KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

CONSTRUCTION ENGINEERING & MANAGEMENT

CEM 520: CONTRACTING

ASSESSMENT OF RISK MANAGEMENT PERCEPTIONS AND PRACTICES OF CONSTRUCTION CONTRACTORS IN SAUDI ARABIA

BY

Talal Al-Hawsawi
Mansour Al-Afaliq
Hani Al-Mofarej
Hussain Al-Rukhaimi

To

Dr. Saadi Assaf

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CHAPTER ONE

INTRODUCTION

1.1 GENERAL

The construction process is one of the most risky and challenging industries. Risk in construction cannot be eliminated but can be managed once taken. It can be controlled, minimized, transferred or shared.
Construction requires the application of different types of resources to see a finished facility such as a multi-story building, a processing plant, an airport or even a small room. These resources might include manpower, equipment and tools, money, time and basic construction materials. Each of these resources has some risks associated with it.

1.2 CHARACTERISTICS OF THE REGION

The Eastern Province of Saudi Arabia is characterized by its unique environmental conditions and industry growth that should be considered in assessing the construction risks, allocating these risks and selecting the appropriate risk management approaches. This region is characterized by high temperatures and humidity conditions as well as large variation in the diurnal and seasonal temperature and humidity. The temperature can reach up to 50 "C and can vary by as much as 20 "C between day and night during a typical summer day and the relative humidity ranges from 40% to 100%. These sudden and continuous variations in the temperature and humidity affect the construction workers' productivity and this directly affects the project schedule and work quality which in turn affects the project cost and increases risks. This unique characteristic of the region should be considered in the safety/ hazards as well as in the schedule / cost estimates of a project to minimize the associated risks.

1.3 PROBLEM STATEMENT

This study is to shed some light on the perception and attitude of the typical construction contactor in the Eastern Province of Saudi Arabia towards construction risks. It is mainly concerned with the allocation of risks, risk importance and their effects on the project as well as the improvements of the understanding by local contractors of risks related to the construction industry.

1.4 RESEARCH OBJECTIVES

The objective is to investigate the assessments and management of construction risks. In particular, the research will:
1st. Present the perception and attitude of the typical construction contractor in the Eastern Province of Saudi Arabia towards construction risks. It is mainly concerned with the allocation of risks, risk importance and their effects on the project.

2nd. Compare the perception of the typical local construction contractor towards allocation of construction risks to the common practice of allocating these risks.

1.5 RESEARCH SCOPE AND LIMITATIONS

Although this research will be done in the Eastern Province of Saudi Arabia, the results and conclusions can be applied to the construction industry in other areas of Saudi Arabia because of the similarities of the rules, regulations and business environment. Moreover, most of the large construction contractors have offices in other areas of Saudi Arabia.
Because of the above reasons and for the purpose of this study, the words Easter Province of Saudi Arabia and Saudi Arabia will be used interchangeably.

This research will be limited to:

A. Medium to large construction contractors (Grades 1 or higher) per the classification of the Chamber of Commerce, Saudi Arabia Eastern Province Branch.

B. Limited to the construction contractors in the Eastern Province of Saudi Arabia.

C. Limited to general contractors lump sum type of construction contracts.

1.6 SIGNIFICANCE OF THIS STUDY

The construction industry is subject to more risks and uncertainties than any other industry. Projects in construction involve hundreds or even thousands of interacting activities, each with cost, time, quality and sequencing problems. Each of these activities carries some risks and uncertainties and if these risks are not managed properly, losses will take place. To minimize these losses, risks and uncertainties must be identified, classified, analyzed and administered. The way these risks are allocated, their importance and their effects on the project will outline the best techniques to be used for managing risks associated with the construction industry.
As Risk assessment in construction in Saudi Arabia is a new concept, this study will shed some light on assessing the risk management practices of construction contractors in this part of the world. It will also
help the local contractors identify the best approach to dealing with these risks, to help contractors minimize losses and clients to save the extra costs of their projects by better understanding how these risks are allocated and dealt with.

CHAPTER TWO

LITERATURE REVIEW

2.1 OVERVIEW

This chapter summarizes the comprehensive literature review of the available work reported on the subject of risk management in the construction industry, and the allocation and importance of risks.

2.1.1 Definition of risk / risk management

The concept of risk can be applied to almost every decision-making action we take ranging from zero risk to full risk. For any decision we make, it should be based on three broad elements. These elements are:

- Certainty
- Risk
- Uncertainty

Certainty exists only when the decision -maker can specify exactly what will happen during the period of time covered by the decision. He is certain of the consequences and the outcome of that decision during that period of time. This type of confidence, of course, does not happen very often in a complex industry like construction industry.
Because risk is inevitable in almost every decision we make, different definitions are given to the word risk. Webster New Collegiate Dictionary defines the word risk as:" the possibility of loss or injury.

In other words, risk could be defined as a situation in which there is a lack of information / data or previous experience to that particular situation being considered by the decision-maker at that time.

While some authors and most people consider risk and uncertainty as two similar and synonymous terms, risk and uncertainty are two different terms meaning completely different issues. Flanagan, R. (1 999) states "There is a general consensus that a decision is made under risk when a decision- maker can assess, either intuitively or rationally, the probability of a particular event occurring".

In this section, risk and risk management is defined from the construction point of view. The following are some of these definitions:

1. Erikson (1979) defines risk in construction as: "Exposure to possible economic loss or gain arising from involvement in the construction process."

2. Jaafari and Schub (1990) define risk as: "The presence of potential or actual construction that could stand in the way of project performance causing partial or complete failure either during construction and commissioning or at the time of utilization".

