100% (39)

Table 38 shows that the majority of contractors, owners and consultants have applied the earned and actual value concepts to monitor expenses related to projects. The earned value concept "provides a system for evaluating the performance of the project through integrating cost, schedule and work. This will assist for evaluation of cost and time performance factors associated with projects". For instance, firms can evaluate the actual and earned value, such that earned value should be more than the actual value, hence the performance related to cost can be considered good enough.

4.4.6 Power and authority delegation to line managers to manage the actual expenses

Table 39 shows frequency and percent for target group in terms authority and power delegation to line-managers to allow them control the real expenses. The Table explains that most owners companies, consultant companies and contractors companies grant authority to line-managers to control the real expenses. Moreover, these kinds of authority assignments tend to depends on firm size. Power delegation

also can enhance effective and fast information dissemination between managers and workers to hasten the procedures and success rate of construction industry in Jordan.

Table 39: Power and authority delegation to line managers to manage the actual expenses, ratio (Ranking)

Items	Owner	Consultant	Contractor
Yes	56.25% (9)	46.16% (12)	51.28% (20)
No	0.00% (0)	11.54% (3)	12.82% (5)
Sometimes	43.75% (7)	42.30% (11)	35.90% (14)
Total	100% (16)	100% (26)	100% (39)

4.4.7 Overall safety factors implementation in a project

Table 40 shows that in all the firms surveyed, they apply safety factors in the workplace in a moderate way and this is as a result of lack of monitoring and follow-up activities by the authorities. There is a need for such surveillance to mitigate workplace accidents in the construction industry of Jordan.

Table 40: Overall safety factors implementation in a project ratio (Ranking)

Items	Owners	Consultants	Contractors
Not at all	12.50% (2)	11.54% (3)	15.38% (6)
Moderately	56.25% (9)	65.38% (17)	56.41% (22)
Extensively	31.25% (5)	23.08% (6)	28.21% (11)
Total	100% (16)	100% (26)	100% (39)

4.4.8 Effect of political and economic conditions on the actual cost relative to the estimated cost

Table 41: Effect of political and economic conditions on the actual cost relative to the estimated cost, ratio (Ranking)

Items	Owners	Consultants	Contractors
Yes	43.75% (7)	30.77% (8)	41.02% (16)
No	6.25% (1)	15.38% (4)	10.26% (4)
Sometimes	50.00% (8)	53.85% (14)	48.72% (19)
Total	100% (16)	100% (26)	100% (39)

Table 41 shows that political and economic factors sometimes affect the performance of the Jordanian construction industry, primarily due to wars and conflicts in countries like (e.g., Iraq, Syria, occupied Palestine), which lead to the closure of the border. Secondly, high dependent on imported building materials all lead to increase in the cost of manufacturing and construction activities.

Chapter 5

CONCLUSION AND RECOMMENDATION

Huge number of errors, rework and poor performance in recent years has led to the implementation of key KPIs and greater awareness of the benefits of measurement in the construction industry. KPIs provide a mechanism to focus on wider business performance measures, which enables firms to implement business improvement. A substantial number of studies have criticized the traditional performance measures for being erroneous and biased, and due to the fact they focused on few factors like cost and productivity, ignoring other factors, like client satisfaction, employee factors.

Given such criticism, there is a need to create a holistic performance measures for the Jordanian construction firms. Several authors have proposed different kind of performance measures and in this study all the measures and factors will be integrated to create a meaningful framework. This framework may serve as a starting point for practioners and scholars in the industry. This thesis aims to present critical KPIs and discuss the findings of a survey from the Jordanian construction industry. The findings will demonstrate how these KPIs influence the performance of the industry.

The first research objective is to identify the factors which affect the performance of the construction industry in Jordan. This was accomplished by screening the relevant

literatures and discussion with local experts. At the end ten (10) factors were determined namely; cost factor, time factor, quality factor, productivity factor, client satisfaction factor, regulatory & community satisfaction factor, employee's factor, health and safety factor, innovation and learning factor and finally environmental factor as noted by local experts and various scholars.

The second research objective is to identify owners, consultants, and contractors perceptions towards the relative importance of the key performance indicators of construction industry in Jordan. Cost factor seems to have relevance to owners as they tend to have more interest in the cash inflow and outflow, as well as the overall profits for any particular project than consultants and/or contractors do. Time factor is important for consultants because they are the master planners of projects and they have great interest in evaluating durations required to complete a project, rework if there are defective parts and so on. Contractors are interested in more quality, because their reputation and expertise can only be assessed through the quality of their work. They also get contracts if they are known to produce quality buildings and although the owners are interested in quality but not as contractors do.

