Assessment and Development of Contractors' Mitigation Practices Towards Risks out of Contractors' Control in the Saudi Construction Industry

by

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ABSTRACT

Recent studies have identified that contractors in the Saudi construction industry are not the main party that cause risks as owners and other parties have the major share of causing risks. However, with the identification that risks out of contractors' control are a leading cause of low performance, there is a lack of efficient risk mitigation practices in Saudi to manage these risks. The main aim of this dissertation is to assess the current practices applied by contractors to minimize risk out of their control and develop a risk mitigation model to manage these risks. The main objectives of the study are: investigating the risks that are out of contractors' control, assessing the contractors' current risk mitigation and performance measurement practices, and finally developing and validating a risk mitigation model to minimize risks out of contractors' control and measure performance of involved project parties. To achieve the study aim, a mixed methodological approach was adopted. Theoretical approaches were utilized to review previous research and to develop a conceptual risk mitigation framework followed by a practical approach that is considered with collecting data from contractors. The quantitative method was mainly used to meet the study objectives through distributing a survey in the form of a questionnaire. As a consolidation of the study findings, the top ranked risks that are out of contractors' control were identified. Furthermore, the results identified that the contractors' current risk management and performance measurement practices are not effective in minimizing projects risks caused by other parties and ineffective in measuring performance of all parties. The developed model focuses on increasing accountability of project parties through mitigating project parties' activities

and risks with measuring the deviations and identifying sources of deviations. Transparency is utilized in the model through sharing weekly updates of the activities and risks combined with updated information of performance measurements of all project parties. The study results showed that project risks can be minimized and projects' performance can be increased if contractors shift their focus using the developed model from only managing their own activities and risks to managing all project parties' activities and risks.

DEDICATION

I would like to dedicate this to my parents and to my wife who have supported me all the way through my academic career.

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This dissertation would never have been possible without the help of my Committee (Dr. Kenneth Sullivan, Dr. Dean Kashiwagi, and Dr. William Badger). I would also like to acknowledge Dr. Jacob Kashiwagi and other fellow researchers at the Performance Based Studies Research Group who have helped me along the way in completing my studies.

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CHAPTER 1

INTRODUCTION

Project delays or time overruns are measures and results of risk occurrence. Through the past three decades, many studies in Saudi Arabia indicated the critical issue of the construction industry with non-performance, inefficiencies, time and cost overruns. Time overrun is considered to be one of the most frequent and serious issues in construction projects in Saudi (Faridi and El-Sayegh, 2006). Four studies identified that between 60% and 70% of public construction projects in Saudi Arabia faced delay in the completion time (Zain Al-Abidien, 1983; Al-Sultan, 1989; Al-Khalil and Al-Ghafly, 1999; and Assaf and Al-Hejji, 2006). Survey results showed that the average delay percentage differed from the original contract duration by between 10% and 30% (Assaf and Al-Hejji, 2006). In recent research, 49 case studies were investigated in the west province in Saudi Arabia and it was found that the average delay of these cases was 39% of the estimated projects schedules (Kashiwagi, *et al*., 2015). According to Abdul-Ghafour (2011), the total value of public projects that fell behind their planned schedules is estimated to be about $147B. Furthermore, the continuous issue of cost overruns in Saudi construction industry has been studied by several researchers (Bubshait and Al-Juwairah, 2002; Alhomidan, 2010; Allahaim and Liu, 2015; Alghonamy, 2015). Al Turkey (2011), surveyed 300 project managers from various sectors and stated that 80% of Saudi construction projects were subject to cost overruns. Another study analyzed 1035 infrastructure projects in Saudi Arabia between the years from 1992 to 2009 and

found that 850 (82%) project were delayed and 41% of the projects faced cost overruns (Althunian, 2010).

The above projects cost overruns and delays are results and measures of risk occurrence that cause a low performing construction industry in the authors' definition of risk as something unexpected or unpredicted resulting in negative deviation from cost and time expectations (Wharton, 1992; Williams, 1995; Akintoye and MacLeod, 1997; Hillson, 2002; Ward and Chapman, 2003). However, the reported data are perceptions of poor performance of projects in Saudi construction industry as there is a lack centralized systems that track and collect actual data to provide precise and quantitative data on projects performance in the governmental organizations in Saudi Arabia (Almutairi, 2017 and Al-Otaibi & Price, 2009). According to Ankrah & Proverbs (2005) there has not been enough consideration of applying project measurement systems in the construction sector. Alsulamy (2015) identified that the construction projects in public organizations in Saudi Arabia suffer from the absence of performance measurement systems that identify the performance of projects and identify the performance of all project parties.

Construction projects are unique and carry different sources of risks. Several parties are involved in projects such as owner, consultant, contractor, designer, suppliers, and other stakeholders. All of these parties inevitably carry certain risks (Peckiene et al 2013). In the context of the Saudi construction industry, several researchers identified causes of risks in the industry and categorized those risks considering the responsible parties. These studies have identified that contractors are not the main party that cause risks as owners, consultants, and other parties have the major share of causing risks in the

industry. Assaf and Al-Hejji (2006) identified and assessed causes of delay in the Saudi construction industry and the final combination of results showed that construction delays are mostly originated by owners, and then followed by contractors, designers, labors and consultants. A recent study assessed the significance of risks inherent in the aviation construction projects in Saudi Arabia (Baghdadi, 2017). The study found that designer related risks is the most important group of risks affecting the aviation projects in Saudi. Client related risks group was ranked second followed by consultant related risks and then contractor related risks. Furthermore, Elawi *et al.*, (2016), identified the ownership percentages of the parties causing risks in 49 case studies the Saudi construction industry and found that majority of delays were created by owners as they were responsible for 53% of the risks followed by contractors who were responsible for 27%, and then other parties responsible for 20%. Additionally, this research applied a quantitative analysis of the literature that studied the causes of time overruns in the Saudi construction industry and concluded with a similar ownership indication as owners were responsible for 49.2%, contractors for 36%, and other parties for 14.8%.

So far, in the Saudi construction industry, there has been little consideration given to applying risk management practices to minimize risks affects in the construction sector. According to Baghdadi and Kishk (2015), there is a lack of efficient risk management practices in the Saudi construction industry. A study was conducted by Ikediashi, *et al.*, (2014), to identify and analyze the infrastructure projects' failure factors in Saudi Arabia. This study found that poor risk management practice is the most critical reason for project failure. Moreover, Albogamy and Dawood (2015), found that there is a

clear lack of risk management practices in Saudi Arabia that identify the impact of the risk factors for project parties in the construction process. In the traditional practices in managing risks in the Saudi construction industry, most of the risks are allocated to vendors and none to clients (Al-Salman, 2004) as clients do not take accountability of risks in traditional practices and automatically transfer them to other parties (Al-Sobiei, *et al*., 2005). However, in the literature discussed above, clients and project parties other than contractors cause a major share of project risks in the Saudi construction industry.

Contractors are playing an essential role in pushing the growth of any construction industry through successful delivering of projects. Failure to deliver projects successfully will impact the growth rate of the construction industry. Consequently, it is important to identify, assess, and manage the risks that impede contractors from delivering projects on specified time, cost and quality objectives (Assaf, et al., 2015). In addition, risk is defined as what contractor has no control over, or areas where the contractor has insufficient information to clearly see into the future (Kashiwagi, et al., 2013). To minimize effects of project risks, according to Algahtany et al (2016), contractors should identify risks out of their control (caused by other parties) and plan in advance how to reduce the effects of these risks. Therefore, the present study intends to investigate risks out of contractors' control in the Saudi construction industry, evaluate the current practices applied by contractors to minimize these risks, and benefit from best practices (as applied in developed countries) to develop a risk mitigation model for the contractors for a potential application in the Saudi construction industry.

Research Problem

Research has shown that construction projects in Saudi Arabia have exhibited poor performance for the past three decades. The traditional risk management practices have been ineffective at helping contractors deliver projects on time and within budget while meeting quality expectations. Recent studies have identified the ownership of parties who cause risks and lead to low performance in the Saudi construction industry. These studies identified that contractors are not the main party that cause risks as owners, designers, consultants, and other parties have the major share of causing risks in the industry. However, with the identification that risks out of contractors' control (caused by other parties) are a leading cause of low performance, there is a lack of efficient risk mitigation practices by contractors in Saudi to manage these risks.

Research Aim and Objectives

The main aim of this dissertation is to evaluate the current practices applied by contractors to minimize risk out of their control and develop a risk mitigation model for the contractors in the Saudi construction industry. Risks out of contractors' control in the Saudi construction industry will be studied through conducting literature review and through assessing these risks based on their importance and occurrence in the Saudi construction industry. Contractors' current practices in managing risks out of their control will be investigated through analyzing their current risk mitigation and measurement practices. The developed risk mitigation model will be validated through identifying

contractors' perceptions of the new approach. In order to achieve the aim of this study, there are three main objectives of the study, which are:

- **Objective 1:** Investigate the risks that are out of contractors' control (caused by other parties) in the context of the Saudi construction industry through identifying, assessing, and reporting an up-to-date ranked list of risks that are out of contractors' control based on risks importance and occurrence in the industry.
- **Objective 2:** Assess the current practices applied by contractors to minimize risks out of their control by evaluating the contractors' current risk mitigation and performance measurement practices.
- **Objective 3:** Develop a risk out of contractors' control mitigation model and identify the contractors' perceptions of new risk mitigation approach.

Research Structure

The research has been undertaken on the basis of evaluating and developing contractors' practices towards risks out of their control in public projects in Saudi. Theoretical approaches to review previous research are included followed by a practical approach that is considered with collecting data. The research process can be classified into the following stages:

Stage 1: in order to achieve the aim, the study started by deriving theoretical insights and observations from the literature, as discussed in the second Chapter. The literature review stage is considered an important stage of research as it leads to more understanding of the nature of the research problem and identify the study theories in

order to construct the theoretical framework of the study objectives. The exploratory phase in the literature review is focused on the literature that investigate risk management methods in the developed countries to establish the knowledge regarding concepts of risk management processes. Using literature and deductive analysis, the traditional method in managing risks in public projects in the Saudi construction industry is investigated.

Stage 2: the research methodology and methods are discussed in details for this study in the third Chapter. This involves a discussion of the research design and process, the sampling related to the empirical work, and the method in which data was collected. Mixed methodological approach was adopted. However, the quantitative method was mainly used to meet the study objectives through distributing a survey in the form of a questionnaire. This stage includes an explanation of the study population and sampling.

Stage 3: in Chapter 4, risks that are out of contractors' control (caused by other parties) in the context of the Saudi construction industry will be investigated through identifying, assessing, and reporting an up-to-date ranked list of risks that are out of contractors' control based on risks' importance and occurrence in the industry. The researcher will use two research methods to collect the data: literature review and survey. In the literature review method, the research will identify the studies that identified and assessed risks and then identify the risks that are out of contractors' control in the Saudi construction industry. In the second method, a survey will be conducted to identify the views of contractors to assess the identified risks based on their importance and occurrence in the industry.

Stage 4: Chapter 5 starts with the assessment of the current risk management and performance measurement practices applied by contractors to minimize risk out of their control (caused by other parties). The contractors' current practices towards minimizing risks out of their control will be investigated using a survey method. This part will include identifying contractors' practices in the identification of projects activities and risks, contractors' practices in mitigating other parties' activities and risks, and contractors' practices in measuring the performance of all project parties.

Stage 5: the second part of Chapter 5 is divided into two phases. The first phase will presents the validation of the proposed model through collecting the contractors' perceptions of new risk mitigation approach. The validation process will be conducted within contractors who have experience in public projects in the Saudi construction industry. The second phase includes providing the practical framework in managing risks out of contractors' control in the Saudi construction industry. Finally, Chapter 6 includes the study conclusions and recommendations which will be constructed based on study results and researcher's observations.

CHAPTER 2

LITERATURE REVIEW

Chapter Introduction

The exploratory phase in the literature review chapter is focused on the literature that investigates risk management methods in the developed countries to establish knowledge regarding concepts of risk management processes. The chapter starts with an overview of the literature that investigates risk management methods and processes in the developed countries. The review of literature investigates the use of continuous risk mitigation and performance measurement in order to evaluate the effectiveness of the planned risk management procedures and effectiveness of the responsible parties for the project risks. Using literature and deductive analysis, the traditional method in managing risks in public projects in the Saudi construction industry will be investigated. This chapter concluded with an initial formulation of conceptual framework for managing risks out of contractors' control.

Risk Management in Construction

In organizations, risk management is identified as an essential component of projects success. Risk management is defined as one of the most creative and resourceful practices in the history of project management (Smith et al., 2009), which is aimed to manage and minimize adverse effects in projects (TAM, 2006). Risk management eventually enables to define and classify risks in projects at the start of their processes

and allows the project managers to successively form their plans supported by systematic evaluation and mitigation of risks (Smith et al., 2009).

Compared to other industrial areas, it is stated that additional risk is expected with the construction sector (Flanagan & Norman, 1993) and low performance of construction projects has been contributed to the lack of success of risk management applications (Loosemoore et al., 2006; CII, 1995). According to Shehu and Akintoye (2010), the lack of applying risk management process in construction projects is thought to lead to time and cost overruns. Many researchers have been triggered to put emphasis on defining and developing risk management processes due to the risky nature of the construction industry. The objectives and processes of risk management include the identification of risks, risks assessment and regulation of the probability and/or influence of risks through mitigating risks throughout project phases (Hubbard, 2009). Among other elements of successful project management, risk management has gained more focus because of the increased vulnerability of the construction sector to risks.

Various risk management processes have been developed and integrated in national and international guidelines and standards owing to the increased focus granted to risk management (Del Cano & de la Cruz, 2002; Dikmen et al., 2004; Hillson, 2003; Raz & Hillson, 2005). The different processes follow similar main stages even though there is a dissimilarity of terminology between them. A collective/standard process of risk management adhering to the various principles and standards can be allocated in Hillson (2009). Different stages and tools are utilized in identifying and managing risks which consist of planning activities, brainstorming exercises, risk breakdown structures,

SWOT analysis, management and mitigation models (Hillson, 2003; Kendrick, 2003). However, the proficiency required to successfully recognize risks early in projects cannot be delivered by these tools singlehandedly even though the industry has several other resources accessible (Hillson, 2003).

Risk Management Plan

The main aim of a risk management plan is to provide effective solutions for project risks that have likelihood of occurrence and may impact project objectives such as cost and time. Risk management plan comprises of the following main phases: risk identification, risk evaluation or assessment and risk response and control (OGC, 2007b; Smith et al., 2013). At the start of the process, through retrieval of information the risks are identified; risk evaluation or assessment is the next step which is significant and used to evaluate and assess risks based on their probability of occurrence and their impact; and the last step is preparation and implementation of risk mitigation plan (OGC, 2007b).

Several authors have documented the components of risk management procedure. Some authors regard the process as a linear one that consists of risk identification, risk evaluation or analysis and risk response (Jordan, 2013). Other authors such as Pennock and Haimes (2001) state that the process of risk management include risk identification, grouping and measurement, assessment, mitigation, and lastly risk control and monitoring. Identification of risks, analysis, control and recording are listed as the important phases of the risk management process by Henley (2007).

Risk Identification

The initial step in risk management is considered to be risk identification (Batson, 2009). The identification of the risk areas which have the necessity of further investigation is the key objective of the risk identification process (Smith, 2003). It has been emphasized by El-Sayegh (2008) that a major step in managing risks is the identification and evaluation of the potential risks in a project. Furthermore, the potential project risks or adverse conditions are revealed and determined by risk identification (Williams, 2000). The initiation of the process of risk management takes place with risk identification through which the basis for the next steps of analysis, assessment and mitigation are developed, in accordance to Tchankova (2002). The projects managers are allowed to examine activities which are exposed to risks in the risk identification step with identifying the source of risks (Tchankova, 2002).

Different tools and processes such as checklists, brainstorming exercises, diagramming techniques, reflective analysis, risk breakdown structures, SWOT analysis, scenario analysis, surveys, and interviews can be adopted by companies in their identification methods (Kasap & Kaymak 2007; Edwards et al, 2009; Hillson, 2003; Kendrick, 2003). The checklists method is considered as a useful technique for identifying risks from different sources such as related projects or companies and experienced project managers. Moreover, another useful technique is thought to be searching for historical data from related projects (Smith, 2003).

Another effective approach in identifying risks is conducting a risk management workshop (Smith, 2003). For acquiring information regarding organizations or project

shareholder risks, this type of workshops can be made use of. In addition, the workshop could benefit from the brainstorming technique, and new ideas regarding potential risks can be brainstormed by the project team and shareholders (Smith, 2003). Moreover, for acquiring the advantages from expert experience, the Delphi method could be utilized as experts are allowed to work mutually for the purpose of achieving a collaborative agreement by converging from their views and ideas (Kerzner, 2006).

During the project stages, risk identification should be carried out continually but especially it should be applied at the start of projects. The application of risk identification before construction is optimal for project performance due to the fact that it allows project stakeholders to align resources to reduce recognized risks (Gibson et al., 2006; Edwards et al, 2009). Cost estimating for project activities is also enhanced by risk identification as Bajaj et al. (1997) identified that the accuracy of initial project estimates is enhanced when a risk identification process is carried out.

Risk Analysis and Assessment

The main objective of the risk analysis or assessment phase is to perform the classification of the identified risks to quantify the effects they cause on an organization or project (Smith, 2003). In addition, risk analysis stage determines the likelihood of risk occurrence, severity of risks and their overall impact (Adams, 2008). For assisting constructing projects' strategic decisions, the assessment of risks and identifying their effects are valuable (Keeling, 2000).

There have been a number of risk analysis approaches adopted by several authors. For example, risk factors are compared graphically through an analysis technique called

the decision tree, through which the experts are assisted in considering every available option for the evaluation of various approaches to managing risks (Dallas, 2008). A connection can be formed between the decisions and their probably outcomes through the decision tree, because of which participants are assisted in assigning probabilities to analysing the identified risks. Alongside the evaluation methods, a probabilistic risks evaluation method is called Monte Carlo, through which a repetitive simulation for project risks is performed while taking into account the probability distribution (PMI, 2004). Additionally, the decision-makers are assisted in analysing risks in a dynamic environment through the sensitivity technique as this method helps in exploring how the risks subsequently change the outcomes (Keeling, 2000; OGC, 2007b). However, it is essential to utilize a simple method in the risk analysis stage as simplicity is considered to be a vital component in the encouragement of contractors to make use of the risk analysis methods in their projects (Renuka *et al*., 2014).

A simple and commonly utilized technique is analysing risks on the basis of their importance, wherein risks are categorized on the basis of their severity of impact and probability of occurrence. As Figure 1 shows below, this analysis could be demonstrated in a logical table. Significantly, for the purpose of specifying the severity effects of risks with their probabilities of occurrence, there is a requirement of expert judgments (Smith et al., 2009).

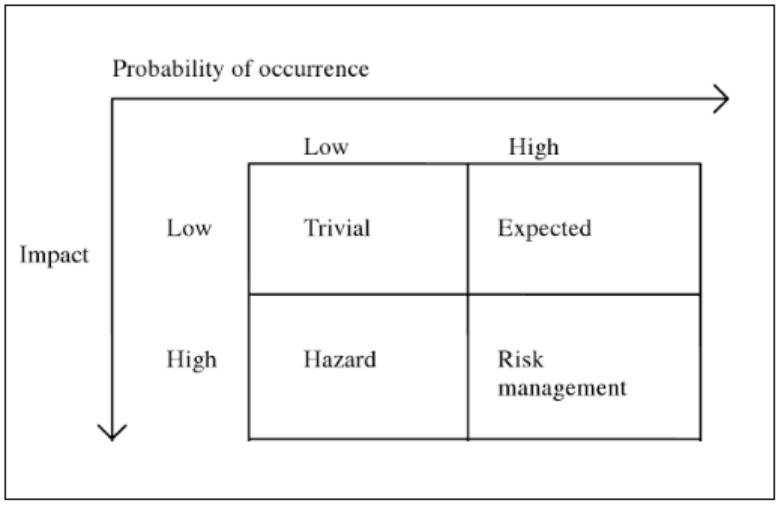

Figure 1: Probability and impact matrix (Smith et al., 2009)

This risk assessment approach measures the risks impact by multiplying the risk severity impact by the risk likelihood of occurrence (Mills, 2001). Moreover, this approach was used by Assaf and Haji (2006) and Albogammy et al (2012) to analyze and rank risks in the Saudi construction industry considering the risks frequency of occurrence in projects and risks degree of impact on projects' cost and time. This assessment approach will be used by the researcher to assess the risks that are out of contractors' control in the Saudi construction industry as it is considered one of the most prevalent approaches in the risk assessment stage (Baghdadi, 2017).