3. Albahar and Crandall (1990) define risk as: "the exposure to the chance of occurrence of events adversely or favorably affecting project objectives as a consequence of uncertainty".

4. Kahkonen and Huovlla (1999) define systematic project risk management as "advanced preparation and decision making for minimizing the consequences of possible adverse future events and, on the contrary, to maximize the benefits of positive future events".

5. International Risk Management Institute, Inc. IRMl (1984 and 1995 supplement) defines risk management as "the process of identifying and analyzing risk, determining the most appropriate techniques for handling those risks, implementing the techniques, and monitoring the results. It differs from the old approach to managing these risks, frequently called insurance management, in that it recognizes that there are alternative techniques for handling these risks, that insurance is frequently the most expensive of all the available techniques, and that insurance should be used only as a last resort"

2.1.2 History of risk management in construction

The topic of risk management has been important ever since the early age of humans on earth. However, in my literature review I found that the actual term "risk analysis" first originated with Hertz (1964). He proposed simulation by utilizing the computer to derive the probability distribution of the rate of return of an investment project.

Risk management is not new, nor does it employ black box magical techniques. Traditionally it has been applied instinctively, with risks remaining implicit and managed by judgment, and informed by experience (Mills, 2001).
People tend to use their intuition, experience and judgment in making decisions in construction.

Zack (1996) states that, in the past, normal risks associated with construction contracts were primarily physical in nature. The risks of underground conditions, availability and productivity of labor, the effect
of weather, Both owners and contractors knew these risks.

But, according to Baker, Ponniah and Smith (1999), formal risk management in construction has become an integral process only in the past few decades due to the rapid advancement of technology. Risk and the management of risk, therefore have become a specialized subject in itself.

2.1.3 Current practice

Hayes (1986) state that the construction industry is one of the most dynamic, risky and challenging businesses. However, the industry has a very poor reputation for managing risk, with many major projects failing to meet deadlines and cost targets. This is influenced greatly by variations in weather, productivity of labor and plant, and quality of material. All too often, risks are either ignored, or dealt with in a completely arbitrary way, simply adding 10 per cent contingency onto the estimated cost of a project is typical.
According to Akintoye and MacLeod (1 997), construction risk is generally perceived as events that influence project objectives of cost, time and quality. Analysis and management of risk in construction depend mainly on intuition, judgment and experience. Because of the lack of knowledge and doubt on the suitability of risk analysis procedures, formal and systematic risk analysis and management procedures are rarely used in the construction industry.

Bing et al. (1999), state that a systematic approach to risk management is not a widely-spread practice in the construction industry due to the complex nature and involvements of this industry.

2.2 WHY RISK ASSESSMENT/SYSTEMATIC RISK MANAGEMENT IS NEEDED

We need to know the importance and benefits of systematic risk management in the construction industry.
According to Godfrey, (1996), the systematic risk management program helps to:

- Identify, assess, and rank risks, and make the risks explicit.
- Focus on the major risks of the project.
- Make informed decisions on the provision for adversity.
- Minimize potential damage should the worst happen.
- Control the uncertain aspects of construction projects.
- Clarify and formalize the company's role and the roles of others in the risk management processes.
- Identify the opportunities to enhance project performance.

Mills, (2001) states that systematic risk management is "expecting the unexpected-it is a tool which helps control risks in construction projects". And it has the following advantages:

- Questions the assumptions that most affect the success of your project;
- Concentrates attention on actions to best control risks;
- Assesses the cost benefit of such actions.

2.3 RISK MANAGEMENT PERCEPTIONS AND TRENDS IN CONSTRUCTION

2.3.1 Importance of Risks and Risks Allocation

Several studies have been conducted to identify the risk categories and to allocate the party lies responsible for each category, whether it is the owner, contractor or shared between the two parties. Strassman and Wells (1988) have identified several risk factors associated with construction.

From a client's perspective, these risks are:

1. Costs will escalate unpredictably

2. Structure will be faulty and need frequent repairs

3. The project will simply be abandoned and partially paid for but incomplete and useless.

Similarly, from a contractor's point of view the risk factors are:

1. Fears of inclement weather
2. Delays in site availability
3. Unforeseen subsoil conditions
4. Inadequate detail drawings
5. Late material deliveries
6. Unanticipated price changes
7. Faulty subcontracting
8. Unproductive labor and strikes

Another study by the American Society of Civil Engineers (ASCE) was made in 1979 to identify risk and the allocation of each risk category.

In a risk identification and allocation survey of the top 100 large USA construction contractors by Kangary, R. (1 995), respondents were asked to identify the importance of risks associated with construction from the owner's and the contractor's perspective. Also, they were asked to place these risks into three allocations. Allocated to the owner, construction contractor, or shared between the two parties. The importance of risks to each party is shown in Table 2.1 and the allocations of risks are shown in Table 2.2.

Table 2. 1: Risk Importance

Level of importance	Risk Description
Most important	Safety
	Quality of work
	Defective design
	Labor and equipment productivity
	(tie) Contractor competence /delayed payment
Least important	Change in government regulations
	Acts of God
	Defective engineering
	(Tie) Permits and ordinances/ inflation

Source: Kangari (1995)

Table 2. 2: Risk Allocations

Risk allocation	Risk description
Contractor	Labor and equipment productivity
	Quality of work
	Labor, equipment, and material availability
	Safety
	Defective material
	Contractor competence
	Inflation
	Actual quantities of work
	Labor dispute
Owner	Differing site condition
	Defective design
	Site access/right of way
	Permits and ordinances
	Change in government regulations
	Delayed payment on contract
	Changes in work
Shared	Financial failure-any party
	Change-order negotiations
	Indemnification and hold harmless
	Contract-delay resolution
Undecided	Act of God
	Third-party delays
	Defective engineering

Source: Kangari (1995)

2.3.2 Contingency / Risk Perspectives

Construction contractor contingency can be thought of as a contractor's estimate of the extraordinary risks or losses they will encounter in the project. These would be risks not covered by bonds, insurance or by the contract and they are uncertain. For examples, unforeseen conditions. Modern estimating textbooks usually represent the contractor's contingency as a fixed percentage of the direct cost. Generally the percentage reported is around 5-10 % of the contract value. This percentage is greatly affected by external factors such as the market, competitions and on-hand projects.

