CHAPTER 1

INTRODUCTION

1.1 GENERAL

Every human endeavor or action involves risk. In our daily life, one faces a variety of situations involving many unknown, unexpected, frequently undesirable and often unpredictable factors. These factors can be conveniently compiled under the category of risk (Hertz and Thomas, 1983)[{65}.]

No construction project is free of risks. The situation becomes worse for the contractors due to the competitive environment of the construction sector. These risks can affect schedule, costs and quality objectives. It can also be argued that risk can be an element of omnipresence in every sector of construction.

The contractors industry is a significant component of most countries. Economies construction industry is a vital part of the Egypt and Yemen economy. It provides jobs for about one and half million people creating a 6.055% of the Yemeni 's gross domestic product. In Egypt, the industry directly employs about 5 million people and accounts for about 5.95% of the national GDP, making it one of the largest sectors of the economy (Ahram newspaper, 2011)[{71}.]

The industry of construction , as any other business, has its own risks and challenges arising from change, which is inherent in construction. The construction industry is widely associated with high degree of risk due to the nature of construction, business activities, process, environment and organization. Construction work involves risks and uncertainties regardless of its size, but as the size and complexity of a project increase, the risk involved will also increase.

Contractors are subject to an assortment of risk factors which are the outcomes of the involvement of diverse parties in different stages throughout life cycle Construction projects.

Construction risk is generally perceived as events that influence project objectives of cost, time and quality. Some of the risks associated with the construction process are fairly predictable or readily identifiable; others may be totally unforeseen. These factors may be internal such as subsoil conditions, labor conditions and many

others, and external factors may be such as weather conditions, economic conditions, inflation and many other.

In project management terms, the most serious effects of risk on the contractors can be summarized as follows:

• Failure to keep within the cost estimate

• Failure to achieve the required completion date

• Failure to achieve the required quality and operational requirements (Syed M. Ahmed, 2004)[64].

The purpose of risk analysis and management is to help contractors avoid these failures. Risk analysis helps in estimating potential impacts of risk and in making decisions regarding which risks to retain and which risks to transfer to other parties.

Identifying the risk factors in the construction process and having information about the extent and types of effects and analyzing them will result in reducing the losses caused by such possible incidents. The application of risk management will result in taking Correct decisions and the Organization (Harinarain et all, 2008)[72].

Unfortunately, in Egypt and Yemen, risk management is not systematic and requires more studies in this context.

1.2 PROBLEM STATEMENT

Most of the large-scale construction projects are operated in complex and dynamic conditions and are constantly confronted with various risks and uncertainties. The risks associated with construction projects differ according to the country and the sector specific to the environment in which they are being implemented. The political, legal, economic and regulatory environment in Egypt are different from Yemen and risk management strategies carried out in other project environments may not be directly suitable in the Egypt and Yemen infrastructure and construction environment. Project risk management is the process concerned with identifying, analyzing and responding to the project risk (PMBOK Guide, 2000)[4].

In case of not recognizing both internal and external risk factors of the project, the managerial decision-making errors take place. Moreover, time and cost assessment forecasts also go wrong. Risk management can identify the risk-generating factors.

Furthermore, risk management can control or remove such risk factors through analyzing and choosing suitable strategies.

Previous researches suggest that the construction industry is particularly subjected to more risks and uncertainty than other industry because of its complexity, financial problems,(Loss due to inflation, increase in the price of materials, labors……etc), devaluation and varying rate of exchange, Cost overrun due to planning estimation, delay in progress payment by the owner). In addition to that problems may arise due to incorrect estimates of labor and equipment requirements (Poor labor productivity, Shortage of labor skill, Failure of equipment, Poor equipment productivity). Other reason are like lost time due to Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ...etc.) . Also the costs due to war, civil disorder, revolution.. ...etc., as well as Effect of subsurface condition (soil composition, existent utilities, high water table ,... ...etc.) may be among the other reasons. Moreover, the other problems could be faced from consultant for example (The conflict between contractor and consultant and Delay in performing inspection & testing by the consultant, delay in approval of contractor submittals by the consultant engineers (sample, tables, planning etc.).

Similar studies also show that most construction contractors have developed risk management techniques that rely on historical information and previous experience, which help to assess risk but do not help to evaluate the consequences of risk. In addition, most contractors make decisions based on their intuition, judgment or experiences rather than through a formal and systematic risk management process due to lack of familiarity with the concept and methods of risk management(Musibau&Tesfa, 2009)[40].

Despite the paramount importance of risk management as one of the subfields of project management, unfortunately less attention has been paid to risk management in Egypt and Yemen.

Based on the official statistics in Egypt in construction industry there are a little of studies and research in the field of risk management. Based on the official statistics in Yemen in construction industry, except for some articles in conferences, there are not any practical guidelines to be properly implemented for risk management in

this industry. This research is an attempt to identify the risk factors affecting the construction contractors in Egypt and Yemen during construction phase in unit price contracts, which are the main construction contracts in the Middle East.

1.3 OBJECTIVES OF THE STUDY

This study aims to improve the implementation of risk management within contractor companies in the Egyptian and Yemeni construction industry through identification and analysis of risks facing construction contractors in Egypt and Yemen and proposes appropriate mechanisms to avoid the risk or respond to the risks. In order to accomplish the aim of this study, the following objectives have been recognized:

1. Identifying the sources of the risk that face the construction contractors during construction projects in unit price contracts;
2. Identifying the importance of the risks which face the construction contractors and estimating the probability of occurrence and impact of the risks;
3. Ranking the risk factors according to all contractors in Egypt sharing in this research;
4. Ranking the risk factors according to all contractors in Yemen sharing in this research;
5. Comparing between the results in Egypt and results in Yemen;
6. Providing the proposal to construction contractors to avoid the risk or respond to the risks.

1.4 SCOPE AND LIMITATION

This research focuses on identifying and analyzing the Risk for construction Contractors in Egypt and Yemen. Therefore, the scope of study is only limited to Egypt and Yemen where respondents have been chosen randomly out of this area.

Therefore, this research will be limited to the following:

1. Construction contractors in Cairo and Alexandria and Suez and Ismailia cities in Egypt who are qualified and registered in the Egyptian Federation for

construction and Building contractors in 2012AD. The construction contractors will be from the 1st grade to the 5th grade. [The questionnaire will be distributed through the interviews with the project managers and engineers and top-level experienced management officials in these firms].

2. Construction contractors in Sana'a and Aden and Taiz and Ibb cities in Yemen and those registered in the Ministry of Public Works and highways in 2012 AD. The construction contractor will be from the 1st grade to the 5th grade. [The questionnaire will be distributed through the interviews with the owner and the project managers and engineers and top-level experienced management officials in these firms].

It is necessary to limit the respondents based on the size of project and company. For that the contractors having the sixth and seventh grade are removed and neglected from this study because they are considered low experienced in the construction industry and their works are very small compared with the top rated companies.

1.5 SIGNIFICANCE OF THE STUDY

The construction industry is subject to more risk and uncertainty than many other industries. The construction industry has a poor reputation in coping with risks. Beyond any doubt, the current economic crisis had a significant impact on the Egyptian and Yemeni construction and real estate sector. These events also had a significant effect on the construction contractors' behavior. Many contractors failed to meet deadlines and cost targets thereby the effect of not delivering a project according to its predetermined specifications, within budget and on time, can be disastrous to all the parties concerned. Thus, an effective analysis and management of construction associated risks remains a big challenge to the industry practitioners (Edwards, 1995)[{5}.]

Cost overrun represents the net loss of money that a contractors faces at the end of a construction project. Cost overrun still creates a significant financial burden to the contractors. Conceivably, contractors could cover these cost overrun burdens with their profits when the economy and competition allow them to win jobs with high markups. However, current sluggish economic growth and highly competitive market conditions have forced contractors to reduce their markups to remain

competitive. Continuous cost overrun in most projects of a firm can lead to bankruptcy (Gorgan 199)[{2}.] Instead, contractors must increase their awareness of risks, and adopt pro-active strategies in order to assess, model, analyse and mitigate risks. Furthermore, the construction industry has witnessed significant changes particularly in procurement methods with clients allocating greater risks to contractors (Bedelian, 1996)[{42}.]

Construction projects can be unpredictable. Risk and uncertainty can potentially lead to damaging consequences for the construction projects (Flanagan and Norman 1993)[{15}.] Therefore, nowadays risk analysis and management continue to be a major feature of project management of construction projects in an attempt to deal effectively with uncertainty and unexpected events and to achieve project success.

The benefits of risk management process include identifying and analyzing risks, improving construction project management processes and effective use of resources. It also helps the key project participants (client, contractor, consultant, and supplier) to meet their commitments and minimize negative impacts on construction project performance in relation to cost, time and quality objectives (NerijaBanaitien et al 2010)[{42}.] Unfortunately, many contractors in Egypt and Yemen are unfamiliar with these risk factors and do not have the experience and knowledge to manage them effectively and efficiently. The results of this study are effectively very useful and usable by construction contractors in Egypt and Yemen .

1.6 CONSTRAINTS

The research aimed at evaluating criticality risk analysis for construction contractors in Egypt and Yemen by carrying out questionnaires distributed to construction contractors . For some of the construction contractors fear that the questionnaire could be used the wrong way against them especially Egyptian contracting companies as opposed to Yemeni companies which return questionnaires signed and sealed by the company.

Among construction contractors in Egypt, out of 150 questionnaires sent, 108 responses were received out of which 5 were incomplete and discarded. The response rate was 72 %.

Among Construction contractors in Yemen, out of 150 questionnaires sent, 124 responses were received out of which 5 were incomplete and discarded. The response rate was 82.67 %.

1. 7 THESIS ORGANIZATION

The thesis is presented in five chapters and are organized as follows: -

Chapter (1) presents an introduction to the research. It is intended to give an overview of the risks in construction and includes the problem statement, the objectives, the scope, the significance of the study, constraints.

Chapter (2) presents the literature review on the meaning of risk, risk types and classification, sources of risks, risk response techniques, and previous studies related to the risk factors facing the construction contractors and construction projects.

Chapter (3) discusses the research methodology which includes the general study approach, the questionnaire development & design, and statistical sampling. The statistical sampling includes sample selection and sample size determination.

Chapter (4) presents and discusses data analysis, statistical methods used, tables and information deduced from statistical analysis and statistical results. It also contains the ranking of the risk factors affecting construction contractors in Egypt and Yemen by mean and significance level and Standard Deviation**.** It also contains the Rank Correlation between Sources of risk for construction contractors and classification contractors in Egypt and Yemen

Chapter (5) summarizes the results and major findings, to present the conclusions and recommendations of this research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Risks have a significant impact on a construction project's performance in terms of cost, time and quality. Modern construction projects in are founded on high quality of design and precise calculation of quantities to however estimate of cost contains by nature uncertainty in factors and risks that might face the project contractors and owners count on then experience and intuition to predict future estimation and costs. Due to this effect the necessity of risk management is increasing in construction industry and contractors are paying more attention to the methods and procedures to manage risks systematically . In particular, they realize that they can maximize profits only when they identify and analyze the risks not after but before happening(G. Y. Abbasi&M. S. Abdel-Jaber(2004)(18).

In this chapter will be reviewed meaning of risk, risk type and classification, sources of risk, risk response techniques, and previous studies pertaining to the risk assessment in construction project.

2.2 MEANING OF RISK

Since there are many different definitions for 'risk' this section aims to give a theoretical overview as well as pinpointing the definition used in this thesis. Risk has been variously defined as:

(Fraser 1978)[23] Define the probability of risk as " Risk could mean that some unforeseen event will occur to upset existing plans, or that there is great uncertainty as to whether some damaging event will occur or not, or that some damaging event is very likely to occur, or that if some damaging event occurs, some amount of money will be involved.