Risk Response and Monitoring

The risk response process is identified by Kerzner (2006), as 'the process that realizes, assesses, decides, and carries out one strategy or more to deal with risk at acceptable levels'. The findings in the risk analysis stage enables the parties responsible for risks to comprehend the effect of risks, and successively form a strategy and

implement it for efficient risk reduction measures to restrict the impact of risks before or at the time of the occurrence. According to Smith (2003), risk response is an important stage in managing risks because they are concerned with maximizing benefits and minimizing risks adverse effects.

There are different responses to risk which include risk avoidance, risk transfer, risk reduction and risk retention (Chapman & Ward, 2007; Akintoye *et al*., 2000). Initially, the avoidance or minimization of the project's risks by altering the project plans in order to eliminate the risks entirely. Furthermore, risk avoidance could be utilized when the project plans does not experience significant changes due to the avoidance of risks (Flanagan, 2006). Another approach to risks response is reduction of risks which can be used when the avoidance of risks leads to major changes in project plans. Additionally, without altering or minimizing risks, risks' responsibility can be transferred from one party to another by using risk transfer. However, it is essential that the risks are transferred to a party which is capable of successively handling and regulating these risks and this has to be ensured by the expert's managers. Lastly, if the party currently bearing the risks is recognized as the most proficient party for managing such risks, then risk retaining could be used (Smith et al., 2009).

Risk monitoring is the last stage after the planning the prior mentioned responses choices (OGC, 2007b). It is to be ensured that the risks are well documented and are continually revised within the risk response implementation procedure (PMI, 2004). Throughout the project construction stage, risks should be mitigated and measured continuously (OGC, 2007a). Risk mitigation and measurement stage evaluates the

effectiveness of the planned risk management procedures and effectiveness of the responsible parties for the projects risks (PMI, 2004). Table 1, shows a comparison of components of the risk mitigation reports between three systems (PMI, 2004; CII, 2014; Kashiwagi, 2016).

Table 1

Risk mitigation report components

Report Component\System	CII	PMI	PIRMS
Risk description	*	*	*
Risk assessment	*	*	
Description of impact (cost & time)	*		*
Mitigation action	*	*	*
Responsible entity	*	*	*
Action due date	*	*	*
Mitigation success\satisfaction	*		*

The Use of Performance Measurement in Managing Risks

In the process of applying risk management in projects, identified and emerging risks should be measured during project phases to identify the areas which require enhancement and to identify project team's performance in mitigating risks (Kashiwagi, 2016). In order to obtain useful information, measurements metrics must be applied strategically. The definition of performance metrics as described by Pitcher (2010) is "quantifiable, simple, and understandable measures that can be used to compare and

improve performance.” Measuring projects performance is an effective method to deliver projects on time and within budget. According to Hatry et al (1990), performance measures are "needed for setting goals and objectives, planning program activities to accomplish these goals, allocating resources to these programs, monitoring and evaluating the results to determine if they are making progress in achieving the established goals and objectives, and modifying program plans to enhance performance".

Performance measurement can be combined with risk management in order to measure and minimize risks affects (Kashiwagi and Kashiwagi, 2012). According to Kim (2010) applying performance measurement methods in managing project risks is necessary to help in measuring risks influence on project time and cost. It has been proposed by Kendrick (2009) that risk metrics must be: 1) easily applicable; 2) approved by all project parties; 3) created to ensure that they cannot be misused; and 4) not to be utilized in order to punish the project team. On the other hand, the three main objectives for having measurement metrics in project are described by Pitt and Tucker (2008) which are: 1) confirmation that goals and objectives have been achieved; 2) assessment, mitigate and enhancement of processes and procedures; and 3) performance analysis and comparison of various companies, individuals, and projects’ teams.

According to Hudson (1997), CII identified performance metric as “a quantifiable, simple, and understandable measure which can be used to optimize performance.” In addition, Hudson showed that the CII and The Metric Handbook published by the United States Air Force (1995), used in their benchmarking system the following principles and attributed for performance metrics:

- A performance metric must provide a value and be meaningful to the stakeholders and to customer requirements.
- A performance metric must establish an objective target and tell how the goals are being met in the activities.
- A performance metric must focus on continuous improvement.
- A performance metric must be simple, logical, understandable, and repeatable.
- A performance metric must show trend such as measures over time (timely).
- A performance metric must unambiguously defined.

In an article written by Robert Behn (2003), multiple managerial purposes were illustrated for measuring performance which includes:

- To evaluate the progress of an organization of how well its performance through providing the needed information of whether issues are worsening or improving.
- To control or monitor responsible parties to see if they have taken the planned actions.
- To motivate and encourage responsible parties in projects to perform better.
- To learn what is contributing to the organization excellent through evaluating and measuring performance.
- To improve performance through benefiting from the learned lessons while measuring performance.

According to Neely (1998) and Beatham et al (2004) the reasons to include performance measurement in companies control plans are:

- Checking position: to continually monitor progress over time and define current status.
- Communicating position: to inform stakeholders on a continuous basis of the performance level of the company in order to encourage participation through increasing transparency.
- Confirm priorities: to show deviations of activities and then identify the priorities of activities.
- Progress compulsion: to encourage increasing the performance level through learning the potential improvement areas.

The use of performance measurement models in projects will dramatically increase the performance level of vendors and the overall level of the industry productivity. Furthermore, vendors will be able to deliver projects on time and within budget (El-Mashaleh et al, 2007). Measuring performance increase projects' performance because it increases accountability and provides a transparent environment. Measuring performance provides transparency to projects by giving insights into activities, responsibilities, costs, and outputs. Furthermore, it is a way of incentive or rewards for projects' activities outputs (De Bruijn, 2002). Considering accountability, performance measurement helps in increasing the accountability of the responsible parties (Ammons, 1995) and it is considered as an effective method of shaping accountability in projects (De Bruijn, 2002).

A change in the organization's culture is usually necessary in the application of measurement metrics. There are six reasons where the application of measurement metrics

results in a failure as described by Zairi (1996): 1) lack of ability in outlining the operation procedure 2) failure to form a connection between the processes and adequate performance; 3) failure in recognizing poor performance; 4) failing to capture low performance; 5) misreading the measurement information; and 6) gathering incorrect and pointless measurements.

Public Procurement System in Saudi Arabia

Saudi Arabia is among the fastest developing economies in the Middle Eastern countries (Alrashed, 2014), and is the largest market economy in the region of Middle East North Africa (MENA) in terms of gross domestic product (GDP) (Sagia, 2017). Both, urban and rural areas in Saudi are experiencing a rapid growth in their infrastructure developments. The public construction sector in Saudi Arabia is considered as the biggest in the Gulf countries with $575 B spent on public construction projects in Saudi between 2008 and 2013 (Deloitte, 2013). In 2017, public spending is projected to be $237 B divided by sectors as follows: education (23%), military (21%), health and social development (14%), public programs unit (12%), security & regional administration (11%), infrastructure and transport (6%), municipality services (5%), economic resources (5%), public administration (3%) (Bhatia, 2017). $40.7 B worth of contracts will be awarded in 2017 for construction projects in Saudi Arabia (AECOM, 2016). Public projects in Saudi Arabia have been built as part of the Saudi national development plans to develop the needed infrastructure for the country (Al-Khalil & Al-Ghafly, 1999b). The low bid procurement method (open completion) is applied to appoint contractors in the public organizations in Saudi (Al-Sedairy, 2001).

The traditional delivery of projects (low- bid delivery) have adverse effects that cause cost overruns, time overruns, and low quality in executed projects (Moore, 1985; Merna & Smith, 1990; Holt et al, 1995; Hatush & Skitmore, 1997; Ng & Skitmore, 2001; Banaitiene & Banaitis, 2006; Waara & Brochner, 2006; Singh & Tiong, 2006; Plebankiewicz, 2008; Jacobson & Choi, 2008; Huang, 2011). In the Saudi Arabian construction industry, several studies have identified that the traditional delivery of public projects is a significant cause of the low performance in delivering projects (Al-Khalil & Al-Ghafly, 1999; Albogamy et al, 2013; Mahamid, 2013; Alzara et al, 2016). Alsulamy (2015) identified the current procurement system and process applied Saudi Arabia to manage and deliver projects in public organizations as shown in figure 2. The project stages, sub-stages and main parties involved with their relationships in the delivering process is shown in the figure.

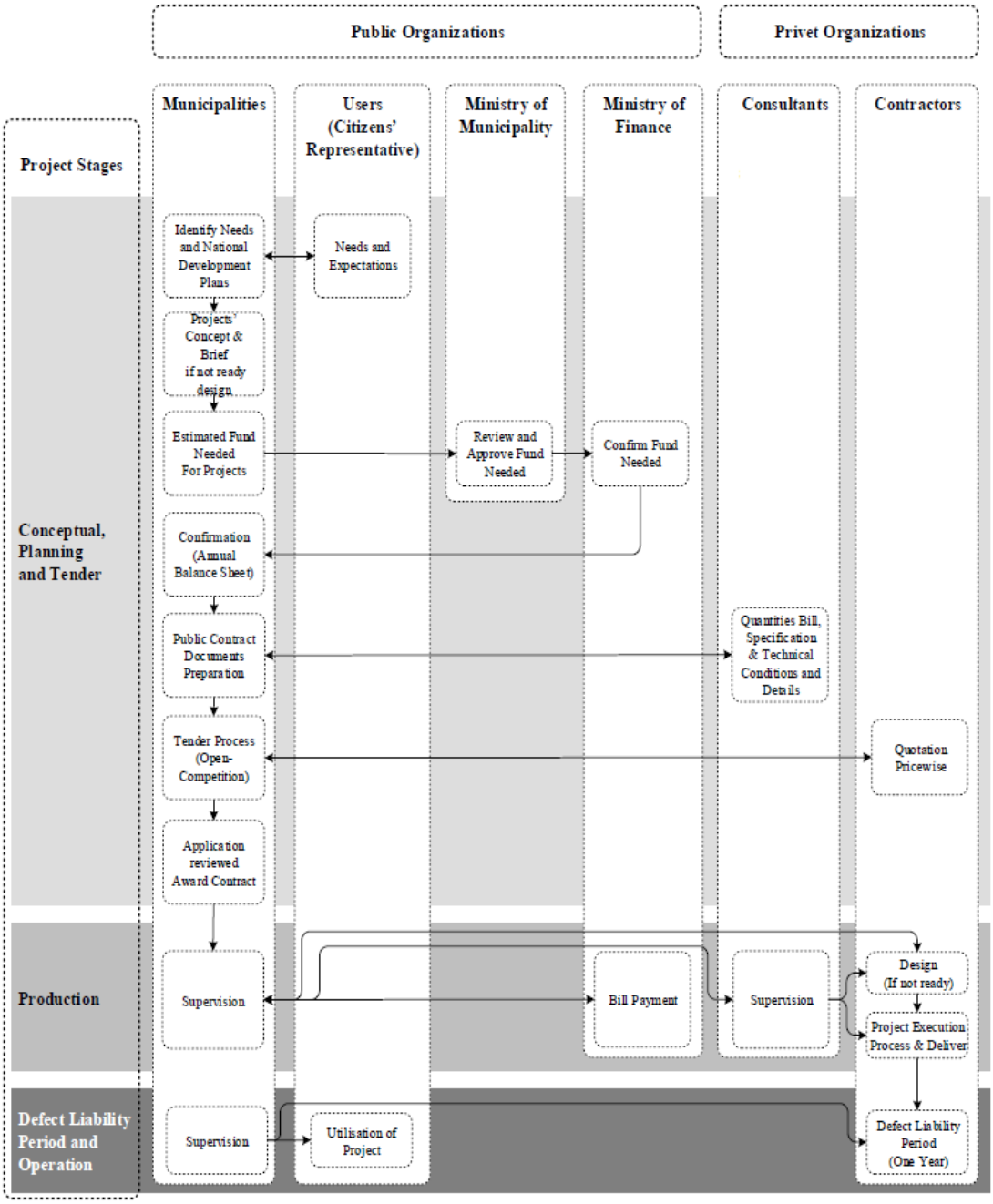

Figure 2: Delivering process for public construction projects in Saudi Arabia

(Alsulamy, 2015)

As shown in the figure, the process of delivering public construction projects in Saudi Arabia consists of three main stages which are the conceptual, planning and tender

stage, the construction stage, and the operation stage (Alsulamy, 2015). Most of the process steps are in the conceptual, planning and tender stage. This stage includes identifying the needs and expectations, developing the project concept and brief, estimating and reviewing the needed funds, confirming the needed funds by Ministry of Finance, preparing the public documents for project contract including bills of quantities, specifications, and technical conditions, then conducting the tendering process through open competition, and finally evaluate the tenders reports and awarding the contract. In the first stage contractors are participated only in submitting their reports that include their technical qualification and the price for delivering the project. The second stage involves completing the design if not already, project execution, and delivering the project. This stage include direct supervision form the owner side and the consultant with payments of project bills.

From the above delivering process for public construction projects in Saudi Arabia, the main parties that are directly involved in projects consist of the related ministry of the public organization that owns the project represented by the organization that owns the project as the project owner and the owner's team includes the owner project managers, procurement agents, and supervision team. Other direct project parties include the designer, consultant, and the general contractor. Other project stakeholders include Ministry of Finance and the project end users. The delivering process for public construction projects shows a continuous involvement from the owners' managerial team in the project delivery stages. The figure also shows that supervision during the execution phase is applied by owners' managerial team and consultants.

In public projects awarding process, the awarded contractors is usually selected at a late stage in project conceptual planning and design. As a consequence, there is often no cooperation or coordination between the owner, owner's managerial team, consultant, and the designer with the selected contractor. This results in the absence of integration between these levels which leads to changes and difficulties in the execution phase (Jacobson & Choi, 2008). In a survey conducted in the Saudi construction industry by Albogamy and Dawood (2015), it was identified that most of the critical risks in early stages of projects are caused by clients. These types of risks are related to insufficient decision making of clients who lack knowledge and experience (Trigunarsyah and Al-Solaiman, 2015). Ibn-Homaid, *et al.,* (2011), concluded in a study on the causes of change orders in the Saudi construction industry that owners are the main source of the risks based on project scope changes and change orders which can cause an average increase of 11.3% of projects' cost.

Traditional Risk Management Model

In the traditional risk management model, the owner's team and project manager (PM) must (Bubshait and Al-Musaid, 1992; El-Sabaa, 2001; Mselle, *et al.*, 2011; Kashiwagi, 2016):

- Be able to assess the impact of the service with regard to expectation, supervise the service, and evaluate the value and performance of the service.
- Know more than the contractor with regard to quality, technical requirements and details, cost, and delivery.

- Write a contract/specification that identifies the owner's expectations with regards to technical requirements.
- Be able to regulate/inspect the contractor to deliver the contract requirements.
- Make sure that they constantly know what is happening through continuous coordination, inspection, measurement and information and ensure they have a thorough project cost breakdown of the contractor.
- Be capable to minimize and manage the risk of change orders while giving the owner the best price.

To explain the traditional risk management model Information Measurement Theory (IMT) will be used as shown in figure 3. IMT uses the event diagram to explain projects. Each project has initial conditions and final conditions. The more information and expertise a person has at the beginning of a project the more the person can predict the final conditions of the project. The traditional risk management model is shown in combination with the event diagram in Figure 3. The client's PM identifies an expected service, duration of delivery and project budget. The difficulty is that the clients' PMs do not have sufficient information to know if their time of delivery and budget are accurate unless they have current technical expertise and they are actually doing the work. Other issues include not having dominant measurement of past similar projects, not having knowledge of the current industry capability and costs (Bageis and Fortune, 2009). The clients' PMs rarely have the accurate information of the initial conditions. Instead, they make decisions based on incomplete information and, then, the designer makes more decisions to make expectations true. Because the clients' PMs' lack of information and

unawareness of technical issues, they hire a technical expert professional who specifies how the owner expectations can be met by a contractor (Al-Kharashi and Skitmore, 2009; Albogamy and Dawood, 2015). The buyer's procurement agents assume all contractors are the same and can meet the specifications. Then, the procurement agents create competition among contractors based on price, and select the lowest priced vendor. The owner's team then attempts to manage, direct and control the risk by supervising and inspecting the contractor's work (Kashiwagi, 2016).

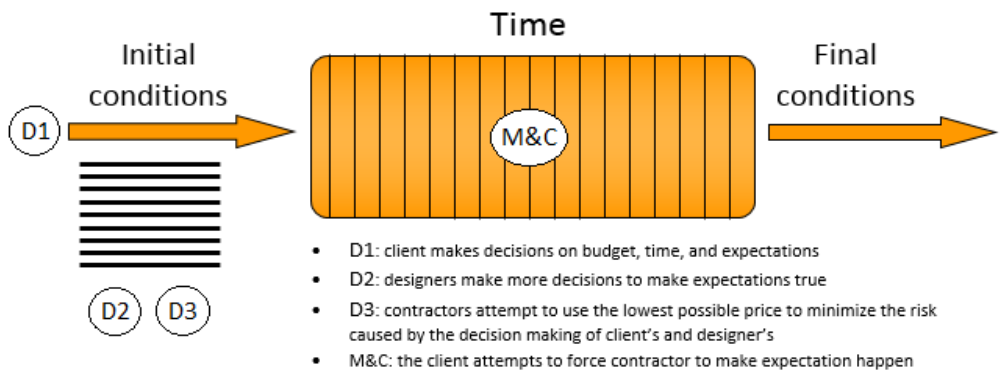

Figure 3: Traditional risk management model (Kashiwagi, 2016)

To assess the traditional risk management practices in the Saudi construction industry, a literature review has been conducted to identify and review academic publications that identified causes of risks in the Saudi construction industry and identify if traditional risk management practices have caused risks in the industry. The traditional risk management activities in the Saudi construction industry discussed above have been frequently identified in the 24 studies as risks as shown in table 2.

Table 2

Frequent risks in the Saudi construction industry

Risk Factor/ No. of Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Freq.
Mistakes in design		*	*	*	*	*	*	*	*	*	*		*	*	*	*		*		*	*	*	*	*	20
Financial constraints by owners and slow payments of done work	*	*	*	*	*	*	*	*	*		*	*	*			*			*	*	*	*	*	*	19
Specifications changes	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*				*			*	*	18
Change of scope	*	*		*	*	*	*	*	*	*			*	*		*	*	*		*			*	*	17
Design changes by owner or consultant		*	*	*	*	*	*	*	*	*				*		*	*			*	*		*	*	16
Owners' practice of assigning contracts to lowest bidder	*	*	*		*	*			*				*		*	*				*	*	*	*	*	14
Unrealistic contract duration	*	*	*	*	*	*	*		*				*			*	*			*			*	*	14
Owner's team lack of experience	*	*		*	*	*	*	*		*	*		*		*			*		*					13
Change orders	*	*				*						*	*		*			*	*	*	*				10

1. (Al-Khalil and Al-Ghafly, 1999) 2. (Assaf and Al-Hejji, 2006) 3. (Assaf, *et al.*, 1995) 4. (Albogamy, *et al.*, 2012) 5. (Mahamid, 2013) 6. (Al-Kharashi and Skitmore, 2009) 7. (Baghdadi and Kishk, 2015) 8. (Alhomidan, 2010) 9. (Alghonamy, 2015) 10. (Albogamy, *et al.*, 2013) 11. (Al-Tami, 2015) 12. (Al-Hammad, 2000) 13. (Mahamid, 2014) 14. (Mohamad, *et al.*, 2012) 15. (Arain, *et al.*, 2006) 16. (Mahamid, 2011) 17. (Bubshait and Al-Juwairah, 2002) 18. (Ikediashi, *et al.*, 2014) 19. (Alhammadi, 2011) 20. (Al-Emad and Nagapan, 2015) 21. (Elawi, *et al.*, 2016) 22. (Alzara, *et al.*, 2016) 23. (Mahamid, *et al.*, 2015) 24. (Allahaim and Liu, 2015)

The problem with the traditional risk management model is that the client, client's PM, procurement agent and client's technical experts are making decisions to determine the requirements and expectations of the vendor service. These expectations of the vendor's services are usually inaccurate and based on incomplete perceptions of the initial conditions (reality of projects). The client's team then attempts to manage the vendor to meet these expectations. Risk is continually caused by clients and their agents who lack information and make insufficient decisions. The Author proposes that decision making should be minimized on a project. The use of an expert who can see into the future by clearly and simply explain the initial conditions and the final conditions of a project can minimize decision making (Kashiwagi, *et al.*, 2013).