Smith, G. And Bohn, C., (1999) concluded from their investigation that contractors had no knowledge of formal modeling techniques published on risk models. Where contingency was included in contracts, the construction managers used a percentage of the total cost approach based on their intuition and previous contract knowledge.

2.4 RISK CLASSIFICATIONS

Jaafari and Schub (1990) classify risks as technical risks and technological risks. Technical risks are those related to the fundamental properties, processes and concepts such as failure of an earth dam embankment in operation due to the overestimating of the shear strength of the structure.

Technological risks are those related to plant and manufacturing and construction processes, state of hardware and the like. Failure of a construction method to achieve its production level is an example of technological failure.
Al Bahar and Crrandal (1990) propose classification of risks that classifies the potential risks according to their nature and potential consequences. Their classification scheme is composed of six categories. They are:

(1) Acts of God
(2) Physical
(3) Financial and economics
(4) Political and environmental
(5) Design
(6) Construction related risks.

Farquharson J.A (2000) classifies risk assessment analysis as qualitative (i .e.,what-if/ checklist analysis) and quantitative analysis. The qualitative analysis is often sufficient for making good decisions about the allocation of resources for safety improvement which in turn results in reliability and cost saving. But project managers and contractors also "seek quantitative -direct- cost/ benefit information upon which to base their decisions, they increasingly turn their attention to the use of a more detailed analysis technique (quantitative risk assessment)".
For Farquharson, the process of risk analysis includes answering three questions:
1. What can go wrong?

2. How likely is it?
3. What are the impacts?

Assaf and Jannadi (1994) classify risk into two types pure and speculative risks. "There are two types of risk that contractors need to manage. These are pure and speculative risks. Speculative risks expose the risk taker to either profit or loss"

Flanagan, R... (1999) suggests three ways of classifying risk "by identifying the consequence, type and impact of risk" as shown in Figure 2.2.

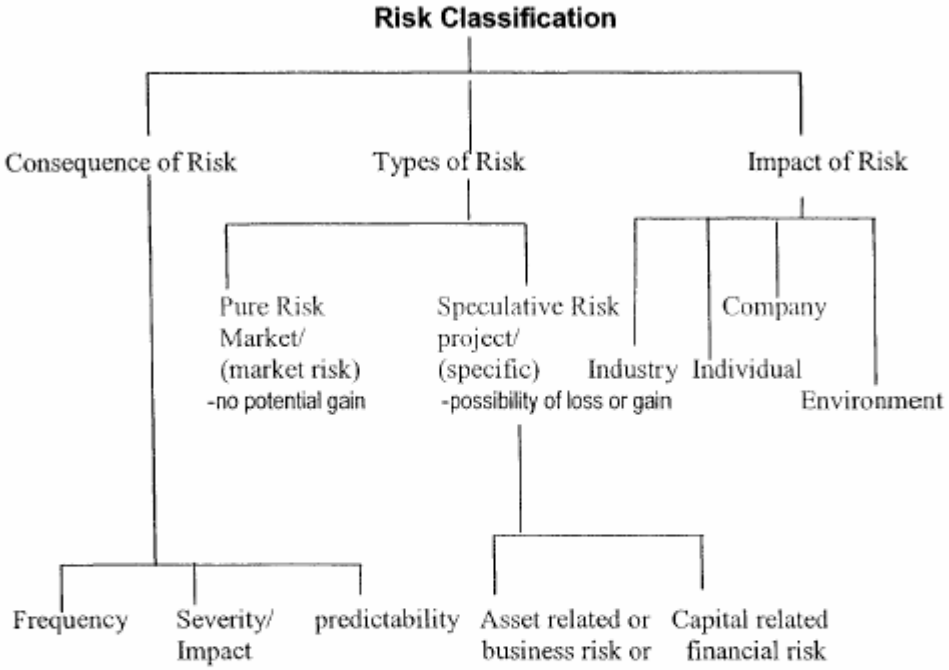

Figure 2. 2: Risk Classification

Source: Flanagan (1999)

2.5 RISK ANALYSIS AND RISK MANAGEMENT

In the construction industry, paying attention to risk is essential to ensure completing the project on time, on budget and with a good quality end product. The management of risks in the construction industry is a central issue for the success or failure of any project. Is it enough to be aware of risks or should we try to quantify them, analyze them and manage them?

However, analysis and management of risk in the construction industry are not well developed. Almost all parties (designers, owners and contractors) involved in this industry approach risk analysis and management from individual intuition, judgment, and experience gained from previous contracts.

Assaf (1982) proposes a systematic approach for the management of pure risk. It includes:

1. Risk identification by either financial statements, flow chart, questionnaire and checklist; or a combination of them.
2. Analysis of risk treatment alternatives by either risk control, avoidance, retention or risk transfer.
3. Risk administration by either the contractor agency or an outside agency.