(Lifson and Shaifer 1982)[23] Defined the risk as "the uncertainty associated with estimates of outcomes. He pointed out that Risk means that there is a chance that results could be better than expected as well as worse than expected"

(Jaafari and Schub 1990)[66] Defined risk as the presence of potential or actual constraints 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.

(Albahar 1990)[23] Define risk as: “the exposure to the chance of occurrence of events adversely or favorably affecting project objectives as a consequence of uncertainty”.

(Kartam and Kartam, 2001)[8] Define the risk as "the probability of occurrence of some uncertain, unpredictable and even undesirable event(s) that would change the prospects for the profitability on a given investment", and in relation to construction; risk is described as "an exposure to economic loss or gain arising from involvement in the construction process", and "a consideration in the process of a construction project whose variation results in uncertainty in the final cost, duration and quality of the project" .

the United Kingdom (UK) association for project management (APM) define risk as " where an uncertain event or set of circumstances which, should it occur, will have an effect on achievement of objectives " (Hillson 2002)[8]

(OddmundGranli 2009)[54]. define risk as “an implication of significant uncertainty which may be upside (welcome) or downside unwelcome”

(WSDOT 2010)[50] define risk as "the combination of the probability of uncertain event and its consequence. A positive consequence presents an opportunity; a negative consequence poses a threat

2.3 RISK TYPES AND CLASSIFICATIONS

Too many trials were made to classify the different risks in construction. Risks were classified according to either their nature or their consequences (controllable, quantifiable). All classifications were mainly done as a prerequisite to the management of the risks.

2.3.1 Classification by Nature

(Johnson and Rood 1977)[23]. Classified risks into the following categories: (1) business risks, (2) project risks, and (3) operation risks.

(Erikson 1979)[7] classified risk as contractual risks and construction risks. Contractual risks arise primarily from the interaction among the different parties to the construction process. Contractual risk is introduced through clarity of contract, absence of communication between the parties involved, and problems of timeliness in contract administration. Construction risks, on the other hand, arise from factors such as weather, differing site conditions, acts of God, resource availability, etc. Construction risk is inherent in the work itself.

(Ashley 1981)[63]classified project risks into three categories: (1) project performance, (2) completion, and (3) liability

(Raftery 1994)[20] considers that there are three separate areas of risk: risk internal to the project, risk external to the project, and the client/the project/project team and project documentation.

(Assaf and Jannadi 1994)[7] 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"

(Abdou 1996)[47] classified construction risks into three groups, i.e. construction finance, construction time and construction design, and addressed these risks in detail in light of the different contractual relationships existing among the functional entities involved in the design, development and construction of a project.

(Conroy and Soltan 1998) [48] refer to four categories of risk, namely human failings, organizational failings, design group failings and design process failings.

(Tah and Carr 2000)[42] categorized risks into two groups in accordance with the nature of the risks, i.e. external and internal risks. the authors grouped risks into six subsets: local, global, economic, physical, political and technological change.

(Shen 2001)[47] categorized them into six groups in accordance with the nature of the risks, i.e. financial, legal, management, market, policy and political, as well as technical risks.

(S. Mubin&G. Mubin 2008)[62] divided risks during construction and operation of oil and gas pipelines to the following categories :

- Political risk

- Socio-economical risk
- Technical risk
- Organizational risk
- Natural catastrophic risk
- Financial risk (investment risk)
- Safety and security risk
- Environment risk

An appreciated work for risk identification was done by (Kangari& Boyer 1981)[22]. Risk of all major parties involved in a construction project (contractors, designer, and owners) were collected and stored in data base files as a part of a knowledge-based system for risk management. Risks were collected from different sources as experts from the American Society of Civil Engineering; different research works for risk analysis, contractors (having 10 years of construction experience). Risks were classified under six primary sources of risk and uncertainty factors as shown in Fig 2.1

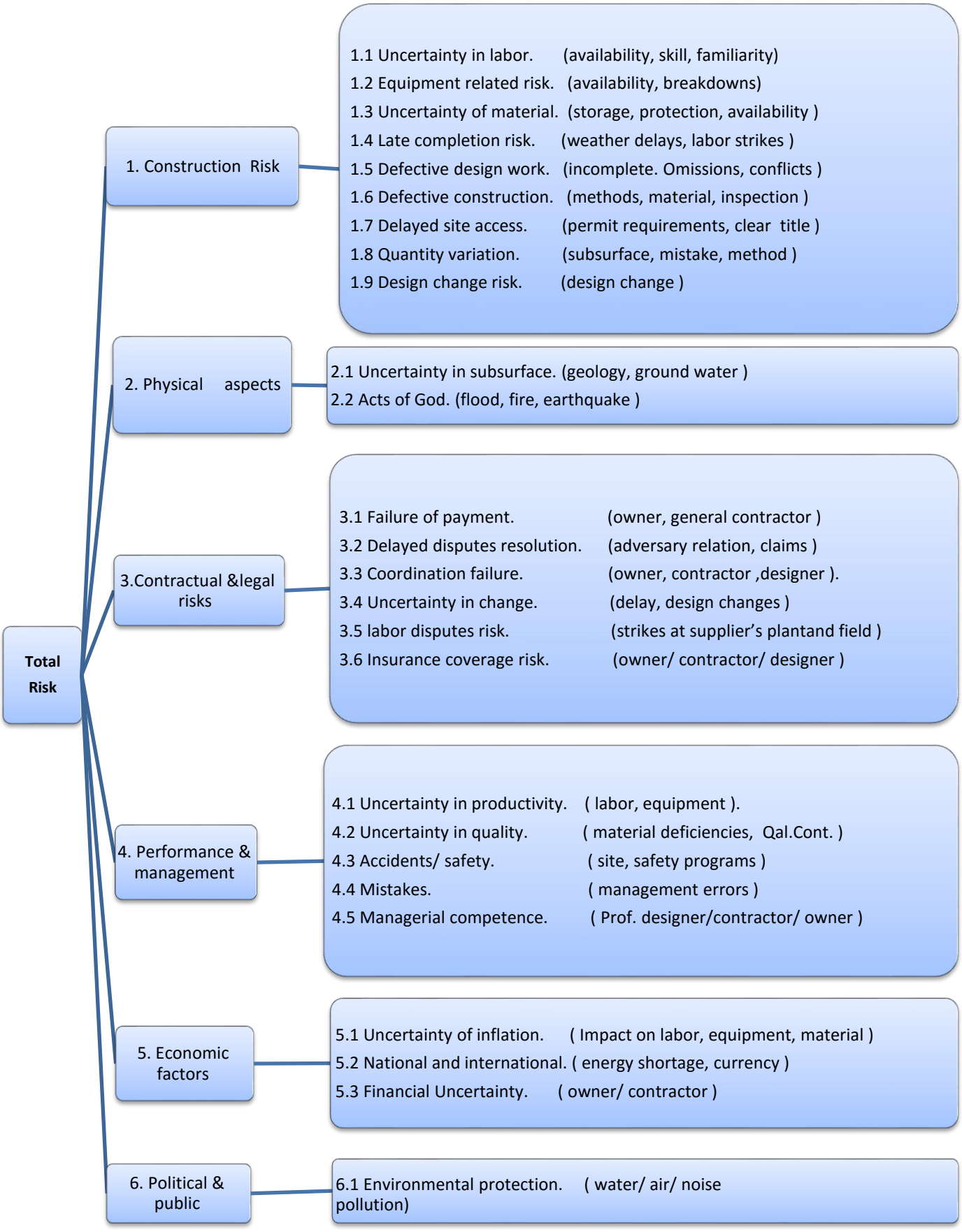


Figure 2.1 Structure of Risk Factors (Kangari& Boyer 1981)[22]

(Al Bahar and Crrandal 1990)[35] proposed 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.

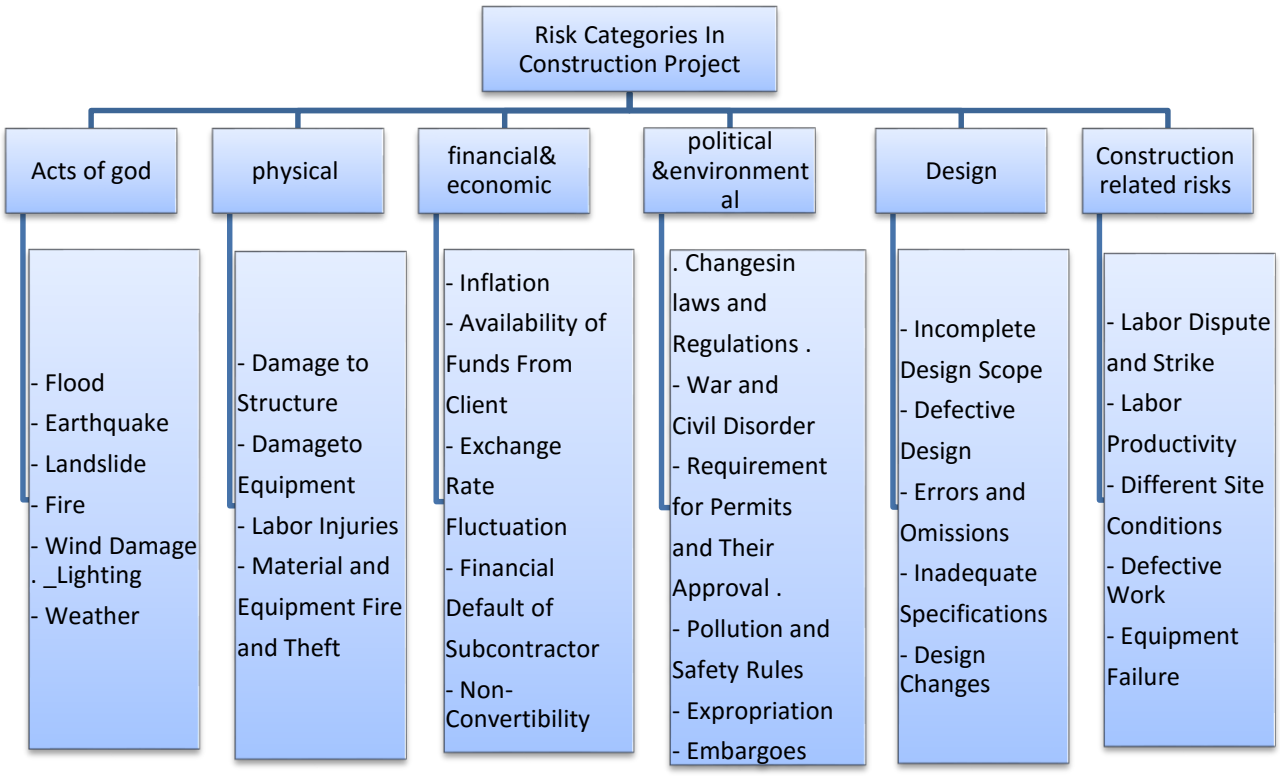


Figure 2.2 .The proposed risk classification scheme Mohammad A. Mustafa & *and* Jamal F. Al-Bahar(1991)[35]

(Smith and Bohn (999)(13) classified the project risk into eight broad categories for consideration as shown in Fig 2.3