The Event Model

Any activity that takes time is defined as an event (Kashiwagi, *et al.*, 2005). The event model shown in figure 4 has the following features (Kashiwagi, 2015):

- It has initial conditions that change over time into final conditions.
- Natural laws, laws of physics for example, regulate the change in conditions.
- If all information of initial conditions is known (e.g. people, physical surroundings, and laws) all final conditions can be predicted.
- The more someone accurately perceive and identify information of the initial conditions, the more simple an event becomes and the more he or she could accurately predict the future outcome (Kashiwagi, *et al.*, 2005).

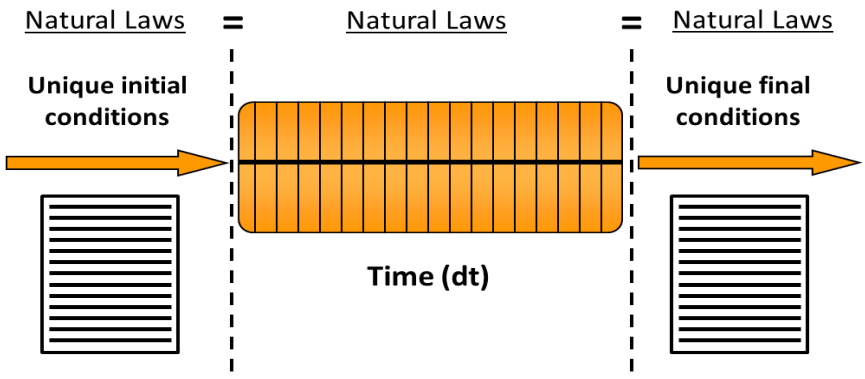

Figure 4: Event chart (Kashiwagi, 2015)

Kashiwagi and Kashiwagi (2012) propose that all events outcomes are singular, predictable, bound by natural laws, and constrained by initial conditions. Once the initial conditions are set, the events cannot be impacted, influenced, or controlled to change the final outcomes to something different that is not linked to the initial conditions.

Furthermore, it is proposed that the idea of randomness is caused by lack of information and is correlated with insufficient management practices (Kashiwagi, 2007). It is been identified using the event model that risk occurs because all information of the initial conditions is not perceived (Mselle, *et al.*, 2011). Human nature leads people to have unrealistic expectations, make decisions, and attempt to control the event.

Decision-Making as a Source of Risk

In a project environment risk is defined according to PMI (2010) and IPMA (2012), as uncertain event that if it occurs has a negative or positive effect on the project objectives such as scope, cost, schedule, or quality. However, a more specific definition of risk has identified that risk is more personal related and not project related as risk is not caused by the complexity level of a project, but by the lack of expertise and experience of personal who are participants of a project (Kashiwagi and Kashiwagi, 2012). Subsequently, risk is what the expert contractor has no control over, or areas where the expert contractor has insufficient information to clearly see into the future (Kashiwagi, *et al.*, 2013). Making decisions in the project environment to recover for the lack of information is a source of risks. According to Kashiwagi (2016), risk is defined as when people inexactly perceive the initial conditions. The need for decision-making in this situation is maximized to recover from the lack of information and choose from various options (Kashiwagi and Kashiwagi, 2012). Based on the inaccurate perception of the initial conditions, expectations of the final conditions are formed [30]. People make

decisions and create inappropriate expectations and they are then unable to accurately predict the outcome (Kashiwagi and Kashiwagi, 2012). Decisions are usually made when (Kashiwagi, 2016; Mselle, *et al.*, 2011):

- The condition seems complex to the decision maker.
- Experts are needed to make decisions.
- Disagreement on perceptions of the initial conditions.
- Critical information is lacked by decision makers.
- People who make decisions do not have accountability and liability for what happens.
- People who make decisions are generally management personnel, not the ones who perform the service.

When situations are complex, the need for decision making is maximized. People in this situation use their own experience to decide upcoming actions. These actions increase risks. According to Kashiwagi and Kashiwagi (2012), "*risk and decision making are related. People who are more dependent on decision making, have higher risk*". A study was conducted to test the validity of the theory that the minimization of decisions throughout construction phases indeed increases the ability to minimize risk (Kashiwagi, *et al.*, 2005). The study participants were project owners who had experienced a traditional low-bid procurement system and a decision-less system called performance based procurement system (PIPS). The results showed that the ability of a process to minimize risk is strongly correlated to the ability of a process to minimize decisions. When decision making goes down, risk goes down.

Risk is continually caused by clients and their agents who lack information and make decisions. While the event is happening, risks appears when created expectations are perceived based on inaccurate conditions and differ from the actual conditions of an event at a specific time (Mselle, *et al.*, 2011). This situation worsens when reactive client PMs, designers and consultants, constantly make decisions and attempt to manage risks to meet the expectations of the client (Kashiwagi, *et al.*, 2009). Clients and their representatives make more decisions when they don't accurately identify the contractors' capability to deliver. Fohom (2016), identified in a literature review the causes of projects failure which include:

- The non-use of expertise and the non-use of predictive information in projects planning.
- Owners decision making and their management, direction, and control practices.
- Lack of transparency in managing and measuring risks.

Risk is decreased through the following (Kashiwagi, 2016; Mselle, *et al.*, 2011; Kashiwagi, *et al.*, 2013):

- Finding the expert who can precisely identify the initial conditions.
- Allowing the expert to identify if client's expectations can be done.
- Reducing attempts to direct, manage and control the event by using experts and preplanning.
- Allowing the expert to have control over their own event because they are the best in identifying the initial conditions, knowing what to do, and how to achieve a realistic final outcome.

Risk is maximized because of the clients' misunderstanding of risks, how minimizing that is also a source of risk, along with their decision making, management, directing, and control approach. The author proposes that the traditional risk management model of making decisions, directing, managing, and controlling is the cause of risks and low performance of the services delivery in Saudi Arabia. A different risk management approach is required.

A New Risk Management Approach

The new risk management model shown in figure 5, will have to meet the following conditions (Kashiwagi, 2016; Algahtany et al, 2016):

- Decision making must be reduced.
- If there is a lot of decision-making and expectations, this must be corrected by the service experts who can state a clear difference between reality and expectations and can be accountable for delivering the outcome.
- Experts should be given authority and responsibility to control and manage the risk that is out of their control. If any party tries to alter requirements of initial conditions or interfere in preplanning of delivering the service, the contractor should have control to identify the risk, document it, and to reduce its impact.
- The new risk management model must allow all parties to have the initial conditions thoroughly understood which will motivate the participants to be accountable for what they have agreed upon.
- The qualified experts must not be directed by the managers.

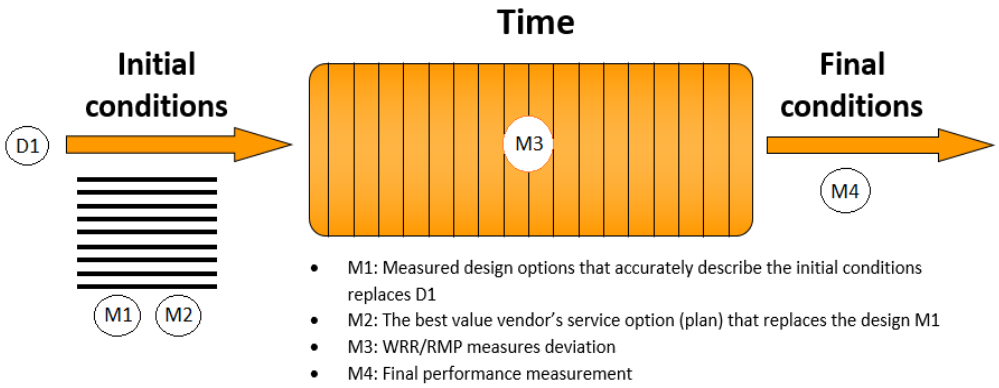

Figure 5: New risk management model (Kashiwagi, 2016)

Therefore, the expert vendor, in the new risk management model reduces risks with the use of expertise through a risk management/quality control model. The buyer's PM minimizes risks by understanding that (Kashiwagi, 2016; Algahtany et al, 2016):

- The perception of the buyer regarding the constraints and requirements is not entirely accurate.
- Expert contractors have a more accurate understanding of the initial conditions (constraints and requirements).
- Expert contractors have no technical risk.
- The only risk that expert contractors have is the risk that is out of their control (from other stakeholders).
- Contractors have no control over other stakeholders and use transparency to reduce the risk they cannot control.
- The expert contractor will preplan, identify the risks they do not control, and minimize the risks.

- The expert contractor is the only party who can effectively perform risk management by documenting the deviations in weekly risk reports from the baseline plan, by justifying all time and cost deviations.
- The buyer's best guess requirement must be replaced by the best value contractor's accurate project perception.

In this new risk management approach, the buyer's PMs do not need to be technical experts, only the vendors. Therefore, there will be a minimization of the decisions and the decisions' impacts. New responsibilities of PMs include identifying the buyer expectations and identifying the best value contractor. The PMs should assist the selected contractor in preparing the documents of final contract. Quality assurance must be carried out by PMs to make sure the contractor performs risk management and quality control to minimize all deviations. This risk management approach is derived from a delivery structure called the Performance Information Procurement System/ Performance Information Risk Management System (PIPS/PIRMS). In 2008, the International Council for Building (CIB) Working Commission W117 sanctioned a group (TG61) to perform a study using a worldwide literature research to detect innovative approaches in construction documented an increase in performance of projects (Egbu, *et al*., 2008). The study filtered through more than 15 million articles and reviewed more than 4,500 papers and identified the PIPS/PIRMS as the most system that had published documentations showing an increase in construction performance on multiple tests.

Chapter Conclusion

Risk management is identified as an essential component of projects success. The literature review in the exploratory phase discussed above focused on the literature that investigates risk management methods and processes in the developed countries which is aimed to establish knowledge regarding concepts of risk management processes. This chapter identified that risk management plan comprises three main phases: risk identification, risk evaluation or assessment and risk response and control. The literature showed that risk identification of all project parties' risks is a major step in managing risks; risk evaluation or assessment is the next step which is significant to evaluate and assess risks based on their occurrence and their impact; and the last step is preparation and implementation of risk mitigation plan.

The literature review in this chapter identified that throughout the project construction stage, risks should be mitigated and measured continuously as risk mitigation and measurement evaluate the effectiveness of the planned risk management procedures and effectiveness of the responsible parties for the projects risks. According the literature, performance measurement should be combined with risk management in order to measure and minimize risks' affects as identified and emerging risks can be measured during project phases to identify the areas which require enhancement and to identify project team's performance in mitigating risks. In addition, measuring performance increases projects' performance because it increases accountability and provides a transparent environment by giving insights into activities, responsibilities, costs, and outputs.

Using literature and deductive analysis, the traditional method in managing risks in public projects in the Saudi construction industry was found to be ineffective at helping contractors deliver projects on time and within budget while meeting quality expectations. The literature review has identified that client and the client's representatives are considered as a main source of risk in the construction industry. This chapter identifies that risks are caused by decision making based on a lack of information which leads to unrealistic expectations. The generation of risks through decision making is aggravated when the client's PM attempts to control, manage and direct the contractor. Decision making can be minimized through utilizing contractors' expertise as their knowledge base provides more accurate understanding of project requirements. Contractors in this risk management approach should be able to explain those risks out of their control (caused by other parties) and present how they plan to mitigate these risks.

The risk management framework for managing risks out of contractors' control includes the following:

- Risks out of contractors' control should be identified at initial stage of projects and assessed based of the risks' occurrence and impact on projects.
- The contractor expertise should be utilized in preplanning project activities and risks with identifying the risks they do not control.
- Risk mitigation reports include: risk description, description of risk impact on project time and cost, mitigation action, responsible entity, and the mitigation due date.

- Performance measurement should be utilized in mitigating risks as it increases accountability of responsible parties and provides a transparent environment through giving insights into activities, responsibilities, costs, and outputs.
- The expert contractors should perform the risk management process with documenting all deviations from the baseline plan using weekly risk reports, by justifying all time and cost deviations.

CHAPTER 3

RESEARCH METHODOLOGY

This Chapter discusses the research methodology and methods in details for this study. This involves a discussion of the research design and process, the sampling related to the empirical work, and the method in which data was collected. Mixed methodological approach was adopted. Theoretical approaches were utilized to review previous research and to develop a conceptual framework for mitigating risks followed by a practical approach that is considered with collecting data from contractors who work in public projects in Saudi Arabia. The quantitative method was mainly used to meet the study objectives through distributing a survey in the form of a questionnaire. This stage includes an explanation of the study population and sampling.

The main aim of this dissertation is to evaluate the current practices applied by contractors to minimize risk out of their control and develop a risk mitigation model for the contractors in the Saudi construction industry. Risks out of contractors' control in the Saudi construction industry will be studied through conducting literature review and through assessing these risks based on their importance and occurrence in the Saudi construction industry. Contractors' current practices in managing risks out of their control will be investigated to through analyzing their current risk mitigation and measurement practices. The developed risk mitigation model will be validated through identifying contractors' perceptions of the new approach.

The quantitative method was mainly used to meet the study objectives through distributing a survey in the form of a questionnaire. According to Creswell (2008), survey method is one of the most popular research methods used to obtain primary data from a representative sample of participants. The questionnaire refers to a set of questions that are carefully designed and given in exactly the same form to collect the required data about a research topic from a group of individuals (Jupp, 2006). The questionnaire can be utilized as an accurate and appropriate method to identify and verify the study participants' perceptions and tendencies (Fraenkel & Wallen, 2000).

The data will be collected using an online questionnaire as it provides an efficient method to collect data from a large population that are geographically separated (Creswell 2012). An online survey has been increasingly used by researchers to collect data because of the low cost and the reduced amount of time for data collection (Taylor 2000; Yun & Trumbo 2000). In addition, this method of collecting data attract acceptable response rate, provides confidential environment for the participants, and is easy to transfer the collected information into databases to be analyzed (Andrews et al 2003). Given the size of the targeted sample and the geographical dispersed of them across Saudi Arabia, the use of online survey was deemed both logistically and financially sound approach.

A pilot study was undertaken before contacting the potential sample. According to Blaxter et al. (2006), pilot study can be applied to identify issues and obstacles within the designed survey. Furthermore, pilot study helps authors to re-frame questions and helps in saving resources and time (Ritchie & Lewis, 2003). Pilot study is used to ensure that

the survey is clear and understood by all participants. It helps in identifying any ambiguities in the meaning of the survey questions, helps in excluding sections that do not provide usable information, and helps in identifying the duration of answering the survey (Rattray & Jones, 2007). The pilot study undertaken in this study provided insight into the survey development and administration and provided an opportunity to evaluate the questionnaire format through testing the questionnaire on sample of respondents (contractors) and experts in the Saudi construction industry. This step provided the researcher with valuable suggestions and feedback to improve the survey, rephrase questions, and eliminate redundant questions.

The Study Research Methodology Phases

The research has been undertaken on the basis of evaluating and developing contractors' practices towards risks out of their control in the Saudi public projects. Theoretical approaches to review previous research are included followed by a practical approaches that are considered with collecting data. The research process can be classified into the following phases:

Phase 1: in order to achieve the aim, the study started by deriving theoretical insights and observations from the literature, as discussed in the second Chapter. The literature review stage is considered an important stage of research as it leads to more understanding of the nature of the research problem and identify the study theories in order to construct the theoretical framework of the study objectives. The exploratory phase in the literature review is focused on the literature that investigate risk management

methods in the developed countries to establish knowledge regarding concepts of risk management processes. Using literature and deductive analysis, the traditional method in managing risks in public projects in the Saudi construction industry is investigated.

Phase 2: risks that are out of contractors' control (caused by other parties) in the context of the Saudi construction industry will be investigated through identifying, assessing, and reporting an up-to-date ranked list of risks that are out of contractors' control based on their importance and occurrence in the industry. The researcher will use two research methods to collect the data: literature review and survey. In the literature review method, the research will identify the studies that identified and assessed risks and then identify the risks that are out of contractors' control in the Saudi construction industry. In the second method, a survey will be conducted to identify the views of contractors to assess the identified risks based on their importance and occurrence in the industry.

Phase 3: the aim of this phase is to assess the current risk management and performance measurement practices applied by contractors to minimize risk out of their control (caused by other parties). The contractors' current practices towards minimizing risks out of their control will be investigated using a survey method. This part will include identifying contractors' practices in the identification of projects activities and risks, contractors' practices in mitigating other parties' activities and risks, and contractors' practices in measuring the performance of all project parties.

Phase 4: this phase is divided into two stages. The first stage will presents the validation of the proposed model through collecting the contractors' perceptions of new

risk mitigation approach in Saudi Arabia. The validation process will be conducted within contractors who have experience in public projects in the Saudi construction industry. The developed model focuses on increasing accountability of project parties through mitigating parties' activities and risks with measuring the activities and risks deviations (time and cost) and identifying sources of deviations. Transparency is utilized in the model through sharing weekly updates of the activities and risks combined with updated information of performance measurements of all project parties. The second stage in this phase includes providing the practical framework in managing risks out of contractors' control in the Saudi construction industry and then the study conclusions and recommendations which will be constructed based on study results and researcher's observations. Figure 6 shows the research methodology diagram for the study.