Regarding productivity factor, it seems to have high relevancy for contractors, a plausible explanation for this is because the level of productivity will determine contractors' earnings, and number of projects done. So they focus on employees and managers' productivity rather than owners and consultants. Consultants seem to pay attention to client satisfaction more than owners and contractors. This is because their responsibilities include coordination of activities, information sharing and exchange with clients and contractors. Although contractors should do the same but

they focus more on the project plan than client satisfaction, this is because of lack of business knowledge. Therein, there is a need for contractors to embrace customer relationship management system.

Consultants and contractors seems to be more interested in rules and regulations within the framework of construction management than owners, the main reason is because they are the ones who deal with the main activities more than owners. Therefore, owners should be enlightened about construction legislations in Jordan, to avoid conflicts with consultants or contractors. This way they will not request for unlawful activities or procedures that may affect the environment or disturb the neighborhood. As mentioned earlier, contractors are more interested in productivity, which is directly related to employee factor. Contractors gave the factor high relevance due to the fact that it motivates employees to work well, which in turn facilitates and fasten work processes to achieve timely results.

The application of security and safety factor was ranked in similar fashion by all target groups, because it is an important and delicate factor to consider in the industry. From owners and contractors perspective theft may lead to property loss; from consultants and contractors perspective loss of reputation and penalties by the law if accident happens to be an avoidable one. Innovation and learning factor is critical for contractors and consultants due to their interest in activities like knowledge management, teamwork, work processes and procedures, learning and the implementation of modern methods. The use of information technology can enhance smooth movement and control of activities in any given project.

The last but not the least, for environmental factor the responses show that the factor has no relevance in the construction industry in Jordan. From a pragmatic point of view, Jordan is classified as a third world country. Developed nations spent billions of dollars to prevent and control environmental pollutions; however developing countries pays little attention as eminent in our findings. Hence, the government should implement legislation that will prevent environmental pollution. This can be done by gearing up monitoring activities and increasing penalties.

The third research objective is to determine the most important KPIs of construction industry in Jordan. The lack of materials often cause delay in projects; secondly, stable cash flow will affect the progress of a construction project; thirdly, site preparation time is an important antecedent for projects. Finally, the performance and the behaviors of employees often have huge impact on the progress of a construction progress. Therefore, managers can benefit from this study by taking account of the important factors before embarking on a project.

The forth research objective is to measure the level of agreement, disagreement among consultants, owners and contractors in terms of ranking the KPIs. The entire respondents agreed that the time required for site preparation is the most important factor for any construction project followed by the financial participation in the market by construction companies. Next is cash flow for the project, delays as a result of lack of materials, the cost required for the commitment of the regulations, learning from own experience and past experiences, the proposed or expected duration to complete the project, application of security and safety factors in project,

the behavior and performance of staff in the site and lastly, compliance with the specifications and conditions agreed by all parties.

The fifth research objective is to compare and see if there is any relationship between the rankings and importance for the target groups regarding key performance indicators. T-test shows that each entity in the target differs in their view and knowledge of the KPIs. This is not surprising as previous scholars have enlisted various reasons why performance measurement is now on the management agenda, but each entity has a different agenda when compared with other entities in the construction industry. First, the new work settings, intense competition; initiatives for improvement; because of quality awards both in national and international fronts; work distribution as opposed to the traditional organizations; changing customer demands; and the influence of information technology.

Based on the extant literatures and findings, the study support the notion that project managers and firms should get involved in the following activities.

- Management of client requirements
- Understanding the client goals
- Communicating both formally and informally
- Involving project managers and other stakeholders
- Defining client requirements
- Describing clearly the initial problem
- Representing a process of iterations and feedback
- Agreeing mutually on ways of working
- Starting with the problem, not with the solution to it

As a recommendation, construction firms in Jordan are encouraged to:

- Establish their position in the market place and monitor their progress internally.
- Communicate with customers and shareholders through priorities and standards, as well as social responsibility.
- Firms should benchmark performance, due to the fact that performance measures stimulate interest and confirm position.
- Motivate people to look for ways of improving performance both from employee and employers perspective.
- Provide a basis for reward for employee, and management control.
- Provide a means of cost control which in turn provide an insight into whether a business is doing well.
- Provide what is important for the customer which in turn provide an insight into what the business needs to focus on and where to invest more

5.1 Limitations

This thesis is not without limitations as, first data was collected online. The absence of researchers control might influence the way the respondents answered the questions. The research is cross-sectional in nature as such there is a tendency of common method bias, which may have profound effect on the observed factors. Future study can adopt a longitudinal approach to eliminate the potential effect of causal inference. The findings are only limited to Jordan, hence the results cannot be generalized and may not be applicable to other countries.