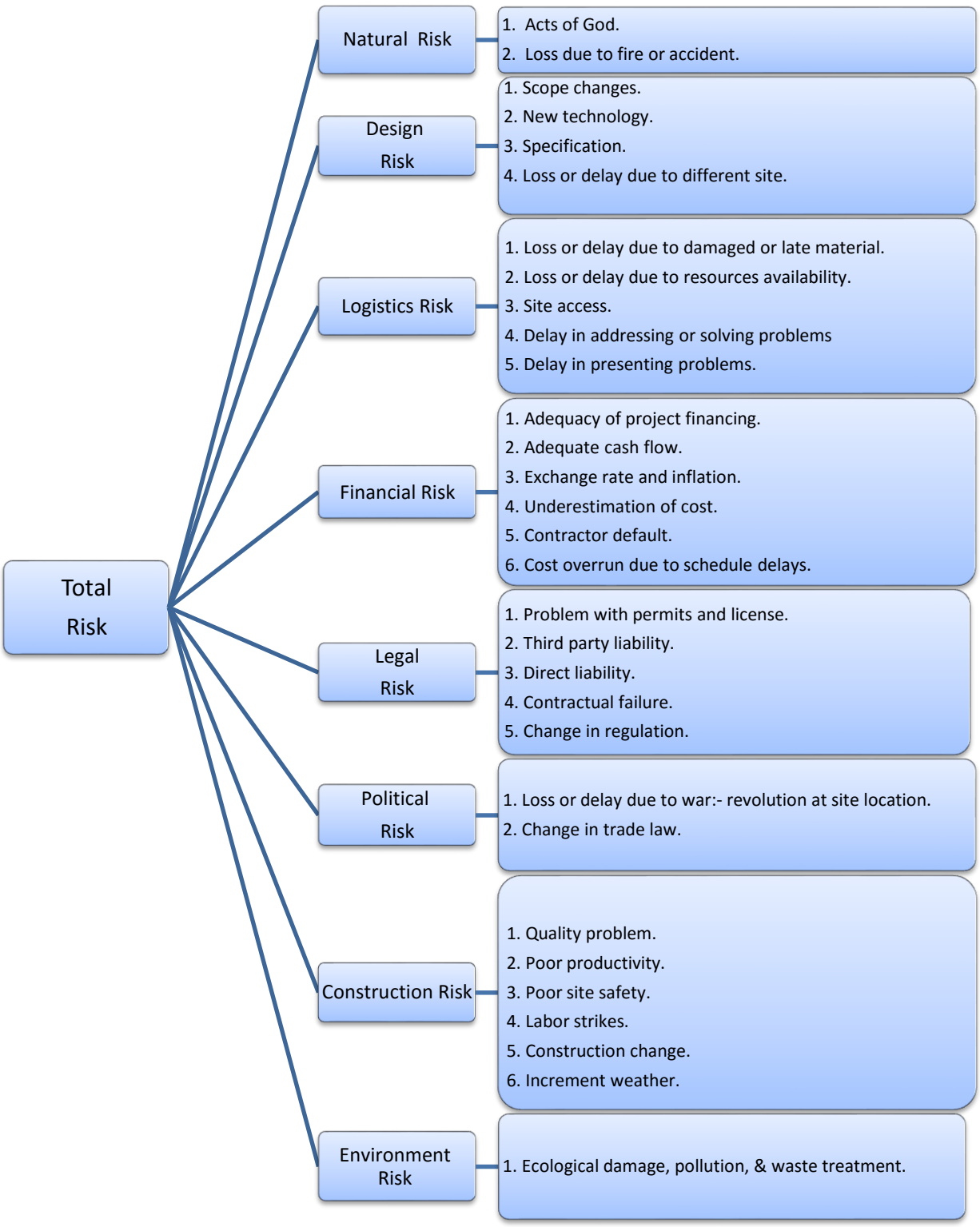


Figure 2.3 Structure of Risk Factors (Smith& Bohn 1999)[13]

(Flanagan,R 1999)[15] suggests three ways of classifying risk "by identifying the consequence, type and impact of risk" as shown in Figure 2.4

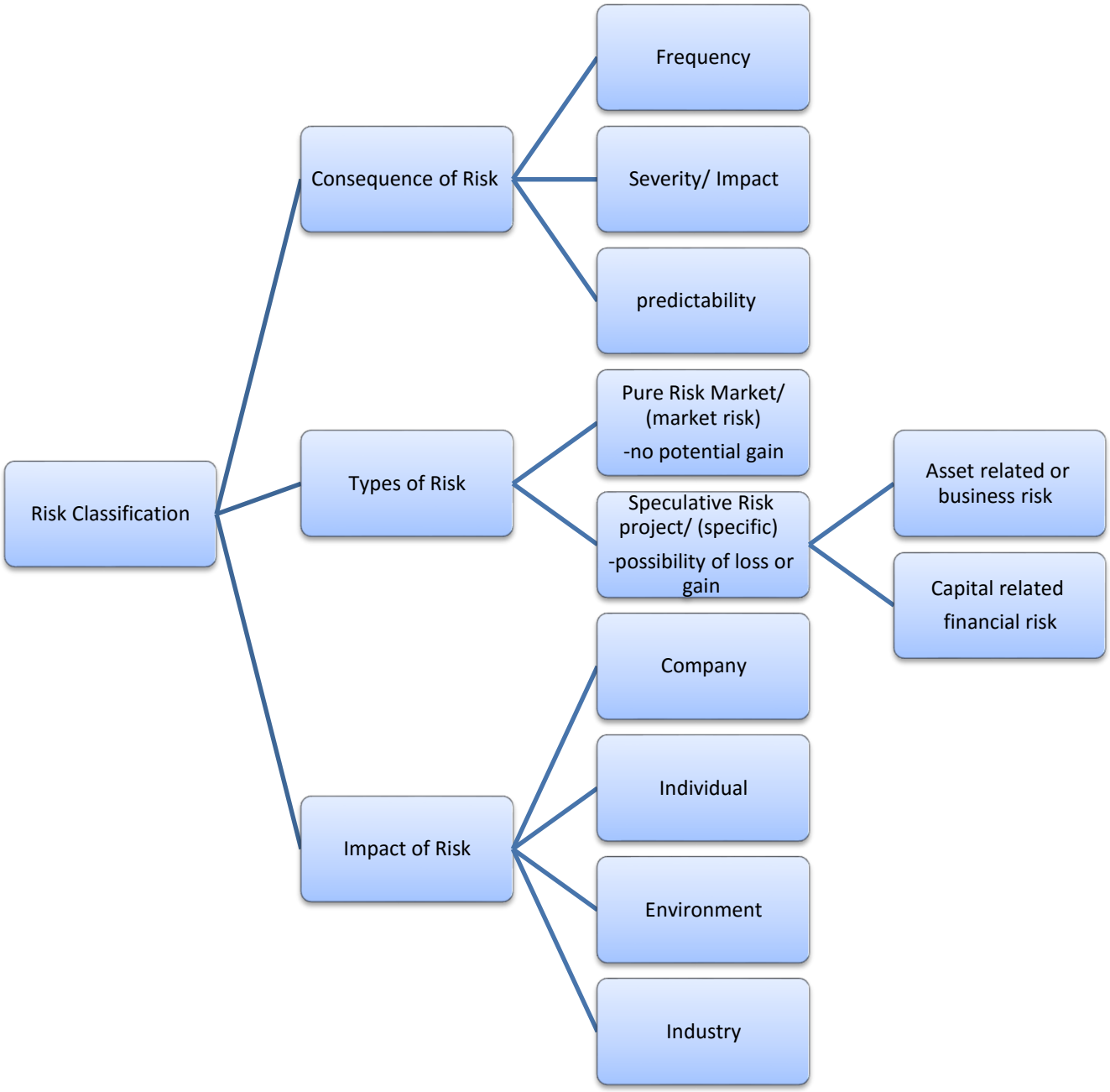


Figure 2.4 risk classification flangan (1999)[15]

Shih-Tong Lu &Gwo-Hshiung (2002)[61] listed five risk and uncertainty dimensions, including economic and financial, contractual and legal, physical and construction related, managerial and performance related, political and societal. From these, twenty assessing factors for the hierarchical structure were used in this study. The hierarchical structure adopted in this study is shown in figure (2.5)

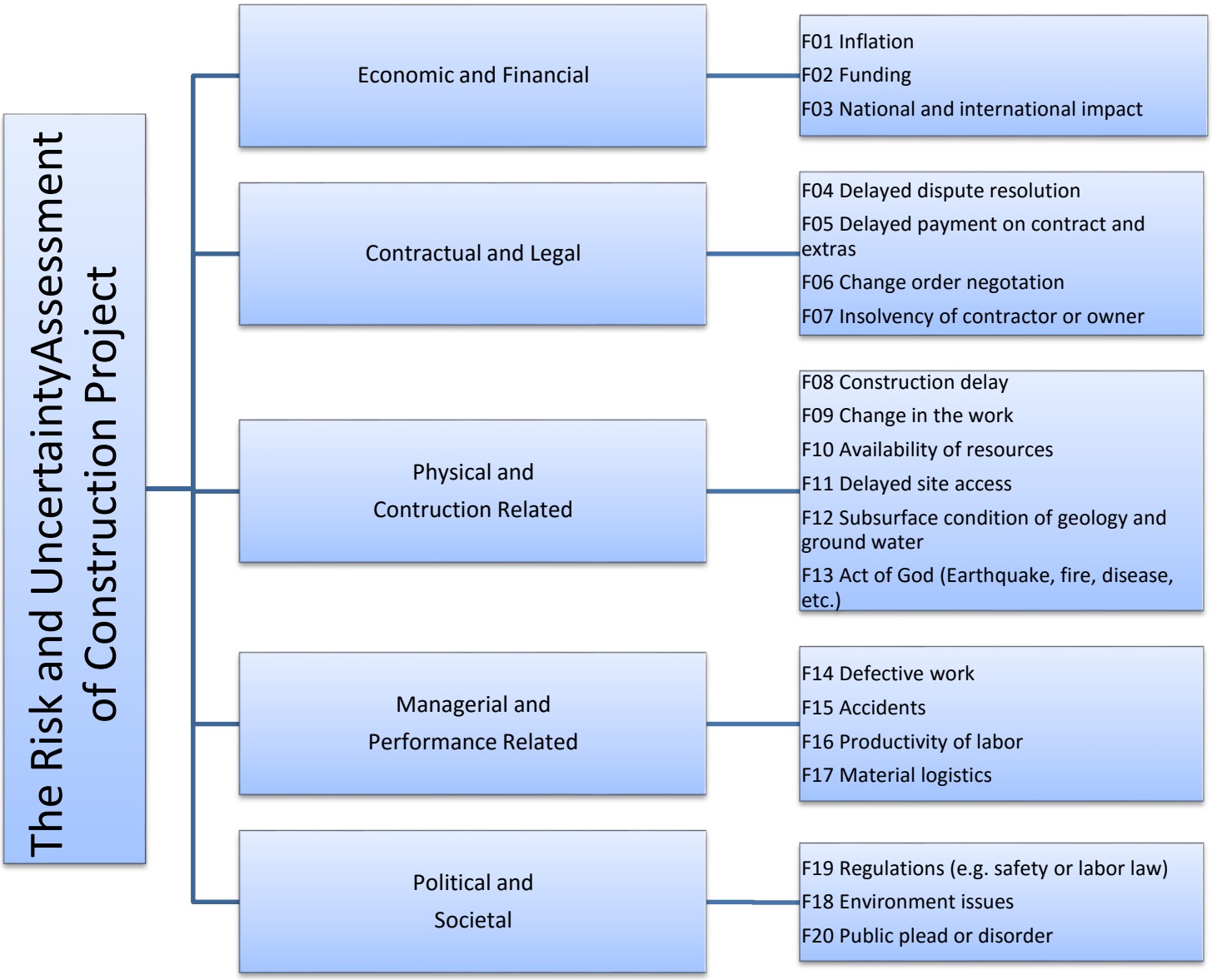


Figure 2.5 the Hierarchical Structure for Risk Assessment of Construction Project

2.3.2 Classification by Consequences

This classification describes common features that all the different risks may follow. This was done as a prerequisite for managing risks.

Levitt (1980)[53] categorized risks into two types controllable and uncontrollable. Controllable risks reflect variations in human performance such as number of design omissions, low worker productivity and material wastage. Uncontrollable risks are random variables such as material price escalation, weather and unpredictable changes in underground conditions or properties.

Wideman (1986)[69] has compiled a risk identification breakdown structure as a framework of the major sources of risk which is subdivided into five classifications of risk: external unpredictable, external predictable but uncertain, internal (non-technical), technical and legal.