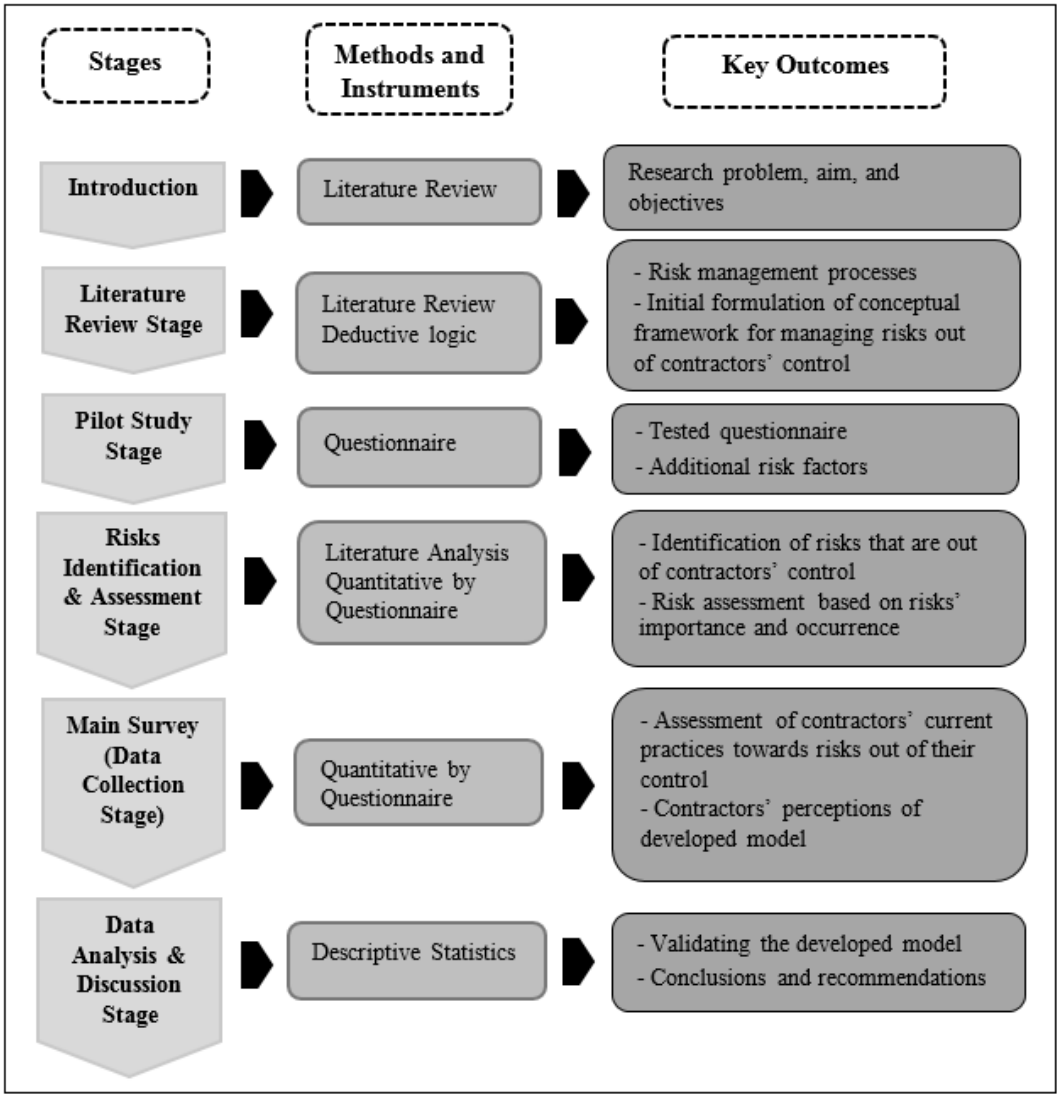

Figure 6: The research methodology diagram for the study

Study Population

The population for this research is contractors who have experience in the Saudi construction industry and worked in public projects. The study sample information was accessed through the Ministry of Municipal and Rural Affairs (MOMRA) website (MOMRA, 2017). The MOMRA website includes a section for the contractors who are

classified (qualified) in different grades and fields to work in public projects in the Saudi construction industry.

According to an article titled with *Contractor Prequalification in Saudi Arabia,* the construction industry in Saudi Arabia relies on the contractors' classification system and the low bid delivery system as the basis for prequalifying contractors and awarding projects in the majority of the public organizations projects to ensure contractors' capabilities and performance (Bubshait & Al-Gobali, 1996). The Saudi contractors' classification system functions within 5 grades and 29 fields (MOMRA, 2017). Within this classification system, contractors can be classified with one or more of the 29 fields and contractors within each field will be given a classification grade level between grades 1 and 5. The grade level that the contractors receive determines the financial values of maximum projects sizes that contractors can bid for in public projects in Saudi Arabia within their fields of classification. Table 3, shows the financial limits for five different fields. The collected data in this study is from contractors who have experience in the Saudi construction industry and worked in public projects who are classified in the following five fields shown in table 3.

Table 3

Example of fields and financial limits (in Million Saudi Royals) (MOMRA, 2017)

Field	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	No grade: Upper Limit
Buildings	>280	280	70	21	7	4.2
Roads	>420	420	140	42	14	4.2
Water and sanitation work	>420	420	140	42	14	4.2
Electrical Works	>280	280	70	21	7	4.2
Mechanical Works	>280	280	70	21	7	4.2

The questionnaire was launched on May 31 2017, and was kept online for more than two months. Two reminder emails were sent to the study sample. The survey was officially closed on August sixth 2017. The covering letter included relevant information such as a general explanation of the study, the objectives of the survey, importance of answering the survey, the expected time of completing the questionnaire, confidentiality and privacy of the collected information, and contact information of the researcher in case the participants had queries. Demographic background in this research included different control variables collected from the respondents to provide a broader view of the research outcome. Six control variables are collected from the respondents. Firstly, the collected personal information include: work position in the company, years of experience within the construction field, and their educational level. Secondly, the collected information about the contractors' companies include: classification grade of the company, companies' classified fields, and places of their projects. Further details of the collected data are provided in the following chapters.

CHAPTER 4

Identification and Assessment of Risks out of Contractors' Control

Chapter Introduction

As shown in the previous chapters, research has identified that contractors are not the main party that cause risks as owners, consultants, and other parties have the major share of causing risks in the industry which lead to low performance in the Saudi construction industry. This chapter investigates the risks that are out of contractors' control (caused by other parties) in the context of the Saudi construction industry and reports an up-to-date ranked list of risks that are out of contractors' control with their importance according to contractors' viewpoint through a questionnaire survey. This chapter is divided into three parts related to the study aim and objectives.

The first part starts with a brief overview of background studies that identified risks in the Saudi construction industry (SCI) then the categories or groups of risks out of contractors' control will be identified through reviewing 8 studies that identified responsibilities of risk factors in the SCI. The second part of this chapter focuses on identifying the risks out of contractors' control in the SCI through conducting literature search and then reviewing 24 studies that studied risks in the context of the SCI. The third part focuses on surveying contractors who work in public construction projects based on risks' importance and occurrence in the SCI. This part presents the demographic variables of contractors participated in the study and then presented the collected data with their analysis. This chapter concluded with the top risks that are out of contractors' control in public construction projects in Saudi Arabia.

Background Studies

Construction projects are unique and carry different sources of risks. Several parties are involved in projects such as owner, consultant, contractor, designer, suppliers, and other stakeholders. All of these parties inevitably carry certain risks (Peckiene et al 2013). In the context of the Saudi construction industry, many researchers identified risk factors in the industry and categorized those risks considering the responsible parties. Assaf and Al-Hejji (2006) identified and assessed 73 causes of delay in the Saudi construction industry using a field survey for owners, contractors and consultants. The results showed that the most common cause of delay identified by the three parties is change orders by owners during construction. The final combination of results showed that construction delays are mostly originated by owners, and then followed by contractors, designers, labors and consultants.

Alghonamy (2015) surveyed 43 contractors to assess 34 causes of cost overruns in the Saudi construction industry. The study concluded that the top causes of cost overruns are owners' use of bid award for lowest price system, frequent changes in design, improper planning and owners' delay of progress payments. Albogamy (2012) conducted a survey to evaluate the relative importance of 63 causes of delay in Saudi construction industry (17 owner related factors, 23 contractors related factors, 11 consultant factors, and 12 external factors). The top risks factors were identified and ranked for the four categories. For owner related factors, low performance of the selected contractors in the Saudi government tendering system ranked first followed by delay in progress payments by the owner. Delays in sub-contractors work was ranked first for contractors related

factors followed by poor qualification and experience for technical staff. For the consultant party, delay in approval of shop drownings and design changes were the highest ranking. Non utilization of professional construction contractual management and rise in the prices of materials were the highest ranking for external factors category.

A recent study assessed the significance of 54 risks inherent in the aviation construction projects in Saudi Arabia (Baghdadi, 2017). The study found that designer related risks is the most important group of risks affecting the aviation projects in Saudi. Client related risks group was ranked second followed by consultant related risks and then contractor related risks. Another recent research identified the ownership percentages of the parties causing risks in the Saudi construction industry (Elawi *et al.*, 2016). This research studied the causes of time overruns for 49 public projects and identified that 53% of the risks were caused by owners. Contractors were responsible for 27%, and other parties responsible for 20%. Additionally, this research applied a quantitative analysis of the literature that studied the causes of time overruns in the Saudi construction industry and concluded with a similar ownership indication as owners were responsible for 49.2%, contractors for 36%, and other parties for 14.8%.

Contractors are playing an essential role in pushing the growth of any construction industry through successful delivering of projects. Failure to deliver projects successfully will impact the growth rate of the construction industry. Consequently, it is important to identify and assess the risks that impede contractors from delivering projects on specified time, cost and quality objectives (Assaf, 2006). In addition, risk is defined as what the expert contractor has no control over, or areas where the expert contractor has

insufficient information to clearly see into the future (Kashiwagi, et al., 2013). To minimize effects of project risks, according to Algahtany et al (2016), contractors should identify risks out of their control (caused by other parties) and plan in advance how to reduce the effects of these risks.

The literature of the Saudi construction industry performance discussed above showed that contractors are not the only party causing risks that lead to low performance in the industry as owners and other parties also have a major share. It has been identified that risks out of contractors' control are a leading cause of low performance in the Saudi construction industry (SCI). The main aim of the chapter is to identify the risks out of contractors' control through literature review and assess those causes based on contractors views based on causes' importance and occurrence in the SCI

The methodology of this part of the study will include the following steps:

1. Identifying the categories of risks out of contractors' control through reviewing 8 studies that identified responsibilities of risk factors in the SCI.
2. Identifying the risks out of contractors' control in the SCI through conducting literature search and then reviewing 24 studies that studied risks in the context of the SCI.
3. Identifying additional and recent risks out of contractors' control through asking experts in the SCI.
4. Surveying contractors based on causes' importance and occurrence in the SCI.

Literature Analysis of Risks out of Contractor's Control in the SCI

To identify the risks that are out of contractors' control in the SCI, a literature review has been conducted to identify and review academic publications that identified risks in the Saudi construction industry. The targeted sources of literature included are only academic journals, refereed conferences and dissertations which were published in English language. For the identification of the related research publications, the following process was followed:

- To ensure the inclusion of the maximum number of relevant publications in the context of Saudi Arabia construction industry, the search parameters were kept as broad as possible. The following research code ("construction industry" OR "construction projects" OR "infrastructure projects") AND "Saudi", was carried out in five difference databases, which are EI Compendex, ASCE Library, ABI/Inform, Emerald Journals , and Google Scholar.
- The relevant publications were identified out of the search results through reading titles, abstracts, and keywords followed by scanning manuscripts of relevant publications to ensure the content of identified publications.
- The next step was identifying other related papers from references lists of previous step findings. The same five search engines were used in addition to the Saudi digital library.

Research results shown in table 4, identified 24 publications that identified risks in the context of construction in Saudi Arabia. The identified studies were reviewed in details and important information were captured in a literature database using Excel. The collected

information from selected studies included study title, abstract, publication source, year of publications. Moreover, all the risks factors identified in the 24 studies were captured and analyzed in the database.

Table 4

Literature search results

Academic Search Engines	Total Results	Identified Publications	Years Range
EI Compendex	374	4	1981- 2016
ASCE Library	250	3	1983 - 2016
ABI/ Inform	3944	6	1986 - 2016
Emerald Journals	224	2	1996 - 2016
Google Scholar	17000	9	1977 - 2016
Total	21792	24	

All of the identified studies are in the context of construction in Saudi Arabia and are classified as: general risk factors' identification (6 studies), causes of delays (12 studies), causes of costs overruns (4 studies), and risks in projects' initial stages (2 studies). 18 studies out of the 24 were published in refereed journals, 4 were published in refereed conferences, and lastly 2 graduate dissertations are included. These 24 studies were published during the period from 1995 to 2016. From 1995 to 2000, 3 studies were published and 5 studies were published between the years 2002 and 2010. However, the number of selected publications increased dramatically between the years 2011 to 2016 as 18 studies were published during the last five years.

To specify the risks out of contractors' control, studies that identified the ownership or responsibility of risks in the context of Saudi Arabian construction industry were utilized. 8 studies out of the 24 publications (Assaf and Al-Hejji, 2006, Al-Kharashi and Skitmore, 2009, Albogamy, et al., 2012, Mohamad, et al., 2012, Albogamy, et al., 2013, Baghdadi and Kishk, 2015, Elawi, et al., 2016, Alzara, et al., 2016) classified the risks based on different categories or groups which shows the ownership or responsibility of the risks. However, those researchers adopted several approaches in classifying risks. Assaf and Al-Hejji (2006) classified construction risk factors into eight groups including project, owner, contractor, design, materials, equipment, labors, and external. Albogamy et al (2013) assigned risk factors into seven groups including material, project, contractor, owner, consultant, design, and external. Baghdadi and Kishk (2015), however, further expanded the classification of risks into three main categories and 11 subcategories as follows:

A. Internal risks including: client-specific risks, designer-specific risks, contractor-specific risks, subcontractor specific risks, consultants specific risks
B. External risks including: political risks, social risks, financial risks, natural
C. Force Majeure risks including: natural phenomena, weather issues

However, an agreement in main classification categories among the researchers in the 8 studies have been noticed which include the four main pillars in most of public projects in SA (owner, contractor, consultant, and designer) as can be seen in table 5. These four categories can represent most of risk factors through relating the factors to their sources. Other risks such as related to other stakeholders or to unforeseen conditions

can be categorized as external. These main categories will be used in categorizing risks out of contractors' control. Table 6, lists the most frequent identified risks out of contractors' control from the 24 identified studies. Table 7 shows the classification categories of the most frequent risks out of contractors' control.

Table 5

The most used classification categories for risks in the Saudi construction industry

Classification Category/ No. of Study	1	2	3	4	5	6	7	8	Frequency
Owner (client)	*	*	*	*	*	*	*	*	8
Contractor	*	*	*	*	*	*	*	*	8
Consultant		*	*	*	*	*	*	*	7
External	*			*	*		*	*	5
Designer				*	*	*		*	4

1. (Assaf and Al-Hejji, 2006) 2. (Albogamy, *et al.*, 2012) 3. (Al-Kharashi and Skitmore, 2009) 4. (Baghdadi and Kishk, 2015) 5. (Albogamy, *et al.*, 2013) 6. (Mohamad, *et al.*, 2012) 7. (Elawi, *et al.*, 2016) 8. (Alzara, *et al.*, 2016)

Table 6

Risks out of contractors' control identified in the literature

Risk Factor/ No. of Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Freq.
Mistakes in design		*	*	*	*	*	*	*	*	*	*		*	*	*	*		*		*	*	*	*	*	20
Delay in progress payments by owner	*	*	*	*	*	*	*	*	*		*	*	*			*			*	*	*	*	*	*	19
Changes in specifications during construction	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*				*			*	*	18
Additional work or changes in the scope of the project	*	*		*	*	*	*	*	*	*			*	*		*	*	*		*			*	*	17
Adverse weather conditions	*	*	*	*	*		*	*	*	*	*		*		*	*	*			*			*	*	17
Cost fluctuation of labor and material during construction	*			*	*	*	*	*	*	*	*		*			*	*		*			*	*	*	16
Design changes		*	*	*	*	*	*	*	*	*				*		*	*			*	*		*	*	16
Changes in government regulations and laws	*	*		*	*		*			*	*	*	*		*	*	*	*		*			*	*	16
Owners' practice of assigning contracts to lowest bidder	*	*	*		*	*			*				*		*	*				*	*	*	*	*	14
Unrealistic contract duration	*	*	*	*	*	*	*		*				*			*	*			*			*	*	14
Availability of construction material	*	*	*	*		*	*	*		*	*		*		*					*	*	*			14
Slow decision making by the owner	*	*	*	*		*		*		*	*	*	*							*	*	*		*	14
Owner's team lack of experience including consultants	*	*		*	*	*	*	*		*	*		*		*			*		*					13
Owner's poor coordination with the construction parties and government authorities	*	*	*	*	*	*	*	*		*	*									*		*			12
Difficulties in obtaining work permits	*	*	*	*		*					*		*							*	*	*			10
Change orders by owner during construction	*	*				*						*	*		*			*	*	*	*				10
Delay in approving shop drawings and sample materials		*	*	*		*					*		*		*					*		*		*	10
Delay in performing inspection and testing by consultant	*	*	*			*		*			*		*							*	*	*			10
Shortage of equipment required	*	*	*	*						*	*		*							*		*		*	10
Excessive bureaucracy in the owner's administration	*		*			*	*						*				*		*	*		*			9
Shortage of manpower	*	*	*								*			*						*		*		*	8
Delays in producing design documents		*			*			*	*		*					*				*			*		8
Effects of subsurface conditions (e.g., soil, high water table, etc.)	*	*	*	*							*		*	*						*					8
Poor communication and coordination by consultant engineer	*	*		*	*	*					*									*		*			8
Unclear and inadequate drawings and specifications		*				*					*	*		*	*					*		*			8
Interference by owner in the construction operations	*					*	*						*							*		*			6
Poor site conditions		*	*	*			*	*				*													6
Delay to furnish and deliver the site to the contractor by the owner	*	*		*		*					*											*			6
Delay in reviewing and approving design documents by consultant		*		*		*				*	*											*			6
Delay in approving major changes in the scope of work by consultant		*				*														*		*			4
External work due to public agencies (roads, utilities and public services)				*						*											*				3
Contract breaching by owner				*			*			*															3

1. (Al-Khalil and Al-Ghafly, 1999) 2. (Assaf and Al-Hejji, 2006) 3. (Assaf, *et al.*, 1995) 4. (Albogamy, *et al.*, 2012) 5. (Mahamid, 2013) 6. (Al-Kharashi and Skitmore, 2009) 7. (Baghdadi and Kishk, 2015) 8. (Alhomidan, 2010) 9. (Alghonamy, 2015) 10. (Albogamy, *et al.*, 2013) 11. (Al-Tami, 2015) 12. (Al-Hammad, 2000) 13. (Mahamid, 2014) 14. (Mohamad, *et al.*, 2012) 15. (Arain, *et al.*, 2006) 16. (Mahamid, 2011) 17. (Bubshait and Al-Juwairah, 2002) 18. (Ikediashi, *et al.*, 2014) 19. (Alhammadi, 2011) 20. (Al-Emad and Nagapan, 2015) 21. (Elawi, *et al.*, 2016) 22. (Alzara, *et al.*, 2016) 23. (Mahamid, *et al.*, 2015) 24. (Allahaim and Liu, 2015)

Table 7

Classification categories of the most frequent risks out of contractors' control

No.	Risk factor	Frequency in 24 studies	Classification Category
1	Mistakes in design	20	Design
2	Delay in progress payments by owner	19	Owner
3	Changes in specifications during construction	18	Owner
4	Additional work or changes in the scope of the project	17	Owner
5	Adverse weather conditions	17	External
6	Cost fluctuation of labor and material during construction	16	External
7	Design changes	16	Design
8	Changes in government regulations and laws	16	External
9	Owners' practice of assigning contracts to lowest bidder	14	Owner
10	Unrealistic contract duration	14	Owner
11	Availability of construction material	14	External
12	Slow decision making by the owner	14	Owner
13	Owner's team lack of experience including consultants	13	Owner/Consultant
14	Owner's poor coordination with the construction parties	12	Owner
15	Difficulties in obtaining work permits	10	Owner
16	Change orders by owner during construction	10	Owner
17	Delay in approving shop drawings and sample materials	10	Owner
18	Delay in performing inspection and testing by consultant	10	Consultant
19	Shortage of equipment required	10	External
20	Excessive bureaucracy in the owner's administration	9	Owner
21	Shortage of manpower	8	External
22	Effects of subsurface conditions (e.g., soil, high water table, etc.)	8	External
23	Poor communication and coordination by consultant engineer	8	Consultant
24	Unclear and inadequate drawings and specifications	8	Design
25	Delays in producing design documents	8	Design
26	Interference by owner in the construction operations	6	Owner
27	Poor site conditions	6	Owner
28	Delay to furnish and deliver the site to the contractor by the owner	6	Owner
29	Delay in reviewing and approving design documents by consultant	6	Consultant
30	Delay in approving major changes in the scope of work by consultant	4	Consultant
31	External work due to public agencies (roads, utilities and public services)	3	External
32	Contract breaching by owner	3	Owner

The researcher presented the list of risks factors to three experts whom have more than 25 years of experience in the Saudi construction industry to provide feedback on the questionnaire for the risks assessment and to add any other important or recent risks not listed in the questionnaire. Three risks factors were added to the list which are: the duration of the consultant contract does not match the duration of the project, wars in region and delays in disputes resolutions.