Perry and Haynes (1985) have suggested a simple and systematic approach for construction management, which consists of three stages:

1. Risk identification
2. Risk analysis
3. Risk response.

Nummedal et al. (1 996), Eloff et al. (1 993) and the British Standards BS 8444 (BSI, 1996) propose five steps to manage risks. These systematic five steps used for a comprehensive risk management procedure are:

1. Risk Identification.
2. Risk Estimation.
3. Risk Evaluation.
4. Risk Response.
5. Risk Monitoring

Risk analysis is an integral part of the risk management system or program. It gives an insight into what happens if the project does not proceed according to plan. There are many theories that can be utilized to analyze risks including a decision tree, decision tables, utility theory, game theory, simulations and an AHP model. But, no matter how good the analytical techniques, it is the application and interpretations of results by the professional that determines the success of the system.

2.6 RISK RESPONSE

Pundist has argued that there are four ways to deal with risk in the construction industry:

1- "The umbrella approach" where you account for every possible eventuality by adding a large premium to the price. This will increase the bidding price and eventually lead to few contracts.

2- "The Ostrich approach" where you bury your head in the sand and assume everything will be alright, and that somehow you will manage.

3- "The intuitive approach" where you only depend on intuition and gut feeling, ignoring any formal analysis.

4- "The brute force approach" where you focus on the uncontrollable risks and say that you can force them to be controlled, which of course they cannot be.

2.6.1 Risk Retention

Risk retention is sometimes called risk absorption. Risks that produce small and repetitive losses that can be best controlled should be retained.

2.6.2 Risk Reduction

Risk reduction is sometimes called risk control. Usually risks related to safety can be reduced. First, is the education and training programs. Second, is the physical protection of people and equipments. Third, are the consistent company's systems and procedures.

2.6.3 Risk Transfer

Transferring risk shifts the risk to another party to deal with it.

2.6.4 Risk Avoidance

Risk avoidance is sometimes called risk elimination. There are other ways of eliminating risks like pre-contract negotiation or including exemption clauses in the contract.

CHAPTER THREE

RESEARCH DESIGN

3.1 INTRODUCTION

This section clarifies the selected strategies for conducting the research, the type of data required and the techniques for collecting the data.

3.2 RESEARCH METHODOLOGY

The research methodology will include the following essential six steps:

Step One	:	A comprehensive literature review
Step Two	:	Definition of important risk parameters and categories
Step Three	:	Design of a questionnaire
Step Four	:	Data was collected and compiled
Step Five	:	Collected data was analyzed.
Step Six	:	Results from the analyzed data were summarized and presented
Step Seven	:	Conclusion of the research, recommendations and suggestions

3.3 DESIGN OF QUESTIONNAIRE

The questionnaire contains 31 short and straight-forward questions. The questionnaire includes two sections. The first section will provide general information about the construction contractor. The second section includes the main questions about the assessment of construction risks. It starts with a brief description to help the applicants better understand the components of each question before answering this part of the questionnaire. The responses to each question are divided into four groups; risk allocation (both perception and common practice), risk importance and effect of that risk on the project.

3.4 SAMPLE SURVEY

Selection of the sample for the survey from the big list of contractors in the construction industry plays a major role in making the research more effective and representative. The

sample survey was selected from the list obtained from the Chamber of Commerce, Eastern Province Chapter. Only medium to large construction contractors working in the Eastern Province of Saudi Arabia (Grades 1 or higher) per the classification of the Chamber of Commerce were included in the survey.

3.5 SAMPLE SIZE

The sample size that would represent the population for the survey was calculated based on the following formula.

$$n^{\circ} = (p*q) / v^2$$

$$n = n^{\circ} / (1 + (n^{\circ} / N))$$

Where:

n°	=	First estimate of sample size
p	=	the proportion of the characteristic being measured in the target population.
q	=	1 – p
v	=	the maximum percentage of standard error allowed.
N	=	the population size
n	=	the sample size

For the purpose of getting the maximum sample size, the values of (p) and (q) were taken as 0.5 for both. The maximum standard error allowed (v) in this study was taken as 10%. The total population considered from the list obtained from the Chamber of Commerce, Eastern Province consisted of 82 construction contractors (Appendix II).

Applying the above formula, the sample size is:

$$n^{\circ} = (0.5 * 0.5) / (0.1)^2 = 25$$

$$n^{\circ} = 25 / (1 + (25/82)) = 19.2$$

The minimum required response rate was (19.2/82) * 100 = 23.4%. However the actual response rate was (28/82) * 100 = 34.15, which exceeded the minimum requirements.

3.6 DATA ANALYSIS

Data gathered from the questionnaire is analyzed and used to identify the respondents' allocation and importance of each type of risk categories and the effect of each risk on the project. The analyzed data is presented in a tabulated format and figures.

3.7 SCORING

The main section of the questionnaire on the importance of risk categories basically uses an ordinal scale. Scoring will be as follows:
"Very important" equals 5 points
"Important" equals 3 points
"Less important" equals 1 point.

Importance Index of each risk category will be calculated as follows:

$II_{R1} = 5x1 + 3x2 + 1x3 / (x1 + x2 + x)$

Where

II_{R1}	:	Importance Index (R1 denoted risk category 1 in this case)
X1	:	Number of respondents answering very important
X2	:	Number of respondents answering important
X3	:	Number of respondents answering less important.

Microsoft Excel is used as software to perform weighting, ranking and to calculate the percentage of each risk category. Printouts of Excel tables are in Appendix V.
Frequencies and ratio calculation will be used for other sections of the questionnaire.

Frequency (%) = n /NT * 100

Where:

n	= number of respondents (frequency)
N_T	= Total respondents

CHAPTER FOUR

RISK CATEGORIES ALLOCATION, IMPORTANCE AND EFFECTS

In this chapter the risk categories used to make the questionnaire survey are explained and the following are three areas investigated by this survey:

1- Risk allocation to either the owner, contractor or shared by the two parties.