Franke (1987)[22] classified risks into quantitative risks and qualitative risks. He defined the quantitative risks, as those require numerical data for their identification, where the costs of which can be forecasted. But the qualitative risks are best expressed in linguistic terms e.g. high, medium, or low, where the cost effects of which cannot be assessed directly. He made the classification in order to analyze and assess the qualitative risks which includes the following:

- Risks resulting from dependencies (customer, suppliers...).
- External influences (authorities, politics...etc.).
- Uncertainties as to payment, liability (delay, penalty….).

Farid (1989)[16] mentioned that the total risk of a project is comprised of two parts systematic risk and unsystematic risk. Systematic risk includes unanticipated increases in inflation or interest rates, labor shortages, and economic downturn or recession. Unsystematic risks include unexpected job conditions, strikes, and particularly financial difficulties.

Jaafari and Schub (1990)[11] classify risks as technical risks and technological risks. Technical risks are those related to the fundamental properties, processes and concepts. Technological risks are those related to plant and manufacturing and construction processes, state of hardware and the like.

Smith and Bohn (1999)[13], categorized of project risks, also, by the controllability concept. Risk factors are categorized into external and internal factors.

- External factors are relatively uncontrollable, this there is a need for the continued scanning and forecasting of these risks and a company strategy for managing their effects (economic risk, political risks, physical risk ...etc.).
- Internal factors are more controllable and vary between projects. Some of these risks factors are local to individual work package within a project (labor risk, plant risk, material risk, site risk...etc) where as other are global to an individual project and cannot be associated with any particular work package (design risk, client risk, management risk ...etc).

Charoenngam and Yeh (1999)[45] categorized construction risks into six groups: construction related, performance related, physical, financial and economic, contractual and legal, political and societal

Farquharson (2000)[11] 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)".

2.4. SOURCES OF RISK FOR CONSTRUCTION CONTRACTORS

There are many risk factors affecting the construction contractors. Those risk factors could result from different sources and parties. Through the literature review, many interviews and discussion with some professionals in the field, and the writer's experience, many risk factors have been identified. There are seventy-one potential factors identified. Those factors could be combined into eleven major groups. These groups are classified according to sources of these factors. These sources are the following: -

1. Construction and job site risks.
2. Design risks.

3. Financial and economic risks.
4. Management risks.
5. Owner risks.
6. Supervision risks.
7. Subcontractor risks.
8. Site conditions risks.
9. Adverse weather and natural risks.
10. Legal risks.
11. Government regulation and policies risks.

Each one of the eleven sources are described briefly while, the most of these risk factors are discussed in the subsection which follow and others factors are self explanatory. The risk factors that result from these sources are identified to establish an overview for the reader of the risk factors affecting the construction contractor. Seventy-one risk factors will be considered in the questionnaire to identify their probability and degree of impact. It is noticed that some of these factors could interface with, or could be a result of, other factors from other source. These risk factors are mentioned to relate them to their sources, in order to evaluate the relative importance of these factors and their sources.

2.4.1 Construction and Job Site Risks

Any construction work will be subject to some technical risks. The contractor performance assumes responsibility for the majority of the construction risks (Smith &Sbohn 1999)[63].

Many construction risk factors could arise in the projects as a result of low contractor performance. The effects of construction and job site risk factors are presented and briefly described in the following sections. The construction and job site risk factors consists of many factors, So it is further the most of these factors divided into two subgroups: -

2.4.1.1 Resources Generated Risk Factors:

A- Manpower: -

Manpower is essential resource of the contractor, who also utilizes the other resources in the most efficient and productive manner. Manpower includes the different laborers, those directly performing the project work. They include skilled, semi-skilled, and unskilled laborers. Skilled laborers involve all craftsmen, such as pipe fitter, equipment operators, carpenters and foremen who link between management staff and manpower. The foreman has an important role in the progress of the work, so normally the contractor assigns a trained foreman who has a good experience in the work with leadership skills and some management abilities. Semiskilled laborers include the assistants of craftsmen and have medium skills, while unskilled laborers include ordinary laborers who perform normal jobs that do not require specific skills. Laborer availability, skills, productivity and experience play an important role in the progress of the work (Bassem2005)[22]

Labor, for many contractors, is considered as the largest risk in construction. Healy (1981) defined two types of risks incurred with labor: (1) availability and productivity, and (2) labor disputes. The contractor should use his expertise to assess the cost and time required to apply the manpower that he needs. In his assessment, the contractor must take the following issues into consideration:

Timely availability at an acceptable price, Labor productivity, Skill level, Union regulations/Work rules ,Job conditions factors, Coordination of work force

Work stoppage due to strikes may increase projects costs and lengthen the project duration. Labor disputes may be concerned with the following issues:

Working conditions, wages and bonus payments, non-union manpower, jurisdictional dispute (Al_bahar 1990)[23]

B. Material- :

In construction projects, material shortages could result in work stoppages and schedule delays. Material shortages may not be a general market trend, and can be due to the failure of one of the suppliers. In this case, the contractor may be forced to find another supplier to purchase the required material As a result, schedule delays and additional costs are incurred by the contractor. The contractor

should assess in his bid the risk of such material shortages to the extent he assumes appropriate. Defects in installed material may force the contractor to remove the material and replace with the specified quality. (Albahar 1990)[23]

Delay in delivery of the materials required could delay the completion of a part of or a whole project. Delivery times should be matched with time schedule of the project and according to the specification and quantities required in the shop drawings. Also the contractor sometimes may not able to provide the materials are to financing and cash flow problems. This could make a shortage in the material and may affect to the contractors. (Bassem 2005)[22]

C-Equipment: -

Equipment plays the major role in the construction and completion of these projects. In some cases, the selection of inappropriate equipment may cause delay due to inefficient operations of the selected equipment. The contractor is responsible for evaluating the operational, mechanical, and economic aspects of the equipment to be used during construction. Such evaluation will affect reliability and profitability of equipment operations and reduces the chance of equipment failure. In selecting equipment, the contractor should balance between job conditions, design specifications, equipment specifications, and equipment operation conditions and maintenance. (Al_bahar 1990)[23]

Shortage or unavailability of the required equipment may slow the progress of the work and may delay the completion of the project. Selection of adequate and proper equipment to perform the work is an important factor in the productivity. Inadequate or improper types of equipment and low skills of operator might reduce productivity and cause considerable delay and cost overrun in the progress of the project (Al-Ghafaly1995)[36]

2.4.1.2 Contractor Performance Generated Risk Factors

The contractor in the construction process is the party who utilizes resources required to execute and complete the construction project. Normally, the contractor carries most of responsibility in the construction. He is responsible for delivering the completed project to owner. The contractor's performance in construction plays an important role in the project performance. The contractor is obliged to complete

the project, on the specified time, within the estimated cost, and with the required quality, according to specification and conditions. (Al-Hazmi 1987)[27]

The most significant factors affecting contractor performance under project characteristics are site conditions, complexity of project and duration of project. It can be inferred that the conditions of a site, water-logged, having a steep terrain would affect the performance of the contractor. Also, the technical complexities to be encountered during the construction process and the estimated time for project completion would also have significant effect on contractor's performance. The three most significant of the client-related factors affecting contractors' performance are the financial capability of client, delay in approvals and delay of progress payment to contractors. (mirfarooq 2002)[33]

The major effects of performance of the contractor on construction projects are improved quality of work, minimal construction errors and mistakes, reduction in waste and reduced construction cost. The major causes of contractor's poor performance are inadequate or poor planning, mismanagement of funds, delay in making decisions and approvals by owner and affection for the use of low quality materials. (Mir farooq 2002)[33]

poor quality considered from risk factors because the consultant rejects poor quality and then the contractor need to rework the working, these reworking may require increase in cost and duration. For this, contractor quality control is an important factor in the project performance. This contributes to all performance measures: time, cost, as well as the quality of work performed. The contractor should perform self-supervision and field inspection to assure that works are done according to specification, drawing, and engineering standards. This will avoid any defects needing repairs, which require time, additional cost and effect on contractor's objectives . (Bassem 2005)[22]

2.4.2 Design Risks

The role of the design engineer is important in construction projects. And risks incurred by him are typically considered the responsibility of the owner and not the contractor. Risks normally incurred by the design professional include defective design, ambiguous and inadequate specification and plans, delays due to required approval of shop drawings, and errors or omissions of design. Other

elements of design risk include: Incomplete design scope, Availability of information, Innovative application, Level of detail required and accuracy, Appropriateness of specification, Interaction of design with methods of construction, Incomplete or erroneous geological and geotechnical exploration.(Al_bahar 1990) [23]

Contract documents are the product of the early planning and design stages of the project. The contract documents normally include the conditions of the contract the form of agreement, special conditions, standard and special specification, the bill of quantities, drawing & plans and addendum. In the contract documents, the owner states all scope, requirements, conditions, specifications quantities, and physical aspects of the project.

Normally during construction, the owner may order changes in scope, design or quantities of work items. These changes could be as result of inadequate or in applicable design, or changes in the owner's requirements, such as improvement in the design and quality of the project. Differing site conditions, deficiencies and faults in the design are the most common reasons for changes in the design and scope of the project. It may take a long time to make necessary correction in specification and drawings, and for approval measures of prices of these changes. This risk factor could delay and cost overrun of the project. (Al-Ghafaly 1995)[36]

"Design variations" were popularly arisen in the design phase of a project and may result from issues such as "variations by the client" and defective designs. To avoid defective design, the design team need not only to fully understand what the clients want as defined in the project brief, but also to establish an efficient communication scheme among the designers. "Inadequate program scheduling" often appears in projects with a tight schedule when some programs need to be reduced to meet the project timeline.

Moreover, uncertainty surrounds most facets of construction projects, Which makes it impossible to accurately predict the time required for various programs. Choosing experienced designers can help to minimize the difference between the proposed and practical program schedules. (Patrick. et. al 2007)[46]

2.4.3 Financial and Economic Risks.

Financial resources are the most important element in the contractor capabilities. Funds are required to procure the other resources: materials, equipment, and manpower. Financing the project is the most important factor that affects the contractor's performance. The contractor could utilize different methods to finance the project. He could finance the project from his own financial resources, or by getting loans provided by commercial banks.

Sometimes the contractors face difficulties in financing their projects due to financial problems: delay in progress payments, no advance payment, and cash flow problems. Cash requirement for procurement of materials and other expenses could lead the contractor into a very critical situation which could make delays in the progress of the work and then the completion of the project.

delays in contractor payment caused by the cumbersome process of making contractor payments in the public sector, create financial problems for the contractor. Unless well managed, this delay is very damaging to contractors who are operating in a location remote from the client (Edmonds and Miles, 1984)[30]

The effect of economic factors on the contractor's cost overburden varies with country in which construction takes place and with the project duration. In countries where there is economic instability (often manifested by high inflation rates), the effect of this factor should not be disregarded. In those countries, some contract clauses are written to hedge the risk of high inflation, so that both an owner and a contractor share the risk of price escalation. If these types of contract clause do not exist, then the contractor should the contractor bears all of the inflation risk. In those cases, a contractor should pay particular attention to the effect of inflation on its cost estimate. (Akinci and Fischer 1998)[2]

Identification of inflation by contractors is hardly a problem; quantifying it, however, is considered difficult. A prudent contractor knowing about the most recent trends in costs of materials, labor, and equipment should include all inflationary costs in his bid. Price indexes of labor, construction materials and equipment, and forecasts of the overall trend of the economy are available sources for contractors in assessing inflation.

Projects that require multi-level approval , such as highways and public utilities, are especially susceptible to time delays and hence, to the effect of inflation and price escalation.