5.2 Future Research Direction

Other researchers should conduct similar studies in other countries. Sample size was small, but the use of judgmental sampling technique gives the confidence to

generalize the results against the population. However, researchers are encouraged to use a large sample size so as to increase the validity of the current findings. Furthermore, data collection can be done physically using a longitudinal approach to avoid common method bias. Future research can be evaluated and identify how construction firms can enact the usage of the aforementioned KPIs by analyzing these factors from human resource management. Evaluating if these factors can enhance productivity of all entities in the construction industry could be a fruitful avenue.

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APPENDICES

Appendix A: Sample of questionnaire

_ Performance measurement of construction industry in Jordan _

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

1-Type of Organization**:**

1-Owner	**2-Consultant**	**3-Contractor**

2. Typical of projects of construction industry

1-Roads and transportation	**3-Buildings construction**
2-Water and sewage	**4-Others**

3. Average number of employees of Construction Company: *Number of employees in your company is ….. employees*

4. Your Job title (responder of questionnaire):

1-Organization Manager or Deputy Organization Manager	**3-Site Engineer & Office Engineer**
2-Project Manager or Deputy Project Manager	**4-Other workers**

5- The responder experience years: *Number of experience years of the responder is ….. Year*

6- Number of projects which accomplished in the last seven years**:**

1-	**1 to 8**	**3-**	**17 to 25**
2-	**9 to 16**	**4-**	**More than 25**

7. Financial value of projects which accomplished in the last seven years**:**

1- less than 1 M	**2- 1 M to 6 M**
3- 6 M to 10 M	**4- More than or equal 10 M**

8. In which field your company specializing of construction sector**:**

1- Buildings construction	**2-infrastructure**	**3-Others**

Part Two: Factors Affecting the Performance of Construction Projects

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

Groups/Factors	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
(1) Cost factors					
Financial participation in the market for construction companies					
Financial liquidity for companies					
Cash flow for the project					
Earnings ratio of the project					
Administrative expenses for the project					
The cost of the project design					
The cost of equipment and materials in the project					
The cost of labors in the project					
Project overtime cost					
The cost of financial incentives and rewards					
The cost of re-implementing some working					
Cost of variation orders					
The proportion of waste in material					
Regular project budget update					

Cost control system					
High prices of materials					
Change in Exchange Rates					

Groups/Factors ***(2) Time factors***	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
The time required for site preparation					
The proposed or expected duration to complete the project					
The proportion of the delay in the approval of work orders					
Time needed to implement variation orders					
The time required to modify and repair the errors and the defects					
The average delay in claims approval					
The delay rate in the financial payments from the owner to the contractor					
Resource availability as planned according to duration of the project					

Delay rate due to the lack of materials					

Groups/Factors	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
(3) Quality factors					
Compliance with the specifications and conditions agreed					
The presence of persons with competence and high experience					
Quality of raw materials and equipment used in the project					
Participation of managerial levels with decision making					
existence the system to assessment the quality in the organization					
The existence of meetings and intensive training for the development of quality					

Groups/Factors	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
(4) Productivity factors					
The complexity existing in project					
The number of new project in the year					
The relationship between employees and project management					
Absenteeism rate through project					
Sequencing of work according to Schedule for the project					

Groups/Factors	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
(5) Client Satisfaction factors					
Coordination in exchange of information between owner and project crew					
Leadership skills for project manager					
Speed and efficiency in service delivery to the owner					
Differences and disputes between owner and project crew					
Number of works					

which require replay					

Groups/Factors ***(6) Regular and community satisfaction factors***	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
The cost required for the commitment of the regulations					
Number of works which infringes the law					
Quality and availability of regulatory documentation					
Problems resulting from the neighbors and the circumstances surrounding the site					

Groups/Factors ***(7) Employees factors***	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
The behavior and performance of staff in the project					
Promote the spirit of competition between employees					
Employees					

motivation					
Belonging to work					

Groups/Factors ***(8) Health and Safety factors***	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
Application of security and safety factors in project					
Ease to reach the site (place of the project and its location)					
The proportion of incidents which recorded in the project					
The proportion of compensation resulting from accidents for workers and others					

Groups/Factors ***(9) Innovation and learning factors***	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
Learning from own experience and past experiences					
Learning the best practice of experienced					
Human resources training by new skills needed for					

the project					
Teamwork					
Appropriate solution					

Groups/Factors ***(10) Environment factors***	***Very low Important (1)***	***Low Important (2)***	***Medium Important (3)***	***High Important (4)***	***Very high Important (5)***
Air quality					
The level of noise and the site					
Existing waste around the site					
Climatic condition at the site					

Part Three: The Practices Concerning with the Factors Affecting the Performance of Construction Projects :

1-Which kind of the following methods you are using in planning and scheduling the project ?