2- Importance of each risk category to the contractor and the construction project.

3- Effect of each risk category on the construction project such as budget, schedule, safety, and quality.

4.1 RISK CATEGORIES

There are 25 risk categories were selected to compose in this survey questionnaire. These categories might have direct or indirect effect on the project.

1- **Permits and regulations:** for every construction project there are some local, national and international laws and regulations that govern the different aspects of that project such as obtaining permits for utility (telephone, water and sewage) and power connection to the project site.

2- **Site access:** this risk category refers to the right of way and access to the project site. It is an important category especially if the project in a remote or undeveloped area.

3- **Scope limitation and work definition:** scope limits might not be clearly outlined and the work might not be well defined depending on the nature of the contract.

4- **Labor, material and equipment availability:** this category is mainly related to the availability of the resources such as labor, material, and equipment. Certain jobs may require specific skilled expertise or special material and equipment that are not available and that will take long time to procure.

5- **Labor and equipment productivity:** certain jobs involving the productivity of labors and equipment might be affected because of the complexity of the job. Morale of the labor and defective tools will affect the productivity.

6- **Defective design:** it is impractical to make 100% error free design. Quite often, among various project documents like drawing, scope of work, or specification sheet, one can find a detailed missed reference or incomplete specification sheet.

7- **Changes in work:** could be change in work procedures or change of plans and scope of work. These changes might lead to change orders, demolitions and reworking and must be considered in the assessment of risk because they affect the project budget, safety…etc.

8- **Differing site condition:** will require extra efforts such as soil condition changes and the contractor might face rock during excavation instead of soft soil or underground buried utility piping.

9- **Adverse weather conditions:** contractor might be forced to alter his work schedule due to adverse weather conditions such as high temperature, humidity, or wind. Saudi Arabia known for high temperature and humidity.

10- **Acts of God:** includes things that could happen beyond the control of human like earthquakes, hurricanes, and other natural phenomena.

11- **Defective material:** there is a need for quality control and quality assurance to eliminate material replacement and rework. This is an important category especially in Saudi Arabian market where material standardization is not common.

12- **Changes in government regulations:** local authorities and government have specific codes and regulations that might be changed or revised from time to time. These regulations must be adhered to by contractors and owners of construction projects. These regulations might include changes in visa regulations or the restriction of some country's nationals from working in Saudi Arabia.

13- **Labor dispute:** when the relationship between management and workforce are tense or workforces are multinational with different background. Since there are no labor unions in Saudi Arabia, labor dispute is either dissolved internally or by local authorities and police.

14- **Safety/Accidents:** can be minimized by following safety rules and the use of safety equipment such as goggles, hats and shoes. Another way of mitigation is by insurance.

15- **Inflation:** depends of the economic conditions of the country. Currently, the inflation in Saudi Arabia is low so that the risk is low too but must not be overlooked in the assessment of risk management.

16- **Contractor competence:** this category is related to capability, skill, experience of the contractor's organization including management and labor.

17- **Change order negotiations:** changes to original plans, scope and specification are inevitable in most construction projects. These changes need initiation and negotiation of change orders for the deviation from original plans.

18- **Third party delays:** delays from third party could affect the schedule or budget of the project. Third party such as subcontractors, material suppliers, and other agencies that are not within the construction contractor's organization.

19- **Coordination with subcontractors:** miss-coordination between subcontractors and material suppliers will lead to schedule and budget overruns.

20- **Delayed dispute resolution:** this category is an important one especially if the dispute is major and deferred without resolution. Disputes should be resolved immediately to eliminate any future consequences. Disputes could be between all parties such as owner, contractor, subcontractor, or material supply.

21- **Delayed payment on contract:** payments on time are important by contractors to maintain the cash flow and eliminate financial difficulties.

22- **Quality of work:** would reflect the reputation of the contractor and might either rank him on the top of contractor or force him out of the market.

23- **Financial failure:** of any party (contractor or owner) will impact the project schedule and budget.

24- **Actual quantities of work:** this is a major risk category especially if the scope of work is not well defined and the actual quantities can't be measured.

25- **Accuracy of project program:** like the appropriate contracting strategy for example lump sum, cost plus, or any other form of contract strategies. Also it includes the financial, management and engineering program for project.

4.2 RISK IMPORTANCE

The questionnaire will elicit a general assessment of the importance of each risk category from the Saudi contractors' viewpoints and the general practice in the Eastern Province of Saudi Arabia.

4.3 RISK EFFECTS

All of the above risk categories will have potential effect on the project parameters namely schedule, budget, safety and quality and these will have a great impact on the project if they aren't correctly assessed and managed.

CHAPTER FIVE

RESULTS DISCUSSION

5.1 INTRODUCTION

In this chapter, the results of the questionnaire will be discussed and summarized in tables and charts.

5.2 DIFFICULTIES ENCOUNTERED

1- Low response rate.
2- Slow delivery of the questionnaire to the contractors.
3- Emails of the contractors were not available.
4-It was difficult to fax the questionnaire to the contractors because it is long

5.3 RESPONSE RATE

1- At the beginning the contractors were contacted by telephone to make sure that they are in the business and interested in this research.

2- The questionnaire was sent to 82 contractors by snail mail and only 2 responded.

3- The questionnaire was sent by email to 82 contractors again and 28 responded.

4-So 30 of the contractors replied to the questionnaire and 2 of them apologized because they are not interested and didn't complete the questionnaire.

5- So with the 28 replies we got a response rate of 34.15

5.4 DESCRIPTION OF RESULTS

The results are presented in five main parts:

5.4.1 Part 1: General background information

This section represents general background information of the respondents like company size, experience and individual completing the questionnaire. Respondents were spread all over the Eastern Province of the kingdom. This is shown in Tables 5.1 and 5.2 respectively.