Project funding is obviously a potential economic risk for contractors. Inadequate sources of project funds by an owner or funding agent may create time delays and financing problems which to many contractors are unbearable. The owner must have enough money to complete the work, and must make that money available to the contractor in a suitable manner and time that enables the contractor to proceed with the work. (Al-bahar 1990) [23]

Small contractors have very low financial reserves and use the profit from ongoing projects to finance their next project; hence a loss in one project ultimately leads to a cash flow problem and liquidation. (Daniel Wasi et el 2001)[30]

Contract-related factors such as change orders (changes in the deliverables and requirements) and mistakes and discrepancies in the contract document result in cost overrun. Mistakes and discrepancies in the contract document can be in scope, deliverables, resources available and allocated, payment terms, achievement of various milestones, and the project duration. In most of the instances, time overrun leads to cost overrun.(MuraliSambasivan 2006)[39].

2.4.4 Management Risks

Risk management is "A formal orderly process for systematically identifying, analyzing, and responding to risk events throughout the life of a project to obtain the optimum degree of risk elimination or control". Such responses may include such defensive actions as mitigation by risk avoidance, deflection by insurance, transfer by contractual arrangements, and retention by loss control programs and contingency planning. (Albahar 1990)[23]

Risk management process should be implemented at the early project phases, when there is still a possibility for fundamental changes . The project should be carefully analyzed as to which kind of methods to use at which project phases and a process needs to be customized according to all project characteristics. The underlying reason for risk management is to ensure well-grounded and unbiased decision making. (Artto .et al2005) [9]

The project management is very important in the contractor performance. The professional management staff can execute the project in the most efficient manner, within the time specified, and budget cost, with the best project performance level. Management staff includes administrative personnel and technical staff as soon as the project is awarded to him, to manage the construction effectively, and to a chive project completion within the specified time with the required quality and within estimated cost.

Administrative personnel perform administration activities concerning public and government relations, accounting, procurement, and labor affairs. Each of these should be done by qualified personnel to procure required resources for construction and to support the project management. Lack of experience, incompetence, unreasonableness and incompatibility of project management team could create delay in delivery of resources and problems in communication and coordination with other parties involved. (Al-Ghafly 1995)[36].

The project risk management process helps project sponsors and project teams make informed decisions regarding alternative approaches to achieving their objectives and the relative risk involved in each, in order to increase the likelihood of success in meeting or exceeding the most important objectives (e.g. time) sometimes at the expense of other objectives (e.g. cost). Risk management encourages the project team to take appropriate measures to:

Minimize adverse impacts to project scope, cost, and schedule (and quality, as a result).

Maximize opportunities to improve the project's objectives with low er cost, shorter schedules, enhanced scope and higher quality.

Minimize management by crisis.

(Project Risk Management Handbook 2007)[45]

Risk management is the process by which the likelihood of risk occurring or its impact on a project is reduced. It has five steps:

1. Identify the potential sources of risk on the project.

2. Determine their individual impact and select those with a significant impact .

3. Assess the overall impact of significant risk.

4. Determine how the likelihood or impact of risk can be reduced.

5. Develop and implement a plan for controlling the risks and achieving the reductions. (The International Marine Contractors Association (IMCA) 2006)[10]

2.4.5 Owner Risks

Owner involvement is an effective factor in the construction process. The role of the owner includes many tasks. The role of the owner includes many tasks. These tasks are very important for the progress of the project. Failure of the owner to perform these tasks will causes problems and risks that may affect to contractor performance.

Owner involvement during the construction is very important to project performance. There are many tasks that they contribute to the contractor performance. Delay in furnishing and handing over any part of the site to the contractor will cause a delay in starting some of the work of the project.

Owner uncooperative with the contractor will create some complexity in the measures of owner administration. Cooperation between the parties will avoid the routing measure. Excessive bureaucracy in the owner organization will create some complexity in measures in the owner administration. This can be seen through lengthy and ineffective measures that could lead to delay in the decisions and approvals of contractor requires, which could affect the progress of the project. Failure of the owner in making decisions within a reasonable time may hold back some of the project work, and delay in settlement of contractor's claims by the owner, such as approval of new work items, prices, and extra costs for changes in design, may obstruct project progress. (Al-Hazmi 1987)[27]

According to the conditions of the contract, the owner has the right to suspend any part of the work, if it is needed to restudy and redesign any part of the project to make necessary modification and corrections. Changes or change orders by the owner are one of the major factors alleged in most delay claims as a critical factor in delay (O'Brien, 1976) . The procedure of issuance of change orders may involve lengthy measures, which take a long time during construction that could cause delay

in the progress and then the completion of the project in the specified time. (Adel Al-Kharashi 2009)[36]

Acceleration Events: may delay the job and shorten the Contractor's time to accomplish his work. Or the Owner may require the Contractor to finish his work sooner than initially scheduled. Either of these cases may call for an acceleration of Contractor's work – that is, Contractor may need to make up time to avoid damages (liquidated or actual) payable to the Owner for the late completion of the project. It is often carried by working overtime and on weekends by adding manpower or even by placing extra shifts and equipment. (Michael Ashworth 2006) [32]

Delay in the progress payments is one of the most critical problems for the contractor. It creates a very critical problem in his financial ability and cash flow. This problem makes the contractor unable to provide required resources and cover his expenses, which leads to delay in the progress of the work. (Al-Ghafly 1995) [36]

.**2.4.6 Supervision Risks**

Site supervision means the general direction, coordination and oversight of the onsite work processes. In particular, occupational health and safety supervision on construction sites involves:

- deciding when particular contractors or phases of the construction process can commence, and when it is necessary to suspend a process;
- providing the necessary coordination and general instruction for work associated with one process so as not to endanger persons engaged in other processes;
- upon becoming aware of a dangerous work practice or situation, issuing prompt directions necessary to safeguard site personnel and/or the general public from harm.
- monitoring the general conduct of work for compliance with the builder's and/or contractors' safety procedures and safe work method statements (if required).

The builder's contractors also have a duty to provide the necessary degree of supervision to their workers to enable them to perform their work in a manner that is safe and without risks to health.(Work safe 2007) [52].

The consultant office or the owner supervision team should manage the construction properly and efficiently. Any lack in their duties will cause problems for the contractor.

Effective involvement in the supervision will help the contractor to complete the project on time. Unqualified and low experienced personnel will cause some problem that may affect in the progress. Delay in checking review, and approval of contractor submittals, material, shop drawings, schedules, payments...etc, all could delay progress of the work. Progress payments should be checked and approved by the consultant engineer in proper time. The consultant has to keep full records for the work items performed and make proper coordination between personnel in the field and the contractor. (Al-Ghafaly 1995)[36]

Coordination and communications between the consultant and the contractor will contribute to the progress of the project. Poor coordination could lead to conflict and problems that delay the progress. Continuous coordination and communications through regular meetings and organized work procedures for approvals, inspection and testing will improve coordination and communication between all parties. Clear inspection and testing procedures are very effective in the supervision in a good standard.(Al-Ghafly 1995) [36]

2.4.7 Subcontractor Risks

Currently in construction, many project activities are being subcontracted out by the general contractor. Although subcontracting has many advantages, it also brings additional risk to a general contractor. These risks are uncertainties related to a subcontractor's technique, qualifications, timeliness, reliability, and financial stability. These risks can result in a time loss and an increase in cost during construction. For example, if a subcontractor does not perform the work as well as the client requires, and then a general contractor will have to bear the cost of finding a new subcontractor or self-performing the work in accordance with the client's requirements. As a result, uncertainties related to subcontractor's performance raise the risk of a cost increase during construction. (Akinci and Fischer 1998)[2]

Typically in huge projects. There are many subcontractors working under main contractors. If the subcontractor is capable, the project can be completed on time as planned. The project can be delayed if the subcontractor under performs because of

inadequate experience or capability. High degree of subcontracting in projects leads to high risk of delays and this leads to inefficiencies in construction industry. (Murali et al 2006)[39]

the contractor has to assure that the subcontractor schedule match with the project schedule and that the work is performed according to required specification and drawings.

In many projects, the contractor needs to subcontract part of his projects to a subcontractor who normally executes special work items in the project, such as mechanicals & electrical work. The shortage or unavailability of subcontractor during construction may cause to wait the contractor and then may affect on performance of contractors.

Sometimes the subcontractor faces difficulties in financing their work due to financial problems may cause delay the progress of the work.(bassem 2005)[22]

2.4.8 Site Conditions Risks

In the construction process, the site conditions risks at the site have some impact on project progress and contractor's performance. The site conditions include change in site conditions, subsurface conditions and social & cultural conditions.

In public water and sewage projects, subsurface conditions are the most important site conditions that affect work progress, include soil conditions, water table, existent utility lines, and other obstructions. Hard rock or very loose soil require special equipment and temporary installations. A high water table needs continuous pumping to lower the water table for construction of utility lines (Al-ghafly1995) [36]

A frequent issue between the contractor and owner, or the contractor and its subcontractors, involves unforeseeable or undetected site conditions encountered during construction. The allocation of risk between the parties regarding unknown site conditions, which can be a significant expense and commonly leads to litigation,should be clearly defined in the pertinent contracts.(John A. Snow 2007) [25]

Commonly, a construction contract simply provides that the contractor has an obligation to visit and inspect the site and is only responsible for information

obtained based upon a competent site visit. The owner, as opposed to the contractor, would then be responsible and bear the risk for unknown or undetectable subsurface conditions. In this situation, the contract should contain a "differing site condition" clause that provides the contractor is entitled to an increase in the contract price and/or an extension of time to complete the project, if the actual conditions encountered were not discoverable upon a reasonable site inspection by the contractor. (John A. Snow 2007) [25]

Some social and cultural conditions have some effect on the progress of the work; traditions, customs, and religion of the manpower play an effective factor in their productivity. Most manpower, if not all in the construction industry in Egypt and Yemen, is imported from different Villages and countryside. They have different social and cultural backgrounds which somehow effect their productivity. Familiarity of the manpower with the society and culture in the country will improve their productivity.

2.4.9 Adverse Weather and Natural Risks

It has been widely accepted and reported that weather condition affect the productivity in construction (Nkado 1995). Some of the changes in weather conditions are expected, like the four seasons and cyclical weather patterns. These are relatively easy to consider in a cost estimate. Because regular weather patterns are predictable, they do not create an uncontrollable risk to contractors.

In addition to these regular weather patterns, there can also be unexpected and an abrupt change in weather can cause delays and increase cost during construction. In evaluating the risk of the weather conditions factor, a contractor should not only investigate the probabilities and cost consequence of unfavorable weather conditions but also assess the exposure of the project to weather condition risk. If the construction project involves mostly outside work, then the significance of weather condition risk becomes higher. In those cases, a contractor should pay special attention to the cost effects of weather conditions (Akinci& Fischer 1995)[2]

there are five risk factors under the category of weather and environmental risks. As it can be seen, all the recognized risk factors acquired moderate risk level. That is because they have low likelihood and consequences of occurrence. These risk factors are lack of consideration of type of work, place of construction site, seasons

of the year, unusual and unforeseen weather- i.e. force majeure, lack of observing the safety measures and OSE by contractor, executing of earth work & road construction in winter, summer (Ghadak 2010)[37]

In Egypt and Yemen the natural risks such as earthquake, volcanic and flood are limited and rarely. But, these risks may occur such as the happening of the earthquake in Egypt in 1992 and Yemen in 1986. When these risks occur, the degree of impact will be high and then affect on construction projects.