The targeted population in this study is contractors who work in public projects in Saudi Arabia. Ninety four contractors responded to this part of the survey. The sent questionnaire for this chapter is composed of three sections. The first section was an introduction about the purpose of the questioner and its goals. The second section was related to general information about the respondent and the company they work in. The third section includes a list of risks which are classified into three groups including owner's related risks, consultant and designer related risks, and external risks. The survey was formed in English and then translated into Arabic and then distributed online through the Survey Monkey website.

Demographic Variables

Demographic background in this research included different control variables collected from the respondents to provide a broader view of the research outcome. Six control variables are collected from the respondents in the following part of the survey. Firstly, the collected personal information include: work position in the company, years of experience within the construction field, and their educational level. Secondly, the collected information about the contractors companies include: classification grade of the

company, companies' classified fields, and places of their projects. The demography of participated respondents is this part of the survey is illustrated in the figures 7 to 9 and tables 8 and 9.

The survey of this research collected information about the respondents' years of experience in the construction industry shown in figure 7. A total of 47 respondents (50%) have more than 15 years of experience in the construction industry. 18 of the respondents (19%) have from 10 to 15 years of experience, 24 of the participants (26%) have from 5 to 10 years of experience, and finally, 5 of the respondents (5%) have less than 5 years of experience in the construction industry in Saudi Arabia.

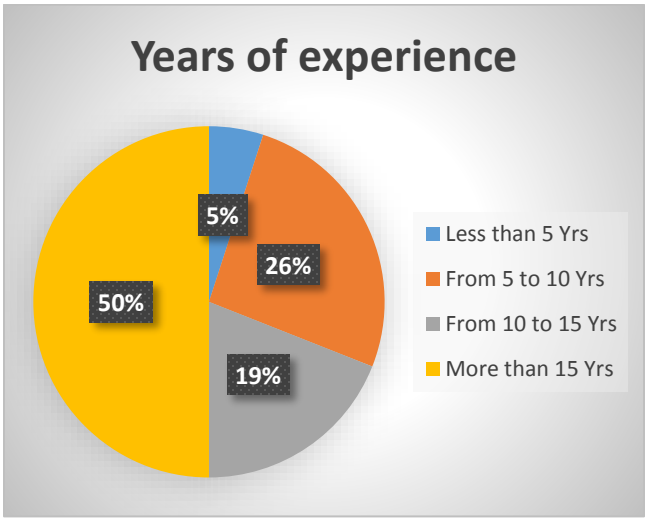

Figure 7: Years of experience of construction personnel participated in survey 1

The next demographic variable is the education level. The educational background of the participants spans over all the different levels of education. The majority of the respondents indicated that they have a bachelor degree (62%) as shown in figure 8. Furthermore, 3 of the participants indicated that they hold PhD degree (3%) and

14% of the participants indicated that they have a master degree. The rest of the respondents indicated they have a diploma degree or lower level of education (20%).

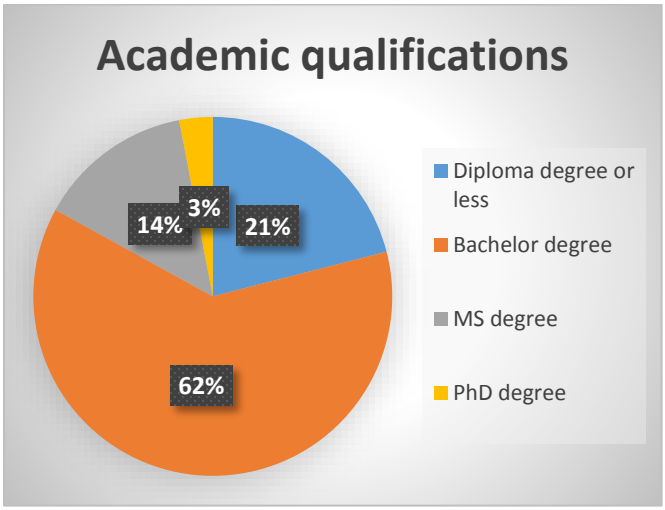

Figure 8: Academic qualifications of the construction personnel participated in survey 1

The next control variable in this study is the working position of the respondents in the construction company. The majority of the participants were the companies' owners as 54 owners (58%) participated in this survey. There were 17 project managers (18%), 4 field engineers (4%), 3 planning engineers (3%), 9 administration managers (10%), and 7 of the participants (7%) choose the final choice (others). The second type of control variables is about the collected information about the contractors companies. Figure 9, shows the numbers of participated contractors in each grade within the contractors' classification grades in Saudi Arabia. Most of the participated contractors are classified in grades 3 and 4 with 26 contractors in each grade.

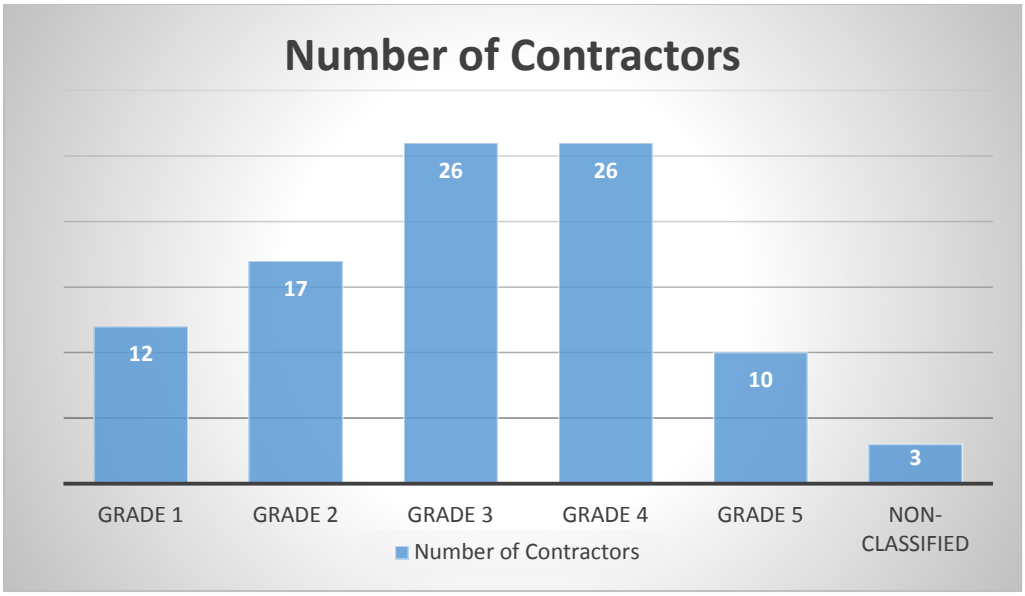

Figure 9: Classification grades of the contractors participated in survey 1

Table 8, shows the regions in Saudi Arabia in which the participated contractors are undertaken projects in. Most of the participated contractors are working in more than one region and 45% of participated contractors work in projects in the region that the capital city of Saudi Arabia is located in (Riyadh).

Table 8

Locations of projects undertaken by the contractors participated in survey 1

Regions in Saudi Arabia	**% Out of the Overall Responses**	**No. of Respondents**
Riyadh	44.68%	42
Makkah	25.53%	24
Eastern Province	24.46%	23
Al Qassim	13.82%	13
'Asir	13.82%	13
Al Madinah	13.82%	13
Jizan	12.76%	12
Tabuk	11.7%	11

Najran	10.63%	10
Northern Borders	8.51%	8
Al Jawf	7.44%	7
Ha'il	4.25%	4
Al Bahah	4.25%	4

Table 9, shows the fields the participated contractors are working in as they are classified in those fields. Most of the participated contractors are classified in multiple fields and the majority of the participated contractors work in buildings projects (77%). 18% of the participated contractors are also classified in other fields that are not included in the choices.

Table 9

Classification fields of the contractors participated in survey 1

Classification Field	**% Out of the Overall Responses**	**No. of Respondents**
Buildings	77.27%	68
Roads	57.95%	51
Water and sanitation work	42.04%	37
Electrical Works	45.45%	40
Mechanical Works	31.81%	28
Other Fields	18.18%	16

Data Analysis and Results

The participants were asked to rate each risk according to its frequency of occurrence on public projects and its degree of impact (severity) on public projects' cost and time. A 5 point scale was used for the evaluation of risks for both severity and

frequency of occurrence. Degree of severity was categorized as follows: Extremely sever, Sever, Moderate, Low, and None (on a 5 to 1 point scale). Similarly, frequency of occurrence was categorized as follows: Always, Often, Sometimes, Rarely, and Never (on a 5 to 1 point scale)

Importance Index was used to analyze the collected data from the questioner including both Severity Index and Frequency Index. This formula was used by Assaf and Haji (2006) and Albogammy et al (2012) to analyze and rank causes of delay in the Saudi construction industry.

Importance Index (II) = (F.I × S.I) /100

The frequency index formula is used to rank risks according to causes' frequency of occurrence in projects based on the participants' point of view.

$$\text{Frequency Index (FI)} = \sum[\text{a.}\left(\frac{\text{n}}{\text{N}}\right)] \times 100/5$$

The severity index formula is used to rank risks based on the causes' degree of impact on projects' cost and time based on the participants' point of view.

$$\text{Severity Index (SI)} = \sum[\text{a.}\left(\frac{\text{n}}{\text{N}}\right)] \times 100/5$$

Where *a* is the constant of weighting given to each response which ranges from 1 for (none) for the severity part and (never) for the occurrence part to 5 for (extremely sever) for the severity part and (always) for the occurrence part, *n* is the responses frequency, and *N* is the sum of responses.

The results of the survey are shown in the following tables. The overall frequency index, severity index, and importance index with their rankings are shown in table 10. Table 11, shows the importance and rankings of risks factors out of contractors' control in the three main provinces in Saudi Arabia (Riyadh province, Makkah province, and Eastern province). Table 12, shows the overall top ranked risks factors compared with the provinces ranking results. Comparison of importance of risks out of contractors' control in five fields of projects with their rankings is shown in table 13. Finally, the comparison of ranking of risks out of contractors' control in five fields of projects with the overall ranking is shown in table 14.

Table 10

The overall importance of risks out of contractors' control in the Saudi construction industry

Risk Factor	FI	Rank	SI	Rank	II	Rank
1- Owner's related risks						
Delay in progress payments by owner	90.740	2	96.559	1	87.618	1
Owners' practice of assigning contracts to lowest bidder	91.111	1	86.956	3	79.227	2
Slow decision making by the owner	79.629	5	82.888	6	66.004	3
Change orders by owner during construction	81.481	3	79.354	18	64.659	4
Excessive bureaucracy in the owner's administration	81.481	3	79.318	19	64.629	5
Delay in approving shop drawings and sample materials	77.037	7	82.173	7	63.304	8
Owner's team lack of experience	77.037	7	79.775	15	61.456	10
Owner's poor coordination with the construction parties and government authorities	75.555	10	80	12	60.444	11
Changes in specifications during construction	71.851	16	80	12	57.481	14
Unrealistic contract duration	72.222	13	79.565	16	57.463	15
Interference by owner in the construction operations	75.849	9	73.333	30	55.622	18
Additional work due to changes in the scope of the project	71.111	18	76	27	54.044	21
Difficulties in obtaining work permits	69.629	22	76.179	25	53.043	24

Poor site conditions	67.924	25	76.091	26	51.685	28
Delay to furnish and deliver the site to the contractor by the owner	63.703	30	71.685	33	45.666	31
Contract breaching by client	57.037	34	75.955	28	43.322	32
2- Consultant and designer related risks						
Delay in approving major changes in the scope of work by consultant	77.974	6	81.842	8	63.816	6
Consultant's lack of experience	72.183	14	87.073	2	62.852	9
Design changes	71.034	19	82.926	5	58.906	12
Delay in performing inspection and testing by consultant	72.183	14	81.219	9	58.627	13
Delay in reviewing and approving design documents by consultant	73.25	12	78.4	20	57.428	16
Poor communication and coordination by consultant engineer	71.494	17	76.829	23	54.928	19
Mistakes in design	69.767	21	78.292	21	54.622	20
Unclear and inadequate drawings and specifications	69.069	23	77.590	22	53.591	23
Delays in producing design documents by designer	68.25	24	76.8	24	52.416	25
The duration of the consultant contract does not match the duration of the project	63.218	31	72.439	32	45.794	30
3- External risks						
External work due to public agencies (roads, utilities and public services)	74.942	11	85.121	4	63.792	7
Cost fluctuation of labor and material during construction	70.352	20	80.952	10	56.952	17
Shortage of manpower	67.529	26	80	12	54.023	22
Availability of construction material	64.470	28	80.952	10	52.190	26
Delays in disputes resolution	65.287	27	79.512	17	51.911	27
Changes in government regulations and laws	63.720	29	75.662	29	48.212	29
Effects of subsurface conditions (e.g., soil, high water table, etc.)	57.209	33	73.012	31	41.769	33
Shortage of equipment required	58.372	32	68.536	35	40.006	34
Adverse weather conditions	56.551	35	64.146	36	36.275	35
Wars in region	41.162	36	70.487	34	29.014	36

Table 11

The importance of risks out of contractors' control in the three main provinces in Saudi Arabia

	Riyadh Province		Makkah Province		Eastern Province	
Risk Factor	**II**	**Rank**	**II**	**Rank**	**II**	**Rank**
1- Owner's related risks						
Unrealistic contract duration	56.720	13	57.777	9	61.717	16
Change orders by owner during construction	62.800	6	69.259	3	65.185	8
Delay in progress payments by owner	88.527	1	86.203	1	88.373	1
Owners' practice of assigning contracts to lowest bidder	76.444	2	77.444	2	76.850	2
Delay in approving shop drawings and sample materials	62.757	7	61.629	6	66.988	6
Additional work due to changes in the scope of the project	49.422	28	54.518	13	57.507	23
Interference by owner in the construction operations	53.094	20	50.785	18	56.345	25
Owner's poor coordination with the construction parties and government authorities	59.669	10	54.777	12	61.818	15
Excessive bureaucracy in the owner's administration	65.603	3	64.476	5	67.407	5
Changes in specifications during construction	57.113	12	53.888	15	62.479	13
Difficulties in obtaining work permits	52.132	24	47.832	23	58.868	18
Contract breaching by client	42.927	31	36.206	35	45.629	32
Poor site conditions	52.194	22	52.567	17	52.398	28
Owner's team lack of experience	59.259	11	61.629	6	60.929	17
Delay to furnish and deliver the site to the contractor by the owner	42.795	32	43.761	25	48.067	31
Slow decision making by the owner	64.898	4	65.030	4	69.935	4
2- Consultant and designer related risks						
Delay in performing inspection and testing by consultant	56.667	14	47.913	22	58.294	20
Delay in approving major changes in the scope of work by consultant	62.588	8	55.733	11	64.863	9
Unclear and inadequate drawings and specifications	51.898	25	42.847	26	57.547	22
Design changes	53.656	18	53.913	14	62.905	12
Mistakes in design	56.241	15	41.289	30	65.526	7
Delays in producing design documents by designer	52.188	23	42	29	56.084	26
Late in reviewing and approving design documents by consultant	54.3064	17	44.685	24	64	10
Poor communication and coordination by consultant engineer	53.322	19	40.644	31	62.315	14
Consultant's lack of experience	63.529	5	53.695	16	72.347	3
The duration of the consultant contract does not match the duration of the project	42.038	33	40.579	32	42.442	33

3- External risks						
Availability of construction material	48.806	29	50.115	19	57.6	21
Cost fluctuation of labor and material during construction	55.815	16	56.449	10	56.428	24
Changes in government regulations and laws	52.525	21	39.420	33	50	29
External work due to public agencies (roads, utilities and public services)	60.427	9	61.152	8	63.2	11
Adverse weather conditions	32.996	35	38.5	34	34.8	35
Shortage of equipment required	34.168	34	42.702	27	37.561	34
Shortage of manpower	50.137	27	49.249	21	58.666	19
Effects of subsurface conditions (e.g., soil, high water table, etc.)	45.252	30	42.239	28	52.457	27
Wars in region	27.25	36	28.405	36	33.133	36
Delays in disputes resolution	50.484	26	49.565	20	48.571	30

The overall top risks out of contractors' control were compared to the results of risks rankings in the three main provinces in Saudi Arabia as shown in table 12. The comparison results show similar results in only the top two ranked risks which are delay in progress payments by owner and owners' practice of assigning contracts to lowest bidder.

Table 12

Overall top ranked risks compared with the provinces ranking results.

Risk Factor	Classification Category	Overall Ranking	Riyadh Province Ranking	Makkah Province Ranking	Eastern Province Ranking
Delay in progress payments by owner	Owner	1	1	1	1
Owners' practice of assigning contracts to lowest bidder	Owner	2	2	2	2
Slow decision making by the owner	Owner	3	4	4	4
Change orders by owner during construction	Owner	4	6	3	8
Excessive bureaucracy in the owner's administration	Owner	5	3	5	5

Delay in approving major changes in the scope of work by consultant	Consultant	6	8	11	9
External work due to public agencies (roads, utilities and public services)	External	7	9	8	11
Delay in approving shop drawings and sample materials	Owner	8	7	6	6
Consultant's lack of experience	Consultant	9	5	16	3
Owner's team lack of experience	Owner	10	11	6	17

Table 13

Comparison of importance of risks out of contractors' control in five fields of projects in the Saudi construction industry

	Buildings		Roads		Water & Sanitation		Electrical		Mechanical	
Risk Factor	II	Rank	II	Rank	II	Rank	II	Rank	II	Rank
1- Owner's related risks										
Unrealistic contract duration	57.121	16	53.611	22	54.567	23	54.607	20	56.333	18
Change orders by owner during construction	64.466	7	64.245	6	66.543	4	65.582	5	68.444	4
Delay in progress payments by owner	87.004	1	87.250	1	86.707	1	86.757	1	86.506	1
Owners' practice of assigning contracts to lowest bidder	78.872	2	79.320	2	79.657	2	78.811	2	79.800	2
Delay in approving shop drawings and sample materials	63.929	8	63.744	7	66.471	5	63.170	8	65.879	7
Additional work due to changes in the scope of the project	54.341	24	52.535	25	55.215	20	54.755	19	54.927	21
Interference by owner in the construction operations	54.703	21	52.610	24	53.324	25	55.233	18	55.261	20
Owner's poor coordination with the construction parties and government authorities	60.902	10	58.902	13	61.333	11	61.577	11	61.486	12
Excessive bureaucracy in the owner's administration	65.686	4	61.526	9	64.226	8	64.777	6	64.623	8
Changes in specifications during construction	58.768	15	56.583	15	59.658	15	59.323	13	61.587	11
Difficulties in obtaining work permits	54.648	22	52.293	26	56.113	17	55.355	17	57.144	17
Contract breaching by client	44.608	32	41.904	33	45.294	32	44.203	32	46.809	30
Poor site conditions	52.075	25	52.894	23	54.751	21	52.597	24	55.795	19
Owner's team lack of experience	60.462	11	61.944	8	64.348	6	61.244	12	63.754	9
Delay to furnish and deliver the site to the contractor by the owner	46.909	30	47.322	29	48.714	29	47.777	28	47.448	28
Slow decision making by the owner	67.269	3	67.928	3	69.793	3	68.481	3	69.195	3