Table 5. 1: Number of Employees

Number of Employees	Number of respondents (Frequency)	Percent (%)
10 – 50	0	0
51 – 100	0	0
101 – 150	2	7.1
More than 150	26	92.9
Total respondents (N)	28	100

Table 5. 2: Experience of Respondents

Experience (years)	Number of respondents (Frequency)	Percent (%)
1 – 5	0	0
6 – 10	4	14.3
More than 10	24	85.7
Total Respondents	28	100

5.4.2 Part 2: Risk allocation

This part represents the allocation of risk categories included in the questionnaire. The respondents were asked to allocate these risks based on their perception to either the contractor, owner, or shared between the two parties also to allocate them based on the common practice in the area. Table 5.5 shows the frequencies of respondents in allocating the surveyed risks as practiced versus the respondent's perception.

Table 5. 5: Risk Allocation Practice Vs. Perception

Risk Description	Risk Allocation (practice)			Risk Allocation (contractor's opinion)		
	Owner	Contractor	Shared	Owner	Contractor	Shared
Permits & regulations	33%	56%	11%	44%	33%	22%
Site access	0%	89%	11%	33%	33%	33%
Scope limitation & work definition	22%	56%	22%	67%	11%	22%
Labor, material& Equip. availability	0%	100%	0%	11%	89%	0%
Labor & equipment Productivity	0%	100%	0%	0%	100%	0%
Defective design	0%	44%	56%	56%	0%	44%
Changes in work	22%	44%	33%	67%	22%	11%
Differing site condition	0%	78%	22%	33%	44%	22%
Adverse weather conditions	0%	89%	11%	11%	22%	67%
Acts of God	11%	22%	67%	22%	0%	78%
Defective materials	11%	89%	0%	11%	67%	22%
Changes in government regulations	11%	67%	22%	44%	0%	56%
Labor disputes	0%	100%	0%	0%	100%	0%
Safety/ Accidents	0%	100%	0%	0%	67%	33%
Inflation	11%	67%	22%	33%	11%	56%
Contractor competence	0%	78%	22%	22%	56%	22%
Change order negotiations	0%	44%	56%	11%	0%	89%
Third party delays	0%	78%	22%	33%	22%	44%
Coordination with subcontractors	0%	100%	0%	0%	78%	22%
Delayed dispute resolutions	0%	67%	33%	0%	11%	89%
Delayed payment on contract	33%	44%	22%	78%	22%	0%
Quality of work	0%	89%	11%	0%	63%	38%
Financial failure	0%	33%	67%	56%	11%	33%
Actual quantities of work	0%	78%	22%	22%	33%	44%
Accuracy of Project Program	0%	100%	0%	11%	33%	56%

For a risk category to be fully appropriated, an allocation method, it requires at least a 60% response rate. If a risk category receives less than 60% response rate for any party, it will be considered as undecided allocation.

For this study, a 65% response rate is assumed for a risk category to be fully allocated to a construction party. Table 5.5 shows the risk allocation from the contractors' perception after applying 65% response rate criteria. Table 5.6 shows the risk allocation as practiced in the construction industry in Saudi Arabia.

Table 5. 6: Allocation from Contractor's Opinion (Perception)

Risk Allocation	Risk Description
Contractor	Labor & equipment Productivity
	Labor disputes
	Labor, material& Equip. availability
	Coordination with subcontractors
	Safety/ Accidents
	Defective materials
Owner	Delayed payment on contract
	Changes in work
	Scope limitation & work definition
Shared	Change order negotiations
	Delayed dispute resolutions
	Acts of God
	Adverse weather conditions
Undecided	Quality of work
	Permits & regulations
	Site access
	Defective design
	Changes in government regulations
	Inflation
	Accuracy of project program
	Third party delays
	Actual quantities of work
	Financial failure
	Contractor competence
	Differing site condition

Table 5. 7: Risk allocation as Practices - Appropriately Allocated

Risk Allocation	Risk Description
Contractor	Labor & equipment Productivity
	Labor disputes
	Labor, material& Equip. availability
	Coordination with subcontractors
	Safety/ Accidents
	Accuracy of project program
	Defective materials
	Quality of work
	Site access
	Adverse weather conditions
	Contractor competence
	Differing site condition
	Actual quantities of work
	Third party delays
	Changes in government regulations
	Inflation
	Delayed dispute resolutions
	Financial failure
	Acts of God
Shared	Permits & regulations
	Defective design
	Scope limitation & work definition
	Changes in work
Undecided	Delayed payment on contract
	Change order negotiations

In practice, not a single risk is allocated to the owner and the contractor assumes most of the risks while in the contractor's opinion, they want to allocate some risks that they think the owner has better control over, like delayed payment in contract. Also, contractors want owners to share more risk with them.

Table 5. 8: Summary of Risks Allocation - Perception Vs. Practice

	RISK ALLOCATION			
	Owner	Contractor	Shared	Undecided
Perception	3	6	4	12
Practice	0	17	2	6

5.4.3 Part 3: Risk Importance

Table 5.9 & 5.10; summarize the importance of these risks from the contract perception
Table 5.9 shows the frequency of each risk category in percentage. These results were ranked to find the importance of each risk category in table 5.10.
The most important risk is quality of work. It is ranked first. It is expected because it is what is matters most to the owner and is paid to deliver quality project in accordance with contract document and specification.
Delayed payment on contract and financial failure are very important risks, 89%.they were ranked second.
Acts of god and labor disputes are low importance risks.
Adverse weather condition is the least important risk category.