The climate in Egypt Most of rain falls in the winter months; rainfall averages only around 2 to 5 mm per year and at intervals of many years. On a very thin strip of the northern coast the rainfall can be as high as 410 mm mostly between October and March. Temperatures average between 27 °C and 32 °C in summer, and up to 43 °C on the Red Sea coast. Winter temperatures average between 13 °C and 21 °C . and Yemen Rain in summer and lower in winter and rainfall 76 mm in the South coast and 229 mm in the West Coast and in terms of temperature, the Eastern and western plains are characterized by elevated temperatures up to 42 m in summer and fall in the winter to 25 m and temperatures gradually towards the Highlands by a height so that the temperatures to a maximum of 33 m and 20 m minimum winter temperatures on the Highlands Almost zero (Wikipedia)[17]. Some of these climatic conditions some time become very severe and the weather may affect the productivity of manpower and equipment, which could affect to contractor during construction, if the contractor did not make the necessary arrangements and precautions

2.4.10 Legal Risks

In the construction projects, the legal system and contract documents are the ground rules between all parties (contractor, owner, & consultant). There are three main functions of legal system and contract documents, they are:-

1. To set rules and standard between parties.
2. Law enforcement.
3. Disputes resolution.

The legal disputes between various parties in project are produced from uncertainty due legal actions or uncertainty in the applicability or interpretation of

contracts law and regulations. Legal disputes are major obstacles for any project. It will eventually delay the project, increase the project cost and makes a bad connection between the parties. (Bassem 2005)[22]

Permits and licenses should be a shared project risk. Building permits are often the contractor's responsibility. A proper contractor license for the jurisdiction is also risk carried by the contractor. Many legal and regulatory liability risks are covered by the various insurance policies purchased by the contracting parties. Changes in regulation, which may create additional project expenditures, are the owner's risk to be considered in their contingency. (Gary R. Smith, 1999) [63].

2.4.11 Government Regulation and Policies Risks

Some risks may arise from the interactions between the contractor and the host government and the surrounding environment or society. A political risk and Policies risk is an area of growing importance in risk identification in recent years. It is an area in which political and social pressures from the host government, different parties participated in the project, and international financing agencies play an important rule in project directions. Such different adversary or conflicting interests will impact the objectives of the project and greatly influences its outcome. Typically, political risks exist more in foreign operations or international projects. The main elements in this area are:

- Civil war and riots
- Expropriation of contractor's equipment by the government
- Customs and export / import restrictions on imported materials
- Embargoes on imported items
- Requirement to use local labor and materials
- Local laws and regulations. (Al-bahar 1990)[23]

In some projects many government authorities are involved in construction, many law and regulation should be considered in the contract and form a part of the contractor obligations. Long procedures and many measures must be applied in the government organizations, which normally take a long time, such as issuance of work permits, safety measures, and laborer and material importing measures.

The contractor should obtain work permits from all concerned government authorities. These authorities consist of municipalities, telephone department, Electricity Company, traffic department civil defense department, labor permits… etc. Each of these authorities has its own laws and regulations regarding work permits. In many cases the contractor faces difficulties in obtaining work permits from some of these authorities mentioned, especially the municipalities if mo. proper coordination has been done in the early planning and design of the project, or the contractor performs poorly.

Work permits are issued with restrictions in work area and time period according to municipalities' regulation. These restrictions could affect work progress. The owner and the contractor should have continuous communications and coordination with concerned government authorities to avoid problems, which may arise during construction. Both the owner and the contractor should coordinate with those authorities to apply their instructions and regulations. (Al-Ghafaly 1995)[36]

Change in some government regulations and law, such labor law, taxes law, trade law…etc. could create problems for a contractor, making him unable to provide the required resources. This then may affect on contractors` performance.(Bassem 2005)[22]

2.4.12 Summary of Risk Factors

The factors of risk facing the construction contractors as described previously could be summarized in groups according to their sources in the following :-

I. Construction and Job Site Risk Factors:-

1. Poor labor productivity.
2. Labor dispute and strike.
3. Shortage of labor skill and lack of labors' experience.
4. Accident on site and disease of labor.
5. Shortage of resources (labor, plant and material).
6. Delay in material delivery.
7. Increase wastage of material.

8. Failure of equipment.

9. Poor equipment productivity.

10. Poor quality.

11. Defective work.

12. Delay of construction project.

13. Loose safety rules and regulations with the contractor's organization.

14. Damage to structure during construction.

15. Stoppage of working.

II- Design Risk Factors: -

16. Incomplete in design and availability of information.

17. Ambiguities, fault, and inconsistency of specification.

18. Design change by owner or his agent during construction.

19. Design errors.

20. Difficulty the design, then difficulty in construction.

21. Late workshop drawing instruction.

III- Financial and Economic Risk Factors: -

22. Loss due to inflation (increase the price of materials, plants, labors .etc.).

23. Devaluation and varying rate of exchange.

24. Cost overrun due to planning estimation.

25. Delay in progress payment by the owner.

26. Cash flow problems and difficulties in financing the project by the contractor.

27. Pay liquidate damage.

IV- Management Risk Factors: -

28. Poor communication and coordination between all parties.

29. Lack of experience, incompetence, inefficiency, unreasonableness, and

In compatibility of project management team.

30. Ineffective planning and scheduling of project by the contractor.

31. Inadequate project organization structure.

32. Shortcoming of the measure and value process.

33. Delay in mobilization to start the project and survey late or survey in error by the contractor.

34. Improper selection of project type and location.

35. Change in key staffing throughout the project.

36. Bad accelerate to deliver project by using extra resources.

37. Improper technical study of project in the bidding stage.

38. Shortage of contractor's administrative personnel.

39. Happening the theft in the site of project.

V- Owner Risk Factors: -

40. Delay in furnishing and delivering the site to the contractor.

41. Delay in settlement of contractor's claim by the owner.

42. Suspension of work by the owner.

43. Delay in making decisions by the owner within a reasonable time.

44. Interference by the owner in construction.

45. Uncooperative owner with contractor.

46. Excessive bureaucracy in the owner administration.

47. Change in the scope of the project from the owner (e.g. quantities of

workitem, new item, new area,…..etc).

48. Original contract duration is too short from the owner.

VI- Supervision Risk Factors: -

49. Poor qualification of supervision staff of consultant engineer.

50. Delay in approval of contractor submittals by the consultant engineer (sample, tables, planning…etc).

51. Delay in performing inspection & testing by the consultant.

52. The conflict between contractor and consultant.

VII- Subcontractor Risk Factors: -

53. Subcontractor's law credibility.

54. Shortage of subcontractors.

55. Subcontractor problems with main contractor.

56. Cash flow problems faced by the Subcontractor.

VIII- Site Conditions Risk Factors: -

57. Change or differing site condition (access to the site, infrastructure surrounding, existing building...etc.).

58. Shortage in supply of water, gas, electricity …etc.

59. Effect of subsurface condition (soil composition, existent utilities, high water table ,...etc.).

60. Difficult to arrive to the site of project.

61. Effect of social and cultural condition.

IX- Adverse Weather and Natural Risk Factors: -

62. Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm...etc.).

63. Happening the floods and flowages.

64. Happening the earthquake.

65. Happening the volcanic.

66. Happening the fire in the site of project.

X - Legal Risk Factors: -

67. Delay to get on legal right.

68. Legal disputes between various parties in the project.

XI- Government Regulation and Policies Risk Factors: -

69. Difficulties in obtaining work permits from the authorities.

70. Change in government regulation and law (taxes law, labor law, trade law...etc).

71. Loss due to war, civil disorder, revolution...etc**.**

2.5 RISK RESPONSE TECHNIQUES

This part reviews the response management process. Once the risks of a project have been identified and analyzed, an appropriate method of treating each risk must be adopted. The various strategies or combination of strategies used to manage risks are developed and will be discussed in this part

2.5.1 The Objective of the Response Management Process:

Having identified the risk exposure, and evaluated probabilistic ally its potential financial impact, it is time to take action. Identifying and evaluating project risks is the preparatory work, and if nothing is done the risks remain. Within the framework of risk management, the contractor should decide how to handle or treat each risk. This is the primary function of the response management process. The contractor will formulate suitable risk treatment strategies. These strategies are generally based on the nature and potential consequences of the risk. The objective of these strategies is twofold: (1) to remove as much as possible the potential impact, and (2) increase control of risk

2.5.2 Response Management Approach

In general there are two basic approaches to managing a risk. First, through measures aimed at avoiding or reducing the probability and/or potential severity of losses occurring. Such an approach is called risk control and includes: (1) avoidance, (2) loss reduction and prevention, and (3) some transfer. Second, through making provisions to finance the losses that do occur. Such an approach is called risk finance and includes: (1) retention through self-insurance and funding, (2) those transfers that are not considered as risk control devices such as contractual transfer, and (3) commercial insurance.

2.5.3 Development of Alternative Strategies

Several authors have suggested different responses to risk. Mason (1973) gave four basic methods of risk treatment. These are: risk avoidance, risk abatement, risk retention, and risk transfer. In his model Mason considered the management of potentially adverse "pure risk events only. We suggest, however, that the concept should be extended to include risk management to achieve benefits through opportunity or loss minimization. Fraser (1978) also identified four responses to risk. There are: avoidance, insurance, control and retention.

Although the terms used are different, it is fairly obvious that collectively five differing responses to

risk can be identified. Within the framework of risk management, these are:

• Risk avoidance

• Loss reduction and risk prevention

• Risk retention

• Risk transfer (non-insurance or contractual)

• Insurance (Albahar 1990)[23]

2.5.4 Risk Avoidance

Avoidance involves changing the project plan to eliminate the risk or to protect the project objectives (time, cost, scope, quality) from its impact. The team might achieve this by changing scope, adding time, or adding resources (thus relaxing the so-called “triple constraint”).These changes may require a Programming Change Request (PCR). Some negative risks (threats) that arise early in the project can be avoided by clarifying requirement, obtaining, improving communication, or acquiring expertise. Project Risk Management Handbook2007 [51].

Risk avoidance is sometimes called risk elimination. A contractor not bidding on a project or an owner deciding not to proceed with the project are simple examples of risk avoidance. Ali salman2004[7]

a different course is taken so that the likelihood of the risk is reduced to zero Rifat Akbiyikli, David Eaton[54]

Risk avoidance is changing the project plan to eliminate the risk or condition or to protect the project objectives from its impact. Although the project team can never eliminate all risk events, some specific risks may be avoided .pmbok2000(4)

baker 1998[60] :Sometimes referred to as risk elimination. Avoiding risk can be as simple as a contractor not placing a bid or even the owner not proceeding with project funding.

There are a number of ways a contractor can eliminate risks and a few examples are

given below:

- placing conditions on the bid, a method employed during pre-contract
- tendering at a very high bid,
- negotiations as to which party takes full responsibility for certain risks, and not bidding on the high-risk portion of the contract

Avoidance actions include: change project management plan to eliminate a threat, to isolate project objectives from the risk's impact, or to relax the project objective that is in jeopardy, such as extending schedule or reducing scope. Some risks that arise early in the project can be avoided by clarifying requirements, obtaining information, improving communication, or acquiring expertise WSDOTPMBOK [50]

2.5.5 Risk transfer

Risk transfer means the shift of risk responsibility to another party either by insurance or by contract. Wang and Chou reported that contractors usually use three methods to transfer risk in construction projects: (1) through insurance to insurance companies; (2) through subcontracting to subcontractor; and (3) through modifying the contract terms and conditions to client or other parties. Wang and Chou (2003)[42]

Risk transference requires shifting the negative impact of a threat, along with ownership of the response, to a third party. An example would be the team transfers the financial impact of risk by contracting out some aspect of the work. Transference reduces the risk only if the contractor is more capable of taking steps to reduce the risk and does so. Risk transference nearly always involves payment of a risk premium to the party taking on the risk Project Risk Management Handbook2007[51].