2- Consultant and designer related risks										
Delay in performing inspection and testing by consultant	60.159	12	56.816	14	59.885	14	61.894	10	58.303	16
Delay in approving major changes in the scope of work by consultant	64.833	5	64.318	4	64.058	9	65.919	4	66.673	6
Unclear and inadequate drawings and specifications	54.379	23	56.039	16	54.628	22	53.165	23	53.943	22
Design changes	58.843	14	59.416	12	56.228	16	58.294	14	60.444	14
Mistakes in design	55.723	19	53.936	20	56.022	19	53.165	22	53.888	23
Delays in producing design documents by designer	50.948	28	54.478	18	53.223	26	51.484	26	50.421	26
Late in reviewing and approving design documents by consultant	59.107	13	59.673	11	61.211	12	57.576	16	61.767	10
Poor communication and coordination by consultant engineer	57.039	17	54.711	17	60.866	13	57.952	15	59.984	15
Consultant's lack of experience	64.493	6	60.182	10	63.133	10	64.215	7	67.862	5
The duration of the consultant contract does not match the duration of the project	46.885	31	45.828	30	48.696	30	44.344	31	46.022	31
3- External risks										
Availability of construction material	51.775	26	50.065	28	53.414	24	46.228	30	47.384	29
Cost fluctuation of labor and material during construction	56.427	18	53.755	21	56.058	18	51.559	25	47.912	27
Changes in government regulations and laws	51.448	27	44.414	31	48.078	31	47.595	29	41.942	32
External work due to public agencies (roads, utilities and public services)	62.577	9	64.268	5	64.250	7	62.145	9	60.846	13
Adverse weather conditions	36.317	35	37.771	35	37.662	34	33.812	35	32.571	35
Shortage of equipment required	38.547	34	42.940	32	38.592	33	34.349	34	36.049	33
Shortage of manpower	55.447	20	54.085	19	49.5	28	51.368	27	51.434	25
Effects of subsurface conditions (e.g., soil, high water table, etc.)	42.546	33	37.899	34	36.539	35	34.662	33	33.953	34
Wars in region	29.866	36	29.579	36	28	36	30.803	36	30.024	36
Delays in disputes resolution	50.874	29	52.048	27	50.011	27	54.519	21	53.142	24

Table 14

Comparison of the rankings of risks out of contractors' control in five fields of projects with the overall ranking

Risk Factor	Overall Rank	Buildings Rank	Roads Rank	Water Rank	Electrical Rank	Mechanical Rank
1- Owner's related risks						
Delay in progress payments by owner	1	1	1	1	1	1
Owners' practice of assigning contracts to lowest bidder	2	2	2	2	2	2
Slow decision making by the owner	3	3	3	3	3	3
Change orders by owner during construction	4	7	6	4	5	4
Excessive bureaucracy in the owner's administration	5	4	9	8	6	8
Delay in approving shop drawings and sample materials	8	8	7	5	8	7
Owner's team lack of experience	10	11	8	6	12	9
Owner's poor coordination with the construction parties and government authorities	11	10	13	11	11	12
Changes in specifications during construction	14	15	15	15	13	11
Unrealistic contract duration	15	16	22	23	20	18
Interference by owner in the construction operations	18	21	24	25	18	20
Additional work due to changes in the scope of the project	21	24	25	20	19	21
Difficulties in obtaining work permits	24	22	26	17	17	17
Poor site conditions	28	25	23	21	24	19
Delay to furnish and deliver the site to the contractor by the owner	31	30	29	29	28	28
Contract breaching by client	32	32	33	32	32	30
2- Consultant and designer related risks						
Delay in approving major changes in the scope of work by consultant	6	5	4	9	4	6
Consultant's lack of experience	9	6	10	10	7	5
Design changes	12	14	12	16	14	14
Delay in performing inspection and testing by consultant	13	12	14	14	10	16
Late in reviewing and approving design documents by consultant	16	13	11	12	16	10

Poor communication and coordination by consultant engineer	19	17	17	13	15	15
Mistakes in design	20	19	20	19	22	23
Unclear and inadequate drawings and specifications	23	23	16	22	23	22
Delays in producing design documents by designer	25	28	18	26	26	26
The duration of the consultant contract does not match the duration of the project	30	31	30	30	31	31
3- External risks						
External work due to public agencies (roads, utilities and public services)	7	9	5	7	9	13
Cost fluctuation of labor and material during construction	17	18	21	18	25	27
Shortage of manpower	22	20	19	28	27	25
Availability of construction material	26	26	28	24	30	29
Delays in disputes resolution	27	29	27	27	21	24
Changes in government regulations and laws	29	27	31	31	29	32
Effects of subsurface conditions (e.g., soil, high water table, etc.)	33	33	34	35	33	34
Shortage of equipment required	34	34	32	33	34	33
Adverse weather conditions	35	35	35	34	35	35
Wars in region	36	36	36	36	36	36

After the respondents assessed the risks identified from the literature based on their occurrence and severity, they were asked to add any additional risks out of their control and not mentioned in the survey based on their experience. Several risks that were added by participants were neglected as they were already included in the factors found in the literature. The respondents added the following risks based on their experience:

- Owners requests of samples and materials with high costs and they are not specified in quantities table.

- Neglecting the contractor's proposals and requirements for the owner even if they are in the owner's interest
- Not choosing an expert consultant for the projects to be responsible for reviewing design documents or shop drawings and be responsible for field supervision.
- Taking rigorous procedures by owner against contractor despite the late payment of accomplished work.
- Not using another way of contracting such as FIDIC as currently the owner and consultant have stronger power over the contractor and that causes losses to contractors which force them to take actions to reduce loss and that leads to delays in projects and having low quality.
- The criteria for contractors' selection process are not efficient.
- Consultant's corruption.
- Consultant requests specifications that are not included in the project specification contract
- The difference of the prices for projects in remote areas or areas with no services are not considered and they are been considered equivalence to prices for projects in cities.
- No transparency in dealing with external parties in projects
- The absence of coordination between project parties before awarding a contract
- Underground services lines are not considered and mentioned in design documents.

- Delay in recruitment and disbursement of workers' visas caused by governmental authorities.
- Lack of transparency in resolving project issues

The participants answered an optional question considering the percentages of responsibilities of projects parties for causing cost or time overruns in the projects that they experienced. The question statement is “based on your experience in executing projects in Saudi Arabia, where there has been an increase in costs or delay in delivery, how can you assign responsibility to project parties in percentages which caused the increase or time overrun? Please consider that the total of ratios equals 100%”. 79 of the participants answered this question and one of the answers was deleted because of the total of the given percentages were over 100. The results of the average of responsibilities percentages given to project parties are:

- Owner and administrative team of owner except consultant = 45%
- Contractor = 25.3 %
- Consultant = 26.75 %
- Other = 2.95 %

Chapter Conclusion

Recent studies identified that contractors are not the main party that cause risks as owners, consultants, and other parties have the major share of causing risks in the Saudi construction industry. This chapter investigated the risks that are out of contractors’ control (risks caused by other parties) in the context of the Saudi construction industry and reported

an up-to-date ranked list of risks that are out of contractors' control. Thirty six risk factors that are out of contractors' control were identified through literature review and a pilot study.

The study identified that the top risks that are out of contractors' control in public construction projects in Saudi Arabia are: delay in progress payments by owner, owners' practice of assigning contracts to lowest bidder, slow decision making by the owner, change orders by owner during construction, excessive bureaucracy in the owner's administration, delay in approving major changes in the scope of work by consultant, and external work due to public agencies (roads, utilities and public services). The comparison results of the overall top ranked risks and the results of risks ranking in the three main provinces in Saudi Arabia showed similar results in only the top two ranked risks which are delay in progress payments by owner and owners' practice of assigning contracts to lowest bidder. Similarly, the comparison results of the overall top ranked risks and the results of risks factors rankings in five fields of projects showed similar results in only the top three ranked risks.

The identified and assessed risks do not cover all risks out of contractors' control in the Saudi construction industry, however, the study results give a general idea about what are the risks out of contractors' control and what is there importance. It is recommended for contractors to identify and assess all risks out of their control before starting projects to include them in projects plans. This will help in knowing how to reduce the effects of these risks and to measure responsibility for any adverse results.

CHAPTER 5

Assessment and Development of Contractors' Practices towards Risks out of Their Control

Chapter Introduction

The previous chapter (Chapter 4), analyzed the data collected from the survey about the risks that are out of contractors' control (caused by other parties) in the context of the Saudi construction industry reported an up-to-date ranked list of risks that are out of contractors' control based on their importance and occurrence in the industry. This chapter investigates the contractors' current practices towards minimizing risks out of their control and develop a risk mitigation model for contractors and validate the proposed model through collecting the contractors' perceptions of new risk mitigation approach in Saudi Arabia. This chapter is divided into four parts related to the study aim and objectives.

The first part presents the demographic variables of contractors participated in the part of the survey. The second part of this chapter investigates the contractors' current practices towards minimizing risks out of their control through identifying contractors' practices in the identification of projects activities and risks, contractors' practices in mitigating other parties' activities and risks, and contractors' practices in measuring the performance of all project parties. The third part will present contractors' perceptions who work in public construction projects in Saudi of the new approach in mitigating risks out of contractors' control. The fourth part includes providing the practical framework in mitigating risks out of contractors' control in the Saudi construction industry.

Demographic Variables

Demographic background in this research included the control variable collected from the respondents to provide a broader view of the research outcome. Six control variables are collected from the respondents in the following part of the survey. Firstly, the collected personal information include: work position in the company, years of experience within the construction field, and their educational level. Secondly, the collected information about the contractors companies include: classification grade of the company, companies' classified fields, and places of their projects. 252 contractors responded to this part of the survey. The demography of participated respondents is illustrated in the figures 10 to 12 and tables 15 and 16.

The survey of this research collected information about the respondents' years of experience in the construction industry shown in figure 10. A total of 103 respondents (41%) have more than 15 years of experience in the construction industry. 66 of the respondents (26%) have from 10 to 15 years of experience, 70 of the participants (28%) have from 5 to 10 years of experience, and finally, 13 of the respondents (5%) have less than 5 years of experience in the construction industry in Saudi Arabia.

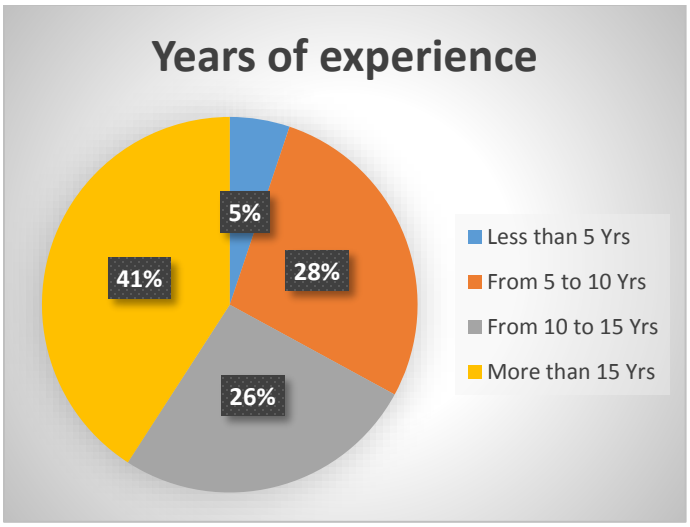

Figure 10: Years of experience of construction personnel participated in survey 2

The next demographic variable is the education level. The educational background of the participants spans over all the different levels of education as shown in figure 11. The majority of the respondents indicated that they have a bachelor degree (65%). Furthermore, 12 of the participants indicated that they hold PhD degree (5%) and 35 of the participants indicated that they have a master degree constituting 14% of the total sample size. The rest of the respondents indicated they have a diploma degree or lower level of education (16%).

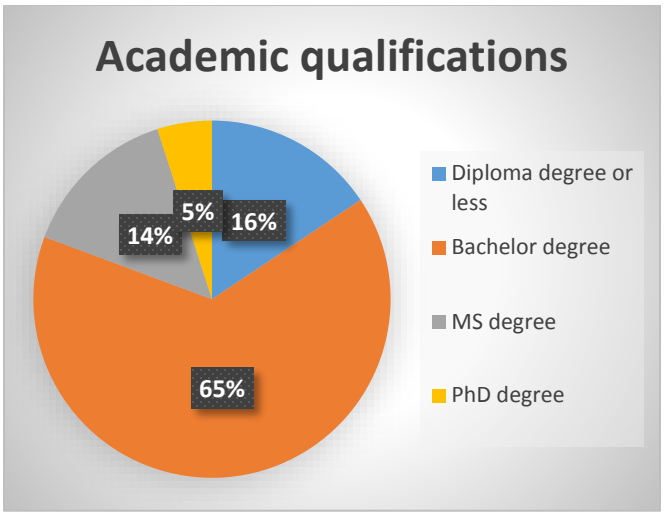

Figure 11: Academic qualifications of the construction personnel participated in survey 2

The next control variable in this study is the working position of the respondents in the construction company. The majority of the participants were the companies' owners as 148 owners (58.73%) participated in this survey. There were 40 project managers (15.87%), 6 field engineers (2.38%), 6 planning engineers (2.38%), 47 administration managers (18.65%), and 19 of the participants (7.54%) choose the final choice (others). Some of the participants had two positions in the company. The second type of control variables is about the collected information about the contractors companies. Figure 12, shows the numbers of participated contractors in each grade within the contractors' classification grades in Saudi Arabia. Most of the participated contractors are classified in grades 3 with 72 contractors and grade 4 with 76 contractors.

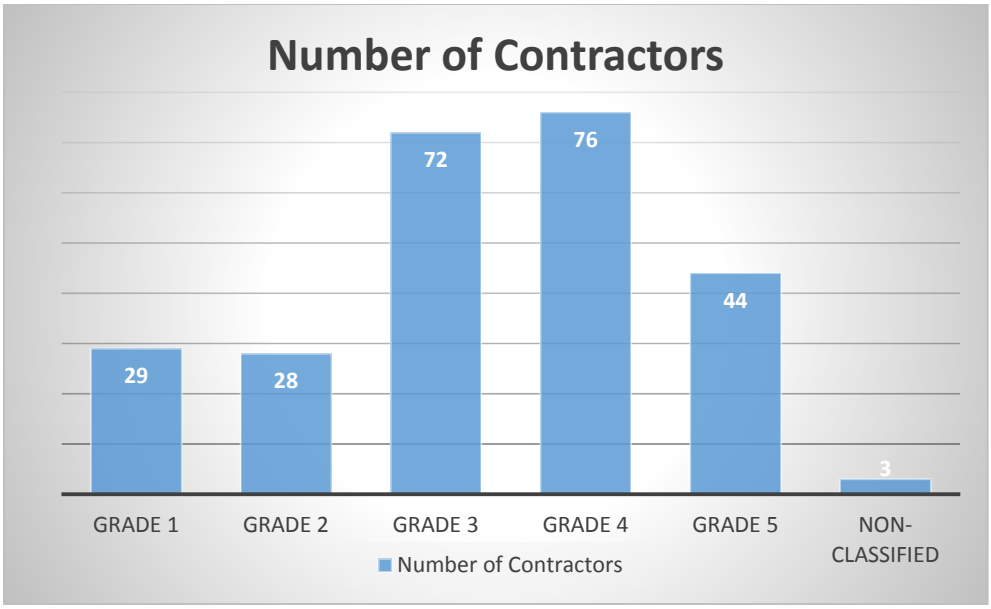

Figure 12: Classification grades of the contractors participated in survey 2

Table 15, shows the regions in Saudi Arabia in which the participated contractors are undertaken projects in. Most of the participated contractors are working in more than one region and half of participated contractors work in projects in the region that capital city of Saudi Arabia is located in (Riyadh).

Table 15

Locations of projects undertaken by the contractors participated in survey 2

Regions in Saudi Arabia	**% Out of the Overall Responses**	**No. of Respondents**
Riyadh	50.20%	126
Makkah	25.90%	65
Eastern Province	23.51%	59
Jizan	17.13%	43
Al Qassim	16.73%	42
'Asir	15.54%	39
Al Madinah	14.34%	36
Najran	13.94%	35

Tabuk	13.15%	33
Ha'il	7.57%	19
Northern Borders	7.57%	19
Al Jawf	7.57%	19
Al Bahah	6.77%	17

Table 16, shows the fields the participated contractors are working in as they are classified in those fields. Most of the participated contractors are classified multiple fields and the majority of the participated contractors work in buildings projects (78%). 13% of the participated contractors are also classified in other fields that are not put in the choices.

Table 16

Classification fields of the contractors participated in survey 2

Classification Field	**% Out of the Overall Responses**	**No. of Respondents**
Buildings	78.05%	192
Roads	43.90%	108
Water and sanitation work	40.24%	99
Electrical Works	46.75%	115
Mechanical Works	33.74%	83
Other Fields	13.01%	32

Assessment of Contractors' Practices towards Risks out of Their Control

The aim of this section is to assess the current risk management and performance measurement practices applied by contractors to minimize risk out of their control through conducting a questionnaire survey. The assessment included the contractors' practices in the identification of projects activities and risks, contractors' practices in mitigating other parties' activities and risks, and contractors' practices in measuring the performance of all project parties.

Using agree, disagree, and don't know choices, the participants were asked if they identify all of their activities and risks and include them in the project plans. The majority of the respondents (82.54%) as shown in figure 13 agreed that at early stages of projects, they identify all of their activities and risks in the project plan. Only 5.95% of the respondents answered negatively to the statement as they do not identify all of their activities and risks and include them in the project plans. In addition, figure 13, shows the approach of the contractors considering the identification of activities and risks of other parties in early stages of projects. A considerable percentage of the contractors (56.35%) agreed that they as a general contractor identify all of other parties' activities and their related risks such as activities of project owner or consultant. However, 29.76% of the respondents disagreed with the statement as they don't identify other parties' activities and risks in projects.

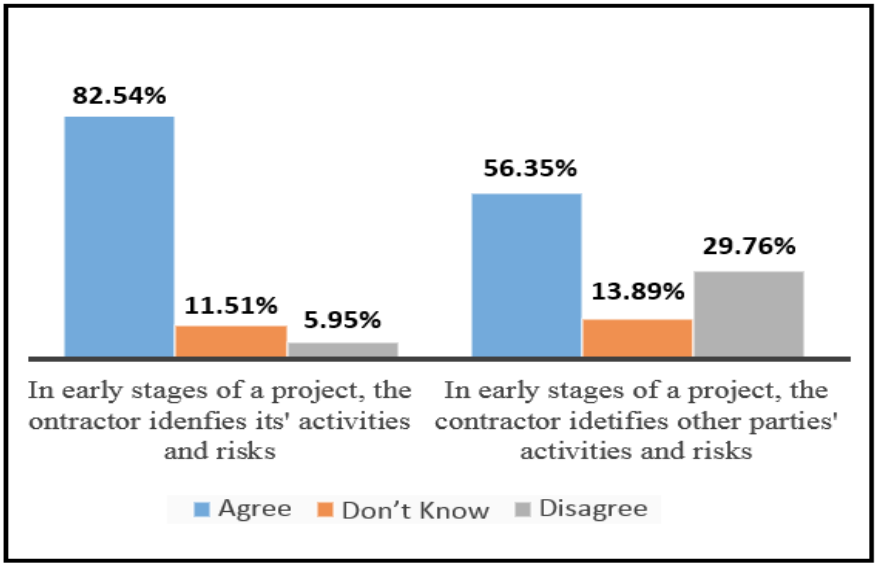

Figure 13: Contractors' practices in the identification of projects activities and risks

A follow up question asked about if the contractors include the activities and risks of other parties in the projects plans or not. As shown in figure 14, only 22.22% of the contractors agreed with the statement as their project plans include all other parties activities and risks whereas 63.89% of the participants disagreed with the statement as they do not include other parties' activities and risks in project plans. Furthermore, the contractors' current risk management practices were investigated considering the mitigation of other parties' activities and risks throughout the project phases by the contractors. As shown in figure 14, the majority of contractors (65.08%) do not mitigate other parties' activities and risks throughout the projects phases and only 15.48% of the respondents agreed that they mitigate other parties' activities and risks in the project phases.