Table 5. 9: Risk Importance

Risk Description	Very Important	Important	Less Important
Permits & regulation	44%	44%	11%
Site access	67%	22%	11%
Scope limitation & work definition	78%	22%	0%
Labor, material & Equip. availability	78%	22%	0%
Labor & equipment Productivity	63%	38%	0%
Defective design	75%	25%	0%
Changes in work	44%	56%	0%
Differing site condition	56%	33%	11%
Adverse weather conditions	22%	44%	33%
Acts of God	33%	33%	33%
Defective materials	56%	44%	0%
Changes in government regulations	33%	56%	11%
Labor disputes	11%	78%	11%
Safety/ Accidents	67%	33%	0%
Inflation	56%	33%	11%
Contractor competence	67%	33%	0%
Change order negotiations	67%	33%	0%
Third party delays	33%	67%	0%
Coordination with subcontractors	38%	63%	0%
Delayed dispute resolutions	56%	33%	11%
Delayed payment on contract	89%	11%	0%
Quality of work	100%	0%	0%
Financial failure	89%	11%	0%
Actual quantities of work	33%	67%	0%
Accuracy of project program	67%	33%	0%

Table 5. 10: Risk Importance Level

Risk Description	Rank	Weighted Importance	Importance Level
Quality of work	1	140	Most important
Delayed payment on contract	2	134	
Financial failure	2	134	
Scope limitation & work definition	4	128	
Labor, material& Equip. availability	4	128	
Safety/ Accidents	6	121	
Contractor competence	6	121	
Change order negotiations	6	121	
Accuracy of project program	6	121	
Site access	10	115	
Defective materials	10	115	
Defective design	12	112	
Changes in work	13	109	
Differing site condition	13	109	
Inflation	13	109	
Delayed dispute resolutions	13	109	
Labor & equipment Productivity	17	106	
Permits & regulation	18	103	
Third party delays	18	103	
Actual quantities of work	18	103	
Changes in government regulations	21	96	
Coordination with subcontractors	22	93	
Acts of God	23	84	
Labor disputes	23	84	
Adverse weather conditions	25	78	Least important

5.4.4 Part 4: Risk Effects

This part discusses the effect of the different risk categories on the budget, schedule, safety and quality of work. Table 5.11 shows the result.

Safety received the least input from respondents. From table, no respondents think that scope limitation, work definition, change in work and quality of work will affect the safety of the project. Coordination with subcontract will affect the budget of the project by 15% while changes in government regulation will affect budget by 64%.
From table 5.11, permits and regulation affect the schedule of project by 62% while Coordination with contract will affect by 54%.

Table 5. 11: Risk Effects

Risk Description	Risk effects			
	Budget	Schedule	Safety	Quality
Permits & regulation	23%	62%	15%	0%
Site access	23%	38%	31%	8%
Scope limitation & work definition	57%	36%	0%	7%
Labor, material& Equip. availability	32%	47%	11%	11%
Labor & equipment Productivity	38%	44%	0%	19%
Defective design	38%	29%	10%	24%
Changes in work	29%	53%	0%	18%
Differing site condition	29%	47%	12%	12%
Adverse weather conditions	33%	44%	11%	11%
Acts of God	40%	35%	15%	10%
Defective materials	26%	26%	16%	32%
Changes in government regulations	64%	29%	0%	7%
Labor disputes	18%	41%	18%	24%
Safety/ Accidents	24%	24%	41%	12%
Inflation	75%	17%	0%	8%
Contractor competence	29%	29%	14%	29%
Change order negotiations	56%	38%	0%	6%
Third party delays	29%	53%	0%	18%
Coordination with subcontractors	15%	54%	8%	23%
Delayed dispute resolutions	38%	50%	0%	13%
Delayed payment on contract	56%	31%	0%	13%
Quality of work	31%	19%	0%	50%
Financial failure	50%	43%	0%	7%
Actual quantities of work	57%	29%	0%	14%
Accuracy of project program	28%	50%	6%	17%

Table5.11 shows that each risk category has an effect on a construction project in one or more of the listed project parameters (budget, schedule, safety and quality) . The respondents frequencies of risk effects shown in table 5.11 will be appropriately assigned to one or more parameter if the frequency is more than 25%. In other words, for a risk category to be fully appropriated an effect on a project , it requires at least 25% response rate .if a risk category receives less than 25% response rate for any parameter , it will not be considered as to effect the project in that parameter. Table 5.12 shows the appropriated and ranked effects of the surveyed risk .some of the surveyed risk have effects on a project in more than one aspect, for example a risk category might affect the budget, schedule and quality of a project. If a risk category has more effect on a project it will be ranked first.

Table 5. 12: Risk Effects (Appropriated and Ranked)

Risk Category	Risk Effects (appropriated and ranked)
Permits & regulation	Schedule
Site access	Schedule, safety
Scope limitation & work definition	Budget, schedule
Labor, material& Equip. availability	Schedule, budget
Labor & equipment Productivity	Schedule, Budget
Defective design	Budget, Schedule
Changes in work	Schedule, budget
Differing site condition	Schedule, budget
Adverse weather conditions	Schedule, budget
Acts of God	Budget, schedule
Defective materials	Quality, budget and schedule (tie budget & schedule)
Changes in government regulations	Budget, schedule
Labor disputes	Schedule
Safety/ Accidents	Safety
Inflation	Budget
Contractor competence	Budget, schedule and quality (tie for all)
Change order negotiations	Budget, schedule
Third party delays	Schedule, budget
Coordination with subcontractors	Schedule
Delayed dispute resolutions	Schedule, budget
Delayed payment on contract	Budget, schedule
Quality of work	Quality, budget
Financial failure	Budget, schedule
Actual quantities of work	Budget, schedule
Accuracy of project program	Schedule, budget