Risk transfer is seeking to shift the consequence of a risk to a third party together with ownership of the response. Transferring the risk simply gives another party responsibility for its management; it does not eliminate it (PMBOK 2000)[4]

Transferring risk does not reduce the severity of the source of risk. It only shifts the risk to another party to deal with it. In some cases, risk transfer can significantly increase risk because sometimes the party to whom it is being transferred may not be capable of handling the risk. For example, a general contractor might transfer risk to an incompetent sub-contractor who can not handle the risk and this ends up in a more risky situation. Ali salman 2004[7]

(Thompson And Perry 1992)[68] Risk transfer can take two basic forms:

1- The property or activity responsible for the risk may Be transferred, i.e. hire a subcontractor to work on a hazardous process.
2- The property or activity may be retained, but the financial risk transferring the risk, for example, through risk sharing or establishing a captive insurance company

Transferring the risks does not eliminate it; the threat still exists however it is owned and managed by another party. Transferring risk can be an effective way to deal with financial risk exposure. Transferring project risk almost always involves payment of a risk premium to the party taking the risk, examples include: Insurance, performance bonds, warranties, etc. Contracts may be used to transfer specified risks to another party. (WSDOTPMBOK)[50]

Transferring risk involves finding another party who is willing to take responsibility for its management, and who will bear the liability of the risk should it occur. The aim is to ensure that the risk is owned and managed by the party best able to deal with it effectively. Risk transfer usually involves payment of a premium, and the cost-effectiveness of this must be considered when deciding whether to adopt .(WSDOTPMBOK)[50]

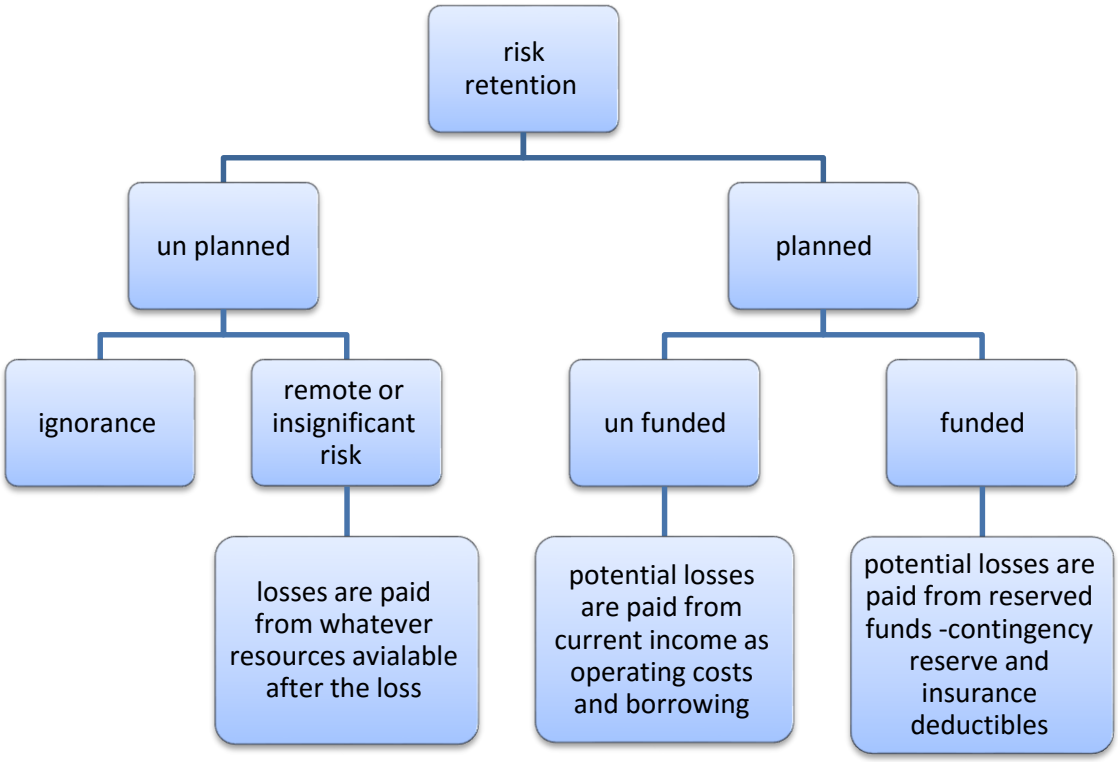
2.5.6 Risk retention

Risk retention is sometimes called risk absorption. Not all risks can be transferred, but even if they can be transferred it may be more economical to retain

them. Risks that produce small and repetitive losses that can be best controlled should be retained .(Ali salman 2004)[7]

Risk retention is becoming an increasing important aspect of risk management when dealing with project risks. Risk retention is the internal assumption, partially or completely, of the financial impact of risk by the firm. The prudent use of risk retention could create substantial cost savings.

Risk retention is a financial plan within the firm to meet its loss exposure. Here, the potential losses attributable to a risk are directly absorbed by the firm. In adopting the risk retention strategy, however, it is important to distinguish between two different types of retention. Risk retention can be either planned or unplanned as shown in Figure 2.6



- **FIGURE 2.6 Risk retention methods albahar 1989[23]**

For some risks, where the potential financial consequences are minor, or insignificant, unplanned retention will commonly be the response mode. This is simply because recognition of their existence is the only attention they warrant, and the cost of treating them is greater than its financial potential impact. (Albahar 1989)[23]

2.5.7 Risk reduction

Risk reduction is about decreasing the probability, the consequences or a combination thereof for a risk to breakout. This could be done in several ways, of which sharing with other parties or taking some action where the probabilities or consequences become reduced is common .(KajsaSimu2006)[26]

Risk reduction is sometimes called risk control. It may be argued that reducing risks is a part of risk retention because the risks have to be retained before they can be reduced (Baker et al 1999)[60].

Usually risks related to safety can be reduced. Reduction falls into three basic categories:

First, is the education and training programs that alert the staff to potential risks within the working environment. Loss prevention programs and safety alerts and training play major roles in preventing accidents and consequently reduce risks.

Second, is the physical protection of people and equipment's? Continuous maintenance and updating of equipment and tools help prevent damages and losses and in turns reduce risks.

Third, is the consistent company's systems and procedures. Clear procedures, good housekeeping, first aid and security procedures can lead to a better working environment, improved labor relations and increased productivity which in turn reduce risks. (salman Ali 2004)[7]

Loss prevention is one of the ways of risk reduction. Loss prevention can be classified into four basic categories:

1-Preconditions for a loss, i.e. faults in the premises, e.g. badly insulated wire,

2- Prevention of loss; devices designed to prevent preconditions for loss, e.g. cut-off switches

3- Early discovery of loss producing events, e.g. sprinkler system, and

4- Limitation of loss, e.g. fire doors, compartmentalization .baker 1997[60]

2.5.8 Risk Mitigation

implies a reduction in the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action is often more effective to repair than trying to repair the damage after the risk has occurred. Examples of mitigation strategies include: adopting less complex processes, conducting more tests and/or field investigations, developing a prototype; measures to address impact include: targeting linkages that determine the severity, such as designing redundancy into a subsystem may reduce the impact from a failure of the original component. (PMBOK2013)[4]

Risk mitigation implies a reduction in the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action to reduce the probability and/or impact of a risk is often more effective than trying to repair the damage after the risk has occurred Project Risk Management .(Handbook2007)[51].

Mitigation or acceptance or the strategies most often used since the number of threats that can be addressed by avoidance or transfer are usually limited. Preventive responses are better than curative responses because they are more pro-active and if successful can lead to risk avoidance. Preventive responses tackle the causes of the risk; where it is not possible to reduce probability a mitigation response should address the adverse impact, targeting the drivers that determine the extent of the severity. (Hillson)[26]

2.6 PREVIOUS STUDIES

Porter (1980)[55] identified the risk factors facing the Russian construction industry. The survey consisted of 46 questions the risks are grouped into four main groups:

- External risks to the project team: complexity of the project, site limitations, remoteness, availability of suppliers, inflation, labor and equipment availability, labor and equipment productivity, etc.
- Internal risks to the project team: the team's track record in construction project management, team's educational and technological experience and competency to undertake the project successfully, sufficient financial sources, etc.

- Project planning and execution risks: input from all groups involved, permits and regulations, scope definition, etc.
- Organizational structure and systems risks: reward structure, operating procedures, dispute resolution processes, etc.
- The authors concluded that there are risk factors considered important by companies. These are:

- Permits and ordinances
- Delayed payment on contract
- Financial failure — any party
- Adequacy of specs and scope definition
- Contract-delay resolution
- Contractor competence (experience in past projects, educational background of team members)

Al-Hazmi (1987)[27]presented causes of delay in large building construction projects in Saudi Arabia. He introduced types and causes of delays, which that may occur in those projects. He mentioned fifty-six significant factors that cause delays, which are combined into nine major areas. He evaluated their degree of important and indicated the most serve factors. He concluded that the most important factors causing delays in large building in construction project are the following: -

1. Financial problems that are given the highest ranking among the causes of delay. These problems result from delay in progress payments that are caused by the owner's or the consultant's late approvals. The delay in progress creates cash flow problems for the contractor, which causes financial problems.
2. Slowness of the decision making process and excessive bureaucracy in owner operation.
3. Design change as a result of inadequate early planning of the project.
4. Difficulties in coordination and communications among various parties in the project.
5. Preparation and approval of shop drawings.

Strassman and Wells (1988)[22] identified several risk factors associated a construction project. From a client's perspective, these risk factors include fears that: -

1. Cost will escalate unpredictably.
2. Structures 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 perspective the risk factors include: -

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 change.
7. Faulty subcontracting.
8. Unproductive labor and strikes.

Kangari (1995)[28]discussed the current attitude of large construction contractors in USA toward risk, determined the most important of risk, and allocated the risk between owner and contractor. He prepared the questionnaire, which contain twenty-three risk factors and distributed to forty-nine U.S contractors to determine the degree of importance of risks. The identification of risk was included in the questionnaire under the heading of importance. The question was designed to determine the relative importance of each risk category from a contractor's viewpoint. The importance of risk was classified into three scales (Low, Mid, High). The author concluded his study by identifying the five most important risk factors affecting the U.S contractors.

Five most important risk factors are: -

1. Safety.

2. Quality of work.
3. Defective design.
4. Labor and equipment productivity.
5. Contractor competence.

Zhi (1995)[21]developed the method of managing various risk factors for oversea construction projects. A useful risk assessment technique was introduced which combines risk probability analysis with risk impact assessment. Whereas, the risk concept was broken down into two main criteria: -

i The probability, which is the possibility of an undesirable occurrence

i. The impact, which is the degree of seriousness and the scale of the impact on other activities if the undesirable thing occurs.

A residential-commercial complex building was studied as a case study. Thirty-six professionals were asked to select the most important risk factors from twenty-one risk factors. The most important risk factors are: -

1. High inflation.
2. Bureaucracy.
3. Low social security at the location.
4. Corruption.
5. Lack of nearby education and transportation facilities.
6. lack of nearby transportation facility;
7. tax rate changes;
8. exchange rate fluctuations;

Abbasi&M.et al (2004)[18] the researcher investigated from the major risk factors influencing the upper three classes of the Jordanian construction industry companies undertaking the majority of the projects. Administrative, financial, resources,

manpower, and technical problems were investigated. Two questionnaires were conducted for the three construction company classes; one to evaluate risk factors and the other to suggest solutions. the Researcher using SPSS for Statistical analysis carried

The study showed According to the first-class companies, two major problems were ranked highest in the administrative category of the questionnaire. These are: the absence of administrative experience in business administration and the contractor's lack of scientific knowledge

Second-class Financial support by the owner is an important risk factor.

All companies of the three different classes agreed that payments delay is the most important risk.

From a technical point of view, the first and second-class companies agreed that the absence of actual supervision and monitoring on behalf of the designer offices is classified as first risk factor. This implies that engineering offices are not providing fully detailed drawings, and therefore more time is consumed on understanding and correcting drawings, leading to less profit

Results had shown that company problems are increasing with the rising in company classification

Aibinu and Odenyinka (2006)[42] investigated and assessed the causes of delays in building projects in Nigeria. The nine factor categories evaluated include: client , contractor , quantity surveyor , architect , structural engineer , services engineer , supplier , and subcontractor caused delays, and external factors (i.e. delays not caused by the project participants). Finally, ten overall delay factors were identified, namely: contractors' financial difficulties, client' cash flow problems, architects' incomplete drawings, subcontractors' slow mobilization, equipment breakdown and maintenance problems, suppliers; late delivery of ordered materials, incomplete structural drawings, contractors' planning and scheduling problems, price escalation, and subcontractors' financial difficulties. The authors pointed the poor risk management as one of the principal delay factors and concluded that actions and inactions of construction project partici- pants contribute to overall project delays.