1- Bar Chart method	**2- Critical path method**	**3- S-Curve method**	**4- Others**

2- When do you held regular meetings to discuss and follow up the project different activities ?

1- Daily	**2- Weekly**	**3- Monthly**	**4- No**

3- Which of the following programs you are using for planning and scheduling in the projects ?

1- Primavera	**2- Microsoft project**	**3- Excel sheet**	**4- Others**

4- Do you have an engineer responsible for the project cost ?

1- Yes	**2- No**	**3- Sometimes**

5- Do you apply the actual value and earned value concept in controlling cost for the Project?

1- Yes	**2- No**	**3- Sometimes**

6- Do you give right and authority for the line managers to manage the actual expenses ?

1- Yes	**2- No**	**3- Sometimes**

7- To what extant has been implemented overall safety factors in the project ?

1- Not at all	**2- Moderately**	**3- Extensively**

8- Does possible the actual cost of project be more than the estimated cost because of political and economic conditions which afflicting Jordan?

1- Yes	**2- No**	**3- Sometimes**

Appendix B: Factor and RII

Factors	All Response	
	RII	Rank
The time required for site preparation	0.833012821	1
Financial participation in the market for construction companies	0.825320513	2
Cash flow for the project	0.823824786	3
Delay rate due to the lack of materials	0.816132479	4
The cost required for the commitment of the regulations	0.81292735	5
Learning from own experience and past experiences	0.808440171	6
The proposed or expected duration to complete the project	0.806944444	7
Application of security and safety factors in project	0.802777778	8
The behavior and performance of staff in the project	0.801923077	9
Compliance with the specifications and conditions agreed	0.798824786	10
Leadership skills for project manager	0.798183761	11
The relationship between employees and project management	0.796794872	12
Financial liquidity for companies	0.795619658	13
Cost control system	0.78792735	14
Employees motivation	0.786431624	15
Sequencing of work according to Schedule for the project	0.784401709	16
Resource availability as planned according to duration of the project	0.784188034	17
prices of materials	0.782692308	18
Time needed to implement variation orders	0.782371795	19
Number of works which require replay	0.781730769	20

Factors	All Response	
	RII	Rank
existence the system to assessment the quality in the organization	0.781517094	21
Belonging to work	0.780876068	22
The delay rate in the financial payments from the owner to the contractor	0.780021368	23
The proportion of the delay in the approval of work orders	0.780021368	24
Promote the spirit of competition between employees	0.778952991	25
Teamwork	0.778952991	26
Coordination in exchange of information between owner and project crew	0.778098291	27
Ease to reach the site (place of the project and its location)	0.777991453	28
Quality and availability of regulatory documentation	0.776602564	29
The cost of equipment and materials in the project	0.774786325	30
Quality of raw materials and equipment used in the project	0.773931624	31
Appropriate solution	0.771153846	32
Speed and efficiency in service deli to the owner	0.77008547	33
The presence of persons with competence and experience	0.767200855	34
The proportion of incidents which recorded in the project	0.767200855	35
The proportion of compensation resulting from accidents for workers and others	0.767094017	36
The time required to modify and repair the errors and the defects	0.764102564	37
The existence of meetings and intensive training for the development of quality	0.763888889	38
Earnings ratio of the project	0.758547009	39
The cost of the project design	0.757692308	40

Factors	All Response	
	RII	Rank
Project overtime cost	0.757371795	41
Regular project budget update	0.755876068	42
Number of works which infringes the law	0.755235043	43
The complexity existing in project	0.754700855	44
The average delay in claims approval	0.753952991	45
Participation of managerial levels with decision making	0.752457265	46
Problems resulting from the neighbors and the circumstances surrounding the site	0.751495726	47
Learning the best practice of experienced	0.748931624	48
Human resources training by new skills needed for the project	0.746794872	49
Differences and disputes between owner and project crew	0.743803419	50
The cost of labors in the project	0.743589744	51
The cost of re-implementing some working	0.743269231	52
Absenteeism rate through project	0.741239316	53
The proportion of waste in material	0.735790598	54
Administrative expenses for the project	0.722863248	55
The number of new project in the year	0.721367521	56
Change in Exchange Rates	0.720833333	57
The cost of financial incentives and rewards	0.715491453	58
Cost of variation orders	0.713354701	59
The level of noise and the site	0.703739316	60
Air quality	0.698931624	61
Climatic condition at the site	0.694123932	62
Existing waste around the site	0.659294872	63