The responses on risk effect of all surveyed contractors in each risk category (table 5.11) were analyzed to see the relative frequency of each project parameter (budget, schedule, safety and quality) on a project. This was done to see the effect of the risk category on each parameter and compare the consequences. Table 5.13 shows risk effect on the budget, schedule, safety and quality of a project with relative frequency. the table shows that the surveyed risk have more impact on the schedule of a project with frequency with 38.5%while the same risk have the least effect on the safety of a project with frequency of 8.5% . The results of table 5.13 are graphed in figure 6.5 to clearly show the risk affect frequencies for easy evaluation. From both table and the graph, it can be seen that the surveyed risk have more affects on the schedule and budget of a project

Table 5. 13: Risks Effect on Four Project Parameters

Risk Effect (1)	Frequency (2)	Relative Frequency (%) (2) / sum *100
Budget	467	36.8 %
Schedule	488	38.5 %
Safety	109	8.5 %
Quality	206	16.2 %
SUM	1269	100 %

5.4.5 Summary of the survey Results

In this section , the results of the survey concerning risk allocation (both in practice and contractors opinion or perception) , risk importance and risk effects are summarized and tabulated in table 5.14 for quick reference and easy comparison .

Risk category is allocated to each party, as listed in tables 5.5 add 6.5 similarly, the importance of each risk category is assigned and ranked as listed in table 5.8. Effects of each risk category on each parameter of the project are assigned if it weighs more than 25% since we have four parameter (budget, schedule, safety and quality). Some risk categories might affect more than one parameter of the construction project as shown in table 5.10.

Table 5. 14: Summary of the Survey Results

Risk Description	**Risk Allocation** (Practice)	**Risk Allocation** (Perception)	**Risk Rank of Importance**	**Risk Effects**
Permits & regulation	Undecided	Undecided	18	Schedule
Site access	Contractor	Undecided	10	Schedule, safety
Scope limitation & work definition	Undecided	Owner	4	Budget, schedule
Labor, material & Equip. availability	Contractor	Contractor	4	Schedule, budget
Labor & equipment Productivity	Contractor	Contractor	17	Schedule, Budget
Defective design	Undecided	Undecided	12	Budget, Schedule
Changes in work	Undecided	Owner	13	Schedule, budget
Differing site condition	Contractor	Undecided	13	Schedule, budget
Adverse weather conditions	Contractor	Shared	Least important	Schedule, budget
Acts of God	Shared	Shared	23	Budget, schedule
Defective materials	Contractor	Contractor	10	Quality, budget & schedule
Changes in government regulations	Contractor	Undecided	21	Budget, schedule
Labor disputes	Contractor	Contractor	23	Schedule
Safety/ Accidents	Contractor	Contractor	6	Safety
Inflation	Contractor	Undecided	13	Budget

Table 5.14 Continued

Risk Description	Risk Allocation (Practice)	Risk Allocation (Perception)	Risk Rank of Importance	Risk Effects
Contractor competence	Contractor	Undecided	6	Budget, schedule & quality
Change order negotiations	Undecided	Shared	6	Budget, schedule
Third party delays	Contractor	Undecided	18	Schedule, budget
Coordination with subcontractors	Contractor	Contractor	22	Schedule
Delayed dispute resolutions	Contractor	Shared	13	Schedule, budget
Delayed payment on contract	Undecided	Owner	2	Budget, schedule
Quality of work	Contractor	Undecided	Most important	Quality, budget
Financial failure	Shared	Undecided	2	Budget, schedule
Actual quantities of work	Contractor	Undecided	18	Budget, schedule
Accuracy of project program	Contractor	Undecided	6	Schedule, budget

5.4.6 Part 5: Added risk categories

In section "C" the questionnaire, the respondents were asked to add and rate any additional risk categories that they think should be added to the list. Five contractors responded to that section and five categories were added; one each.
This risk and rating are listed in table 5.15 bellow.

Table 5. 15: Added Risk Categories by Respondents

Risk Category	Allocation		Importance	Effect
	Perception	Practice		
Pre commissioning/ commissioning	Contractor	Contractor	Very important	Budget/schedule
Knowledge of owner /representative	Owner	Contractor	Very important	Budget/schedule/quality
Proper budgeting	Owner	Owner	Very important	Budget/schedule/quality
Cooperation of owner/decision maker	Owner	Contractor	Very important	Budget
Extension of schedule	Shared	Contractor	Very important	Schedule

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSION

1- Risk assessment is anew concept to the construction contractors in Saudi Arabia. it is a relative new concept to the construction industry world wide , based on the literature review .

2- The perception of construction contactors in Saudi Arabia in allocating the surveyed risk is different from the common practice of allocating this risk. In practice, most of the risks are allocated to contractors none to owners.

3- Quality of work is the most important risk while an adverse weather condition is the important risk.

4- The surveyed risk has the highest impact on the schedule of a project with the response frequency of 38.5%. While the same risk affects the safety of the project least (only with the response frequency of 8.5%) most of the risk categories affect schedule and budget more other other project parameters.

5- Construction contractors in Saudi Arabia want owner to accept and share more risk with them.

6.2 RECOMMENDATIONS

1- All construction contractors in the eastern province of Saudi Arabia are encouraged to consider the results revealed by this research to have a better understanding when dealing with risk in the construction industry in this part of the world.

2- All construction industries in the eastern province of Saudi Arabia are advised to consider trends of allocation, importance and effect of important risk categories to help them facilitate proper management of this risk based on the results of this research.

3- Although this research was done in the eastern province of Saudi Arabia, the results and conclusions can be applied to the construction industry in other areas of Saudi Arabia.