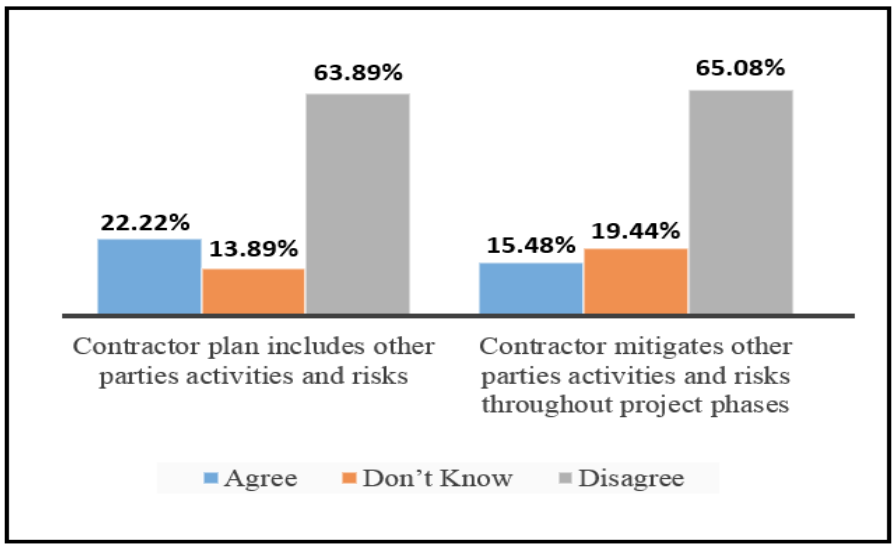

Figure 14: Contractors' practices in mitigating other parties' activities and risks

The measurement practices for the participated contractors were investigated considering measuring their own performance and measuring other parties' performance during the project phases. As shown in figure 15, most of the participated contractors (84.92%) measure and track their performance during projects phases based on time and cost deviations, while only 6.35% of the participated contractors do not measure and track their performance during projects phases based on time and cost deviations. However, their measurement practices considering other parties change as only 40.08% of the participated measures the performance of all parties in projects (i.e. client and consultant's performance) during projects phases based on time and cost deviations and 43.65% do not measure the performance of all parties during project phases. A following question was asked for the participated contractors who measure all parties' performance during projects' phases to investigate if they share the measurement information of all parties' performance periodically with all parties involved in projects. Only 31% of the

participated contractors who measure all parties' performance during projects' phases share the measurement information of all parties' performance periodically with all parties involved in projects.

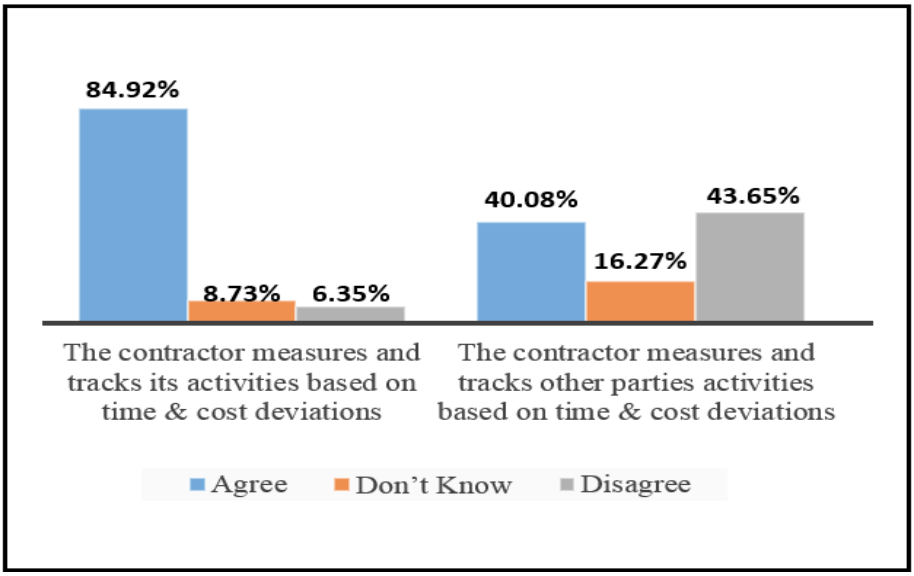

Figure 15: Contractors' practices in measuring the performance of all project parties

As it is shown in table 17, a statement was assessed by the participants about the activities of project parties and if they should be dealt with as risks to the project as they may cause time and cost deviations to the project if they are not done as planned. The majority of the respondents (91.27%) agree or strongly agree that activities of other parties in projects (activities out of contractor's control) are risks to the project if they are not done as expected. The literature of the Saudi construction industry performance discussed in previous chapters showed that contractors are not the only party causing risks that lead to low performance in the industry as owners and other parties also have a major share. It has been identified through the literature analysis that risks out of contractors' control are a leading cause of low performance in the Saudi construction

industry. This finding was validated by the participants in the survey as 84.92% of respondents either strongly agree or agree that risks and activities that are out of contractor's control (generated by other parties) are a leading cause of low performance in projects in Saudi Arabia.

Another question was answered by respondents about the effectiveness of the current risk mitigation practices applied in their current projects in minimizing risks. 83.73% of respondents either strongly agree or agree that the contractors' current risk mitigation practices are not effective in minimizing risks because they do not identify and mitigate risks and activates of other parties (out of contractors' control) in projects in the Saudi construction industry. This shows that the current practices applied by contractors are not focused on risks and activities of other parties through the identification and mitigation of these risks throughout the projects phases. This situation led to a conclusion that the current risk management practices applied by contractor are not effective in minimizing project risks.

A following statement was answered by the participants about the need for a proactive risk mitigation practices to manage risks and activities of other parties in projects other than contractor. The majority of the respondents (90.47%) agree or strongly agree that there is a need for a proactive risk management practices that identify and mitigate risks and activates out of contractors' control in projects in the Saudi construction industry. This high percentage shows the need to shift the focus of contractors' risk management practices in the Saudi construction industry from only their own activities and risks to include all project parties' activities and risks. The final

statement that was answered by respondents in this part of the survey was about the need for a performance measurement system in the Saudi construction industry that can enable all parties to know their performance status in projects to differentiate the actual performance of contractors in projects from the performance of other parties. The majority of the respondents (91.67%) agree or strongly agree that there is a need for a performance measurement system that identifies all parties' performance in projects to differentiate the actual contractors' performance from others' risks and performance. This high percentage indicates that the current practices of measuring performance do not differentiate the performance of each party in project based on the responsibility of causing risks or causing deviations in project time and budget.

Overall, table 17 provides the results of the descriptive statistics for the contractors' views towards the current risk mitigation approach and the need for a new approach. The answers' scale range from 5 for strongly agree to 1 for strongly disagree. The table shows the analysis of sample response using the concept of weighted mean and standard deviation. The formulas that were used to calculate the mentioned statistical indices are (Urdan, 2016):

1. The mean

$$\text{Mean } (m) = \Sigma\ [a.\ (n/N)]$$

Where:

a is the weight being used

n the weight frequency

N is the sample size

2. The standard deviation

$$SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

Where:

x is the response value

x bar is the mean

n is the sample size

The results indicate that the statement represented by statement no. 5 (there is a need for a performance measurement system that identifies all parties' performance in projects to differentiate the actual contractors' performance from others' risks and performance) has recorded the greatest mean (4.43) while the statement represented by statements no. 2 and 3 (risks and activities that are out of contractor's control (generated by other parties) are a leading cause of low performance in projects in Saudi Arabia and the contractors' current risk management practices are not effective in minimizing risks because they do not identify and mitigate risks and activates of other parties (out of contractors' control) in projects has ranked the last order as they recorded the minimum mean (4.13). All other values ranged between these two values.

Table 17

Descriptive statistics for the contractors' current risk mitigation practices in the Saudi construction industry

No.	Question	%					Mean	sd
		Strongly agree	Agree	Not sure	Disagree	Strongly disagree		
1	Activities of other parties in projects (activities out of contractor's control) are risks to the project if they are not done as expected.	46.43	44.84	5.95	1.98	0.79	4.34	0.75
2	Risks and activities that are out of contractor's control (generated by other parties) are a leading cause of low performance in projects in Saudi Arabia.	39.29	45.63	5.16	8.33	1.59	4.13	0.95
3	The contractors' current risk mitigation practices are not effective in minimizing risks because they do not identify and mitigate risks and activates of other parties (out of contractors' control) in projects in SA.	37.30	46.43	9.92	5.16	1.19	4.13	0.88
4	There is a need for a proactive risk mitigation practices that identifies and mitigates activates out of contractors' control in projects in SA.	49.60	40.87	7.14	1.98	0.40	4.37	0.74
5	There is a need for a performance measurement system that identifies all parties' performance in projects to differentiate the actual contractors' performance from others' risks and performance.	54.37	37.30	6.35	1.19	0.79	4.43	0.73

The analysis of the collected data showed the current approach of mitigating risks applied by contractors in the Saudi construction industry and their perceptions towards their current risk mitigation practices. According to contractors' views, the activities of other parties in projects (out of contractors' control) should be dealt with as risks as according to their views these activities and risks that are out of contractors' control are a

leading cause of low performance in projects in Saudi Arabia. However, after the analysis of the contractors' current approach in mitigating these risks, results showed that most of the contractors in their current risk mitigation practices do not include the risks and activities out of their control in their plans and do not mitigate them throughout project phases. Furthermore, Considerable percentage of contractors do not measure the risks and activities of all parties in projects and most of the contractors do not share the measurement information periodically with all parties in projects.

The survey results showed that the contractors' current risk mitigation practices are not effective in minimizing risks because they do not identify and mitigate risks and activates of other parties (out of contractors' control) in projects. In addition, the contractors' current performance measurement practices are not effective measuring performance of all parties. According to the majority of the participated contractors in the study, there is a need for a proactive risk mitigation practices that identifies and mitigates activates out of contractors' control in projects and there is a need for performance measurement system that identifies all parties' performance in projects to differentiate the actual contractors' performance from others' risks and performance.

Development of Contractors' Mitigation Practices Towards Risks out of Their Control

The aim of this section is to identify the contractors' perceptions who work in public construction projects in Saudi of the new approach in mitigating risks out of contractors' control. In the first factor considering the respondents' perceptions about the importance of having an expert project manager with the contractor who can plan project from start to end and can identify all activates out of contractor control. As shown in table 18, almost all of the respondents (98.64%) either strongly agree or agree that the existence of an expert project manager with the contractor who can plan project activities from start to end and can identify all activates of other parties in the project is essential to the success of project. This shows the importance of having experts within the contractor who is doing the work in the field as experts are always efficient at their work and don't have technical risks and the main risks they face are from other parties involved in the project. Experts know the scope of their expertise and can identify what is out of their scope and deal with it as risk that needs to be mitigated.

The second statement of this part of the survey was about identifying and including the activities and risks of projects parties in the project plans. 89.79% of the respondents either strongly agree or agree that when contractors make a milestone schedule for a project, they should identify and include all risks and activities of client and other related parties in the plan. This step is essential in managing project activities and risks and it depends on the expertise within the contractor who can identify their scope of work and identify other parties' activities and risks to study them include them in the project plans.

The next element that participants assessed is about helping the project parties to act better to perform the tasks they are responsible for by following up by the contractor with their activities and risks through reminding them of what, when and how to manage these risks and activities. The majority of the respondents (91.84%) agree or strongly agree that following up with risks and activities of project parties by reminding them what, when, and how to manage them, would help responsible parties to act better to perform their tasks. This rate of agreement shows the importance of contractors following up with other parties' activities and risks which helps them to act better in performing the tasks they are responsible for. Furthermore, increasing transparency in managing all parties' project activities and risks will also help and motivate project parties to do better and be accountable for their activities. 93.2% of respondents either strongly agree or agree that being transparent by sharing with project's parties a weekly update of all upcoming activities and risks that need to be managed will help and motivate those responsible to be more accountable for their activities. This rate of agreement shows the importance of having a transparent environment among all of the project parties as it will motivate and help responsible parties to act better.

Two statements in this part of the survey were about the use of performance measurement in managing all parties' activities and risks. The first statement was about the way of measuring parties' performance through identifying activities' deviations from the planned schedule and cost, explaining why the deviation occurred and identifying the responsible party. 89.8% of the respondents strongly agree and agree that identifying activities' deviations from the planned schedule and cost, explaining why the deviation

occurred and identifying the responsible party would help in measuring all parties' performance. This step depends on the projects plans that include all activities and risks of all parties and shows the time line, cost and responsibility of each activity. This way of measuring performance provides information about any deviation through showing how the planned activities deviated from the planned time schedule and cost and provides information of why the deviation occurred and identifies the responsible party for the deviation.

The second statement that assessed the use of performance measurement was about using transparency in measuring performance to help and motivate responsible parties to act better and be more accountable for their activities. The majority of participants (90.45%) either strongly agree or agree that being transparent by sharing with project's parties a weekly update of all parties' performance information will help and motivate them to be more accountable for their activities. Using transparent environment in measuring performance information will enable all parties to follow up with their performance results to know there current status. Moreover, involved parties will act better accordingly to maintain competent performance results as it will be available to all parties involved in the project. Whenever metrics are kept, and transparency is created, project parties will be motivated to improve their performance.

According to the respondents' views, project contract should include the project plans that include all project activities of all parties. The majority of participants (95.24%) either strongly agree or agree that the addition of projects plans that include all parties' activities in the project contracts will help the parties to comply with their

responsibilities. Another statement was assessed by respondents about the systematic procedure of the weekly reports and who should prepare the weekly report and how it can be checked and reviewed. 84.36% of respondents either strongly agree or agree the contractor who is doing the work is the best party that can prepare the weekly reports to mitigate and measure the project activities and risks and client or consultant can review the report. In this scenario, the client's PMs or consulting engineers can ensure that contractors are keeping measurement of project performance which can be used as a quality assurance process which is important to make sure contractors are performing the quality control process of project activities and risks to minimize time and cost deviations.

Finally, the participants' views of this approach of managing risks through the identification and then mitigation of activities and risks of other parties were identified. The majority of participants (94.56%) either strongly agree or agree that the identification and mitigation of project parties' risks by the contractor (by knowing how they will manage or minimize the risks) will help in reducing risks' affects. Furthermore, 88.44% of respondents either strongly agree or agree that if the contractor includes all activities and risks out of contractor's control in the plan and measures all parties' performance during projects, this will minimize disputes during project execution. In the conclusion, the participants agreed that this approach of managing risks and measuring performance will increase the performance of the project as 91.15% of respondents either strongly agree or agree that if the contractor makes a milestone schedule for project plan from

beginning to end that includes risks and activities of all stakeholders and measures all parties' performance during projects, this will increase the performance of the project.

Overall, table 18 provides the results of the descriptive statistics for the contractors' views towards the new risk mitigation approach. The table shows the analysis of samples response using the concept of weighted mean and standard deviation. The results indicate that the statement represented by question no. 1 (the existence of an expert project manager with the contractor (who can plan project from start to end and can identify all activates out of contractor control) is essential to the success of project) has recorded the greatest mean (4.82) while the statement represented by question no. 8 (the contractor who is doing the work is the best party that can prepare the weekly reports to mitigate and measure the project activities and risks and client or consultant can review the report) has ranked the last order as it recorded the minimum mean (4.19). All other values ranged between these two values.

Table 18

Descriptive statistics for the contractors' perceptions of the new approach in mitigating risks out of contractors' control

No.	Question	%					Mean	sd
		Strongly agree	Agree	Not sure	Disagree	Strongly disagree		
1	The existence of an expert project manager with the contractor (who can plan project from start to end and can identify all activates out of contractor control) is essential to the success of project.	85.03	13.61	0.00	1.36	0.00	4.82	0.48
2	When contractors make a milestone schedule for a project, they should identify and include all risks and activities of client and other related parties in the plan.	53.74	36.05	6.80	2.72	0.68	4.39	0.79
3	Following up with risks and activities of project parties by reminding them what, when, and how to manage them, would help responsible parties to act better to perform their tasks.	53.74	38.10	5.44	2.72	0.00	4.43	0.72
4	Being transparent by sharing with project's parties a weekly update of all upcoming activities and risks that need to be managed will help and motivate those responsible to be more accountable for their activities.	54.42	38.78	4.76	1.36	0.68	4.45	0.71
5	Identifying activities' deviations from the planned schedule and cost, explaining why the deviation occurred and identifying the responsible party would help in measuring all parties' performance.	40.14	49.66	7.48	2.04	0.68	4.26	0.74
6	Being transparent by sharing with project's parties a weekly update of all parties' performance information will help and motivate them to be more accountable for their activities.	44.90	45.58	6.80	2.72	0.00	4.33	0.72
7	The addition of projects plans that include all parties' activities in the project contracts will help the parties to comply with their responsibilities.	62.59	32.65	4.08	0.68	0.00	4.57	0.61
8	The contractor who is doing the work is the best party that can prepare the weekly reports to mitigate and measure the project activities and risks and client or consultant can review the report	46.26	38.10	6.80	6.80	2.04	4.19	0.97

9	The identification and mitigation of project parties' risks by the contractor (by knowing how they will manage or minimize the risks) will help in reducing risks' affects.	45.58	48.98	4.08	1.36	0.00	4.39	0.63
10	If the contractor makes a milestone schedule for project plan from beginning to end that includes risks and activities of all stakeholders and measures all parties' performance during projects, this will increase the performance of the project.	54.42	36.73	7.48	1.36	0.00	4.44	0.69
11	If the contractor includes all activities and risks out of contractor's control in the plan and measures all parties' performance during projects, this will minimize disputes during project execution.	44.90	43.54	8.16	2.72	0.68	4.29	0.78

Risks Out of Contractors' Control Mitigation Model

The developed risk mitigation model shown in figure 16, focuses on increasing accountability of project parties through mitigating parties' activities and risks with measuring their deviations (time and cost) and identifying sources of deviations. Transparency is utilized in the model through sharing weekly updates of the activities and risks combined with updated information of performance measurements of project parties. The practical framework in mitigating risks out of contractors' control consists of a Weekly Risky Report (WRR) that includes a project activities schedule & milestones table that identifies project activities with their responsible party, percentage of completion, and deviation from the planned schedule. Secondly, the WRR includes a project risks deviations table that identifies the plan to minimize risk deviation, effect of risk on the planned schedule and budget, explaining why the deviation occurred and identifying the responsible party. Finally, the WRR includes a performance measurement table which identifies the performance measurements of project and project parties based on deviations from the planned schedule and budget. The contractor is responsible for

maintaining the WRR and sending it out weekly to project parties. The client's project manager or consulting engineer would be used to ensure that contractor is keeping the dominant performance information of time and cost deviations along with explaining the risk, why it occurred, and identifying the responsible party.

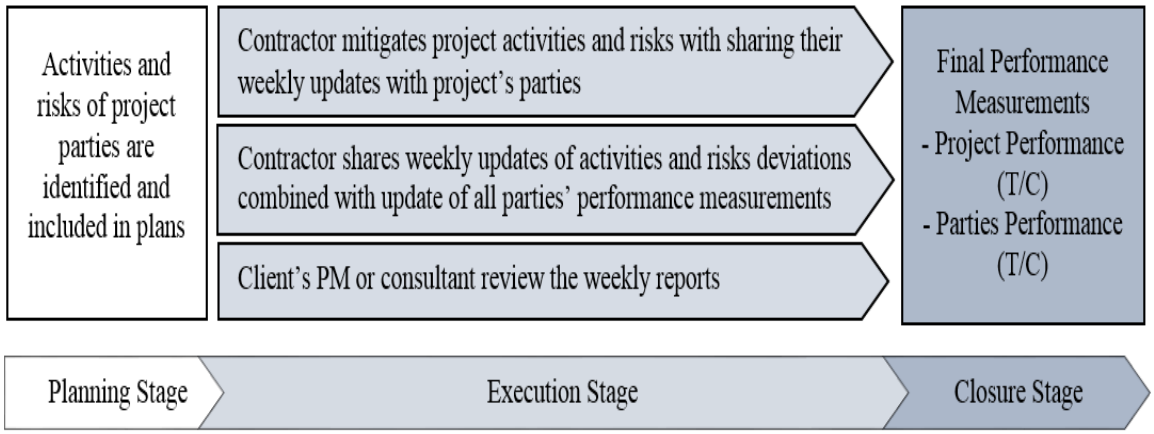

Figure 16: Risks out of contractors' control mitigation model

The general contractor who is responsible for the work should clarify the work plan before the project starts with providing the following:

1. A detailed milestone schedule for all project parties' activities with milestones represented by time and completion metrics.

2. The identification of risks that are out of the contractor control (related to other parties), and the risk mitigation plan.

3. The contractor will then create the Weekly Risk Report (WRR) on an Excel sheet and it should be included as a part of the contract.

The Weekly Risk Report (WRR)

The Weekly Risky Report (WRR) is an excel file that must be submitted every week through project closeout. The WRR is used as a performance tool which measures all deviations from a project's initial contract schedule and cost. The WRR must be reviewed by a client representative or project consultant each week. The contractor is responsible for maintaining the WRR and sending this out weekly to all project parties through email. Client representative or consultant, are responsible for validating all information contractor has inputted into WRR. In this procedure, the client's project manager or consulting engineer should ensure that the contractor is keeping the dominant performance information of activities and risks time and cost deviations along with explaining the risk, why it occurred, and identifying the responsible party. This quality assurance process is important to make sure that the contractor is performing the quality control process and risk mitigation to minimize all project parties' activities and risks deviations.

Weekly Risk Report Content

Contract Information Table

The first sheet of the WRR presents general information about the project which include the title of the project, name of project owner, name of the main contractor who is responsible for the work, contact information and numbers of owner and contractor project managers, date of awarding project and the initial contract cost and duration.

Schedule & Milestones Table

The schedule and milestones table shown in table 19, is the schedule of the entire project that include all project parties' activities. The schedule and milestones table should include the following:

- **Activity:** List of all key activities of all project parties to track the status of the project.
- **Entity Responsible:** Entity who is responsible for the activity (Client, Contractor, Consultant, Designer, other).
- **% Complete:** Percent complete of corresponding activity. This should be updated weekly.
- **Initial Schedule:** The initial contract schedule awarded to the project from beginning to end. This should exclude all modifications and should never change throughout the project.
- **Actual Schedule:** The current live schedule adjusted according to known delays. This should be accurate and complete from beginning to end of project at all times.
- **Risk #:** Number of risk on the deviations table associated with the deviation of corresponding activity.

Table 19

Project activities schedule & milestones table

Milestone Schedule						
#	**Activity**	**Responsible Entity**	**% Complete**	**Initial Schedule**	**Actual Schedule**	**Risk #**
1	Milestone 1	Name	%	Date	Date	
2	Milestone 2	Name	%	Date	Date	
3	Milestone 3	Name	%	Date	Date	#
4	Milestone 4	Name	%	Date	Date	
5	Milestone 5	Name	%	Date	Date	

Project Deviations Table

A deviation is considered to be any event (activity or risk) which causes the project to deviate from initial contract costs or dates. Each event which causes deviation should be listed as a separate item and be approved by the client with correct documentation. The project deviation table is shown in table 20.

- **Date Entered:** Initial date that the event was entered into the WRR, not the date of occurrence.
- **Plan to Minimize Risk:** Brief description of deviation which should include why the deviation occurred, how to minimize the deviation, and the responsible party for the deviation.
- **Date Resolved:** Date deviation is resolved.
- **Impact to Days and Cost:** Actual impact the deviation caused the project to deviate from original dates and cost. Contractor should give an estimated impact to cost and

days until actual final impact is known. (If a modification is not awarded or risk causes no deviation to project, the impact should be placed at 0.)

- **Entity Responsible:** Entity who is responsible for the occurrence (Client, Contractor, Consultant, Designer, External). However, the contractor is still the one responsible to resolve that risk.

Table 20

Project deviations table

#	Date Entered	Plan to Minimize Deviation	Date Resolved	Impact to days	Impact to Cost	Entity Responsible
0	Date	**(1)** Problem background - Why is this a risk for the project? **(2)** What will be done to minimize this? **(3)** Who is responsible for the plan?	Date	# of Days	SR	Cl/Cont/Const/Des/Ext
1	Date	Risk assessment and mitigation description	Date	# of Days	SR	Name
2						
3						
4						
5						

Performance Table

The performance table shown in table 21, provides an overview of the project's progress that is easy to view. This increases transparency and allows the owner and related parties to understand what is going on regarding the project at all times. The table is automatically calculated based off of the numbers in other sections of the Weekly Risk Report and these numbers should not be adjusted.

Table 21

Performance Table

Budget	
Initial Contract Awarded Cost	SR
Current Estimated Budget	**SR**
$ Over Budget	**SR**
$ Due to Client	SR
$ Due to Contractor	SR
$ Due to Consultant	SR
$ Due to Designer	SR
$ Due to External	SR
% Over Budget	**%**
% Due to Client	%
% Due to Contractor	%
% Due to Consultant	%
% Due to Designer	%
% Due to External	%

Schedule	
Initial Contract Start Date	Date
Initial Contract Completion Date	Date
Current Completion Date	**Date**
Days Delayed	**# of Days**
Days to Client	# of Days
Days to Contractor	# of Days
Days to Consultant	# of Days
Days to Designer	# of Days
Days to External	# of Days
% Over Schedule	**%**
% Due to Client	%
% Due to Contractor	%
% Due to Consultant	%
% Due to Designer	%
% Due to External	%

Chapter Conclusion

In the first part of the chapter, the analysis of the collected data showed the current approach of mitigating risks applied by contractors in the Saudi construction industry and their perceptions towards their current risk mitigation practices. According to contractors' views, the activities of other parties in projects (out of contractors' control) should be dealt with as risks as according to their views these activities and risks that are out of contractors' control are a leading cause of low performance in projects in Saudi Arabia. However, after the analysis of the contractors' current approach in mitigating these risks, results showed that most of the contractors in their current risk mitigation practices do not include the risks and activities out of their control in their

plans and do not mitigate them throughout project phases. Furthermore, considerable percentage of contractors do not measure the risks and activities of all parties in projects and most of the contractors do not share the measurement information periodically with all parties in projects.

The survey results showed that the contractors' current risk mitigation practices are not effective in minimizing risks because they do not identify and mitigate risks and activates of other parties (out of contractors' control) in projects. In addition, the contractors' current performance measurement practices are not effective measuring performance of all parties. According to the majority of the participated contractors in the study, there is a need for a proactive risk mitigation practices that identifies and mitigates activates out of contractors' control in projects and there is a need for performance measurement system that identifies all parties' performance in projects to differentiate the actual contractors' performance from others' risks and performance.

In the second part of the chapter, the contractors' perceptions of the new approach in mitigating risks out of contractors' control were identified. The analysis of the collected data showed that performance of projects can be increased if contractors shift their focus from only managing their own activities and risks to managing all project parties' activities and risks. According to contractors' views, the existence of an expert project manager with the contractor who can identify and plan project activities and risks of all parties (out of contractor scope) is essential to the success of project. These activities and risks should be identified and included in project plans and added to project contract to help the parties to comply with their responsibilities. According to the

majority of the participated contractors in the study, accountability of project parties increases when contractors mitigate and measure activities and risks deviations with identifying sources of deviations. Furthermore, accountability also increases when transparency increases through sharing weekly updates of upcoming activities and risks with project parties combined with the updated information of performance measurements of the activities and risks with updating project parties' performance information.

According to the study results, the contractor is the best party that can prepare the weekly reports to mitigate and measure the project activities and risks and client or consultant can review the report. In this procedure, the weekly report will be maintained and distributed by the contractor and monitored by the client and the consultant. The client's project manager or consulting engineer would be used to ensure that the contractor is keeping the dominant performance information of time and cost deviation along with explaining the risk, why it occurred, and identifying the responsible party. This quality assurance process is essential to make sure vendors are performing the quality control process and risk management that can minimize deviations.

The developed model focuses on increasing accountability of project parties through mitigating parties' activities and risks with measuring the activities and risks deviations (time and cost) and identifying sources of deviations. Transparency is utilized in the model through sharing weekly updates of the activities and risks combined with updated information of performance measurements of all project parties. The practical framework in mitigating risks out of contractors' control consists of a Weekly Risky

Report (WRR) which is used as a performance tool which measures all deviations of all parties' activities and risks from a project's initial contract schedule and cost. The contractor is responsible for maintaining the WRR and sending it out weekly to all project parties and client representative or consultant, are responsible for validating all information. This quality assurance process is important to make sure that the contractor is performing the quality control process and risk mitigation to minimize all project parties' activities and risks deviations. The analysis of the study results showed that project risks will be minimized and performance of projects will be increased if contractors shift their focus using the new model from only managing their own activities and risks to managing all project parties' activities and risks. In addition, in this paradigm shift, disputes during project execution will minimized when activities and risks out of contractors' control are included in project plan, mitigated, and measured.

CHAPTER 6

CONCLUSIONS

CONCLUSION

The Saudi Arabian construction industry has suffered from non-performance and inefficiencies for the past 30 years. The traditional risk management practices in the Saudi construction industry have been ineffective at helping contractors deliver projects on time and within budget while meeting quality expectations. Recent studies have identified ownership of parties who cause risks and lead to low performance in the Saudi construction industry. These studies identified that contractors are not the main party that cause risks as owners, consultants, and other parties have the major share of causing risks in the industry. However, with the identification that risks out of contractors' control (caused by other parties) are a leading cause of low performance, there is a lack of efficient risk mitigation practices by contractors in Saudi to manage these risks. This dissertation aimed to assess the current practices applied by contractors to minimize risk out of their control and develop a risk mitigation model for contractors who work in public construction projects in Saudi Arabia to mitigate risks out of contractors' control. In order to achieve the aim of the study, following objectives were set up:

Objective 1: Investigate the risks that are out of contractors' control (caused by other parties) in the context of the Saudi construction industry

The risks that are out of contractors' control (risks caused by other parties) in the context of the Saudi construction industry have been investigated and the study reported

an up-to-date ranked list of risks that are out of contractors' control. Thirty six risk factors that are out of contractors' control were identified through literature review and a pilot study and the risks were assessed based on their importance and occurrence in the industry.

The study identified that the top risks that are out of contractors' control in public construction projects in Saudi Arabia are: delay in progress payments by owner, owners' practice of assigning contracts to lowest bidder, slow decision making by the owner, change orders by owner during construction, excessive bureaucracy in the owner's administration, delay in approving major changes in the scope of work by consultant, and external work due to public agencies (roads, utilities and public services). The comparison results of the overall top ranked risks and the results of risks ranking in the three main provinces in Saudi Arabia showed similar results in only the top two ranked risks which are delay in progress payments by owner and owners' practice of assigning contracts to lowest bidder. Similarly, the comparison results of the overall top ranked risks and the results of risks factors rankings in five fields of projects showed similar results in only the top three ranked risks. The study results give a general idea about what are the risks out of contractors' control and what are their importance in the Saudi construction industry.

Objective 2: Assess the current practices applied by contractors to minimize risks out of their control by evaluating the contractors' current risk mitigation and performance measurement practices.

This study assessed the current approach in mitigating risks applied by contractors who work in public construction projects in the Saudi construction industry and the contractors' perceptions towards their current risk mitigation practices were identified. According to contractors' views, the activities of other parties in projects (out of contractors' control) should be dealt with as risks as according to their views these activities and risks that are out of contractors' control are a leading cause of low performance in projects in Saudi Arabia. However, after the analysis of the contractors' current approach in mitigating these risks, results showed that most of the contractors in their current risk mitigation practices do not include the risks and activities out of their control in their plans and do not mitigate them throughout project phases. Furthermore, considerable percentage of contractors do not measure the risks and activities of all parties in projects and most of the contractors do not share the measurement information periodically with all parties in projects.

The survey results showed that the contractors' current risk mitigation practices are not effective in minimizing risks because they do not identify and mitigate risks and activates of other parties (out of contractors' control) in projects. In addition, the contractors' current performance measurement practices are not effective measuring performance of all parties. According to the majority of the participated contractors in the study, there is a need for a proactive risk mitigation practices that identifies and mitigates

activates out of contractors' control in projects and there is a need for performance measurement system that identifies all parties' performance in projects to differentiate the actual contractors' performance from others' risks and performance.

Objective 3: Develop a risk out of contractors' control mitigation model and identify the contractors' perceptions of new risk mitigation approach.

The developed model focuses on increasing accountability of project parties through mitigating parties' activities and risks with measuring the activities and risks deviations (time and cost) and identifying sources of deviations. Transparency is utilized in the model through sharing weekly updates of the activities and risks combined with updated information of performance measurements of all project parties. The contractors' perceptions of the new approach in mitigating risks out of contractors' control were identified. The analysis of the collected data showed that performance of projects can be increased if contractors shift their focus from only managing their own activities and risks to managing all project parties' activities and risks. According to contractors' views, the existence of an expert project manager with the contractor who can identify and plan project activities and risks of all parties (out of contractor scope) is essential to the success of project. These activities and risks should be identified and included in project plans and added to project contract to help the parties to comply with their responsibilities. According to the study results, accountability of project parties increases when contractors mitigate and measure activities and risks deviations with identifying sources of deviations. Furthermore, accountability also increases when transparency

increases through sharing weekly updates of upcoming activities and risks with project parties combined with the updated information of performance measurements of the activities and risks with updating project parties' performance information.

According to the study results, the contractor is the best party that can prepare the weekly reports to mitigate and measure the project activities and risks and client or consultant can review the report. In this procedure, the weekly report will be maintained and distributed by the contractor and monitored by the client and the consultant. The client's project manager or consulting engineer would be used to ensure that the contractor is keeping the dominant performance information of time and cost deviation along with explaining the risk, why it occurred, and identifying the responsible party. This quality assurance process is essential to make sure vendors are performing the quality control and risk management that can minimize deviations.

The practical framework in mitigating risks out of contractors' control consist of a Weekly Risky Report (WRR) which is used as a performance tool which measures all deviations of all parties activities and risks from a project's initial contract schedule and cost. The contractor is responsible for maintaining the WRR and sending it out weekly to all project parties and client representative or consultant are responsible for validating all information. This quality assurance process is important to make sure that the contractor is performing the quality control and risk mitigation to minimize all project parties' activities and risks deviations. The analysis of the study results showed that project risks will be minimized and performance of projects can be increased if contractors shift their focus using the new model from only managing their own activities and risks to

managing all project parties' activities and risks. In addition, in this paradigm shift, disputes during project execution will minimized when activities and risks out of contractors' control are included in project plan, mitigated, and measured.

Based on the study results, it is recommended for contractors to identify and assess all risks out of their control before starting projects to include them in projects plans. This will help in knowing how to reduce the effects of these risks and to measure responsibility for any adverse results. Further research can be performed to investigate the risks out of contractors' control in specific types of projects with evaluating the level of effect of all parties on projects. The author recommends implementing the developed model in actual case studies to test and evaluate its practical significance to the current environment in the Saudi construction industry. Further research can be performed through identifying the level of impact of the developed model on each risk out of contractors' control and the level of impact of the model on the project parties' performance and overall projects' performance.

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APPENDIX A

SURVEY 1: ASSESSMENT OF RISKS OUT OF CONTRACTORS' CONTROL

Q: Please rate each risk according to its frequency of occurrence on public projects and its degree of impact (severity) on public projects' cost and time:

Risk Factor	Frequency	Severity
5 Point Scale	Always, Often, Sometimes, Rarely, and Never	Extremely sever, Sever, Moderate, Low, and None
1- Owner's related risks		
Delay in progress payments by owner		
Owners' practice of assigning contracts to lowest bidder		
Slow decision making by the owner		
Change orders by owner during construction		
Excessive bureaucracy in the owner's administration		
Delay in approving shop drawings and sample materials		
Owner's team lack of experience		
Owner's poor coordination with the construction parties and government authorities		
Changes in specifications during construction		
Unrealistic contract duration		
Interference by owner in the construction operations		
Additional work due to changes in the scope of the project		
Difficulties in obtaining work permits		
Poor site conditions		
Delay to furnish and deliver the site to the contractor by the owner		
Contract breaching by client		
2- Consultant and designer related risks		
Delay in approving major changes in the scope of work by consultant		
Consultant's lack of experience		
Design changes		
Delay in performing inspection and testing by consultant		
Delay in reviewing and approving design documents by consultant		

Poor communication and coordination by consultant engineer		
Mistakes in design		
Unclear and inadequate drawings and specifications		
Delays in producing design documents by designer		
The duration of the consultant contract does not match the duration of the project		
3- External risks		
External work due to public agencies (roads, utilities and public services)		
Cost fluctuation of labor and material during construction		
Shortage of manpower		
Availability of construction material		
Delays in disputes resolution		
Changes in government regulations and laws		
Effects of subsurface conditions (e.g., soil, high water table, etc.)		
Shortage of equipment required		
Adverse weather conditions		
Wars in region		

APPENDIX B

SURVEY 2: ASSESSMENT OF CONTRACTORS' PRACTICES TOWARDS RISKS OUT OF THEIR CONTROL

Q: Based on your experience in public projects, please rate the following statements using the scale below:

No.	Question	Agree	Not sure	Disagree
1	In early stages of projects, we as a contractor identify all of our activities and risks in the project plan.			
2	In early stages of projects, we as a general contractor identify all of other parties' activities and their related risks such as activities of project owner or consultant.			
3	Your company's approach in managing risks, does not mitigate risks and activates of other parties throughout the project phases.			
4	Your company measures and tracks its performance during projects phases based on time & cost deviations.			
5	Your company measures the performance all parties in projects (i.e. client and consultant's performance) during projects phases based on time & cost deviations.			
6	Your company shares the measurement information of all parties' performance periodically with all parties involved in projects			

No.	Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
1	Activities of other parties in projects (activities out of contractor's control) are risks to the project if they are not done as expected.					
2	Risks and activities that are out of contractor's control (generated by other parties) are a leading cause of low performance in projects in Saudi Arabia.					
3	The contractors' current risk mitigation practices are not effective in minimizing risks because they do not identify and mitigate risks and activates of other parties (out of contractors' control) in projects in SA.					
4	There is a need for a proactive risk mitigation practices that identifies and mitigates activates out of contractors' control in projects in SA.					

5	There is a need for a performance measurement system that identifies all parties' performance in projects to differentiate the actual contractors' performance from others' risks and performance.					

APPENDIX C

SURVEY 3: DEVELOPMENT OF CONTRACTORS' PRACTICES TOWARDS RISKS OUT OF THEIR CONTROL

Q: Based on your experience in public projects, please rate the following statements using the scale below:

No.	Question	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
1	The existence of an expert project manager with the contractor (who can plan project from start to end and can identify all activates out of contractor control) is essential to the success of project.					
2	When contractors make a milestone schedule for a project, they should identify and include all risks and activities of client and other related parties in the plan.					
3	Following up with risks and activities of project parties by reminding them what, when, and how to manage them, would help responsible parties to act better to perform their tasks.					
4	Being transparent by sharing with project's parties a weekly update of all upcoming activities and risks that need to be managed will help and motivate those responsible to be more accountable for their activities.					
5	Identifying activities' deviations from the planned schedule and cost, explaining why the deviation occurred and identifying the responsible party would help in measuring all parties' performance.					
6	Being transparent by sharing with project's parties a weekly update of all parties' performance information will help and motivate them to be more accountable for their activities.					
7	The addition of projects plans that include all parties' activities in the project contracts will help the parties to comply with their responsibilities.					
8	The contractor who is doing the work is the best party that can prepare the weekly reports to mitigate and measure the project activities and risks and client or consultant can review the report					
9	The identification and mitigation of project parties' risks by the contractor (by knowing how they will manage or minimize the risks) will help in reducing risks' affects.					

10	If the contractor makes a milestone schedule for project plan from beginning to end that includes risks and activities of all stakeholders and measures all parties' performance during projects, this will increase the performance of the project.					
11	If the contractor includes all activities and risks out of contractor's control in the plan and measures all parties' performance during projects, this will minimize disputes during project execution.					