WenzheTang&MaoshanQiang (2007)[68] This paper reports the finding of an empirical Chinese industry survey on the importance of project risks, application of risk management techniques, status of the risk management system, and the barriers to risk management, which were perceived by the main project participants. The risk management strategies adopted in the Three Gorges Project were also studied. The study reveals that:

The Five most important project risks are “poor quality of work,” “premature failure of the facility,” “safety,” “inadequate or incorrect design,” and “ financial risk.

- The overall rating on the extent to which the project participants apply the risk management techniques is moderate.

- The risk management systems applied in the industry tend to be informal, which are inadequate to manage project risks;

- Lack of joint risk management mechanisms by parties

SamehMonir (2007)[59]. Identified and assess the significant risks in the UAE construction industry and addresses their proper allocation. Data were collected through a questionnaire distributed to construction experts. The study reveals that economic risks such as inflation and sudden changes in prices, shortage in material and labor supply are significant. Other significant risks include owner risks such as unrealistic construction schedule, improper intervention and changes in design. Political, social and cultural risks are found to be insignificant.

Ahmed et al. (2007)[29] reviewed techniques that can be used for development of risk management tools for engineering projects. Techniques for context establishment, risk identification, risk assessment and treatment were provided. Application of risk management tools depends on the nature of the project, organization’s policy, project management strategy, risk attitude of the project team members, and availability of the resources

suliman(2007)[8] discussed the risk assessment methodology that provides a decision support tool, directed for Turkish construction organizations, which can be utilized through the bidding decisions for international construction projects. Within this context the analytic network process technique is implemented to develop a risk assessment model, which is used to derive the relative priorities of the risk factors

associated with international construction projects . They concluded their study by risk assessment model have demonstrated that the most significant sources of risk are vagueness of contract conditions about risk allocation, client, and immaturity of legal system in the host country, the company's experience, contract type, level of the available project data from the outset, and project delivery system

M. E. Abd El-RazekH. A.Bassioni A. M. Mobarak (2008)[31]he objective of this research was to identify the main causes of delay that affect building projects in Egypt, discussed the main causes of delay in construction projects in Egypt from the point of view of contractors, consultants, and owners . The survey included different factors leading to causes of delay.

The overall results indicated that the most important causes are: financing by contractor during construction, delays in contractor's payment by owner, design changes by owner or his agent during construction, partial payments during construction, and non utilization of professional construction/contractual management. Furthermore, causes of project delay were discussed based on the type and size of the project.

They concluded the Most Important Causes by Project Size are the following :

<5,000,000 EGP

Design changes by owner or his agent during construction

Financing by contractor during construction

Unexpected foundation conditions encountered in the field

Obtaining permits from municipality

Delays in contractor's payment by owner

Inspection and testing procedures used in the project

5,000,000–24,000,000 EGP

Financing by contractor during construction

Slowness of the owner decision making process

Difficulty of coordination between various parties ?contractor, subcontractor, owner, consultant ? working on the project

Controlling subcontractors by main contractor in the execution of work

Delays in contractor's payment by owner

>24,000,000 EGP

Partial payments during construction

Design changes by owner or his agent during construction

Delays in contractor's payment by owner

Slow delivery of materials

Financing by contractor during construction

Azhar 2008[43] studied of construction contractors in Pakistan about the risk associated with its activities and the extent to which the industry uses risk analysis and management techniques . The study has investigated the perception of the contractors regarding risk importance and risk allocation. The purpose was to provide insight into the current attitude of Pakistani contractors towards construction risk allocation and also to examine the importance of different risk categories. The research results indicated out that The main difficulties during the risks management processes in the descending order are: the lack of qualified experts; lack of budget; complexity of tools and techniques; lack of top management commitment and support; and lack of historical data. This research also presents two types of risk management methods: preventive, which are effective at the early stages of the project life, and mitigative, which are remedial actions aimed at risk minimization during construction.

Enshassi , et al (2008)[1] presented the research study seeks to identify and evaluate key risk factors and their preventive and mitigating measures in building projects in Palestine. It also seeks to investigate the severity and allocation of each identified risk factor according to the contractors' perspective. the Researcher was conducted A questionnaire survey and a total of forty-four critical risk factors were identified and categorized into nine groups : physical, environmental, design, logistics, financial, legal, management, political, and construction..

The authors concluded that there are ten risk factors considered very important by contractor. These are:

Financial failure of the contractor

1. Working at hot (dangerous) areas (close to IDF positions)
2. Closure
3. Defective design (incorrect)
4. Delayed payments on contract
5. Segmentation of Gaza Strip
6. Unstable security circumstances (Invasions)
7. Poor communication between involved parties
8. Unmanaged cash flow
9. Awarding the design to unqualified

Saleh (2009)[5], presented This paper presents the findings of a survey aimed for identifying some of the most important causes of That lead to delays in construction projects in the Zentan (Libya)

They concluded their study by identifying the most important risk factors That lead to delays in construction projects in the Benghazi . These are: -

Improper Planning, Lack of Effective Communication, Design Errors, Shortage of Supply i.e. steel, concrete, etc. ,Financial Issues, Shortage of Material , Cash-Flow Problems During Construction ,Mismanagement by The Contractor (Financial, Supplier Support, Sub-Contractor), Executive Bureaucracy in The Owners' Organizations, Changes in Site Conditions ,Conflicts in Work Schedules of Subcontractors.

Researcher also found to some of the points that Avoidance of delays in construction projects in the city of Zentan. These are:-

Making Risk Management, Proper Planning, Proper Payment from Client, Prepare Insurance Claims, Good Scheduling Programmed ,Client Representative for Project .Selecting Expert Understand Their Assignment ,Clear Contract and BQ ,Compute the Amount of Financial Damages

Musibau (2009)[40]This study was conducted to assess the risk management practices of major contracting firms in the United States. The population for the study consisted of top 400 contractors listed in the ENR 2008 publication. Of this population, a sample of 200 participants was randomly selected to participate in the

study and use of Monte Carlo simulation for risk analysis. The study found that most contractors had formal written procedures for risk management, indicating an awareness of the importance of risk management in construction business. Also, contractors of all various work specialties had similar perception towards the importance of project risks. General contractors did not differ in their practices of risk management techniques, except for the use of site visit in risk identification, consideration of economic condition of the country in assessing risk importance. During the process of risk management, contractors use a wide variety of techniques in their practice. However, in risk analysis, traditional method of analysis using intuition/judgment/ experience is still the most commonly used technique. Qualitative risk analysis methods are also widely used. The findings of this study parallel other research findings that suggest that only few techniques were currently being used for risk monitoring. Although there was no single dominant barrier to risk management implementation, the lack of joint risk management, risk consciousness, expertise in risk management, and lack of time need to be addressed in order to improve risk management practices.

Analysis of the findings shows that 7 of the 14 construction project risks were ranked by the general contractors to be very important or severe. These risks include: safety, defective design, quality of work, financial risk and incompetence of subcontractors and Claims and disputes and Inflation & sudden changes in price (in descending order).

NerijaBanaitien,AudriusBanaitis (2009)[42] identified the risk factors associated with the Lithuanian construction company. risk factors on construction projects split into two major groups: (1) Internal risks, which fall within the control of clients, consultants and contractors; and (2) External risks, which include risk elements that are not in the control of key stakeholders.

The identified external risks according to their potential effect on construction project objectives were ranked. In the first survey, the top three important external risks identified are: (1) Natural forces; (2) Inflation and interest rate; and (3) Fiscal policy. In the second survey, the top three important external risks identified are: (1) Fiscal policy; (2) Natural forces; and (3) Political controls.

Mostafa (2010)[37] discussed the risk management implementation in the iranian construction industry from contractors' perspective, The aim of this study is to improve the implementation of risk management within contractor companies in the Iranian construction industry through the evaluation of the contractors' perception of risk management.

The results show that there are eleven barriers in Iranian construction industry preventing contractors from implementing risk management, seven of which evaluated as important, whereas the rest had average importance. The important barriers are as follows:

i. Lack of familiarity with techniques

ii. Lack of information and knowledge

iii. Unsupportive culture in construction industry

iv. Lack of practical experience in the techniques

v. Multiplicity of variable factors in projects which makes the recognition and using of them very hard in risk management

vi. Lack of political, financial, cultural,... stability which will result in difficulty predicting everything

vii. Lack of real & practical planning

Muna (2012)[38] presented the sources of risks that effect on construction projects in Syria. A questionnaire was designed to define the probability of risk occurrence and their effects, also to define the level of their effects by multiplying the probability occurrence with the effects. Another questionnaire was designed to define the extent of the effects of the most important risks on each target of the project, and to specify the procedures applied as a response to the risks.

The results of this research revealed that "the Inflation, price changes" and "the difference between contracted quantities and actual quantities " are seen as the most important risk, where the studied risks in this work affect the schedule more than any other project targets. Also the results showed that avoiding the risks at the construction stage is the most used action.

Mohammad AnisurRahman& Nicholas Chileshe (2012)[34] addressesd the process of pricing quality related risk at the bidding stage in the competitive method of procurement, While some studies have been undertaken in other states of Australia, they are limited studies dealing with contractor's perception about quality while considering risks and during bidding stage in the South Australia region. The aim of this study is to ascertain the attitudes, perceptions and identify the general practices of contractors in pricing risks and secondly to find out their practices towards quality related risks during the tendering stage. The data was elicited using a survey sample of a cross-section of 23 construction contractors registered with the Master Builders Association of South Australian (MBASA), and the results were analysed using frequency distribution. The results show that the majority of the contractors do not use any risk management processes. Usage was dependent on experience and judgment of the decision makers. Three prominent practices established were consideration for adding only high ranked risks with the base cost, additional of a percentage in the overall cost, and pricing high ranked risks independently and then adding additional lump sum for the residual risk. The identification of these practices could benefit the contractor's in pricing risks more effectively and negate the conflicts arising through the dissatisfaction from the non-performance and quality related issues.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Several Problems have been observed taking place in the construction industry. One of the most important risks facing the construction contractors are due to the factor that affect productivity, performance, quality, duration and/or budget the construction project.

For this reason definition and analysis of risk facing contractor is an important part of the decision making process and allow avoiding problem in construction companies

This research is a field survey study through a structured questionnaire which directed to the construction contractors in Egypt and Yemen.

This chapter will explain how the research was conducted to achieve the objectives of this study. The chosen research methodology is composed of an extensive literature review, questionnaire survey among construction contractors in Egypt and Yemen . The survey will identify the probability of occurrence and degree of impact of risks, and ranking these risks based on their importance .the methodology of this research which includes the general study approach, the questionnaire development & design, and statistical sampling. The statistical sampling includes sample selection and sample size determination .

3.2 GENERAL STUDY APPROACH

The research procedure for this thesis includes for the following:

• Clear understanding of the problem being studied

• Definition of the research objectives

• Description and justification of the point of departure

• Identification of fundamental research issues

• Definition of all the elements and components that comprise the research

• A clear methodology to perform the investigation, and summarizing in the following points(as shown in figure . 3.1) :-

1. Preliminary interviews with experts were carried to get some ideas to establish the problem and to understand the nature of the risk analysis.

2. Perform a comprehensive literature review of related to the topic, of this study, in addition to interviews and discussions with contractor's engineers and consultant engineers, to collect data and identify the types of risks facing the contractors in construction projects.

3. Use the collected data to develop and design a comprehensive questionnaire that covers the required risk sources of risk and their probability of occurrence and their impact.

4. Conduct a field surveys in Egypt and Yemen (as a sample) by electronic mails and by hand to the prospective respondents for collecting the field data and their opinions.

5. Perform statistical analysis for data by using applicable statistical techniques.

6. Ranking the sources of risks according to their importance.

8. Report and discuss results and major findings to introduce , conclusion and recommendations for future work.

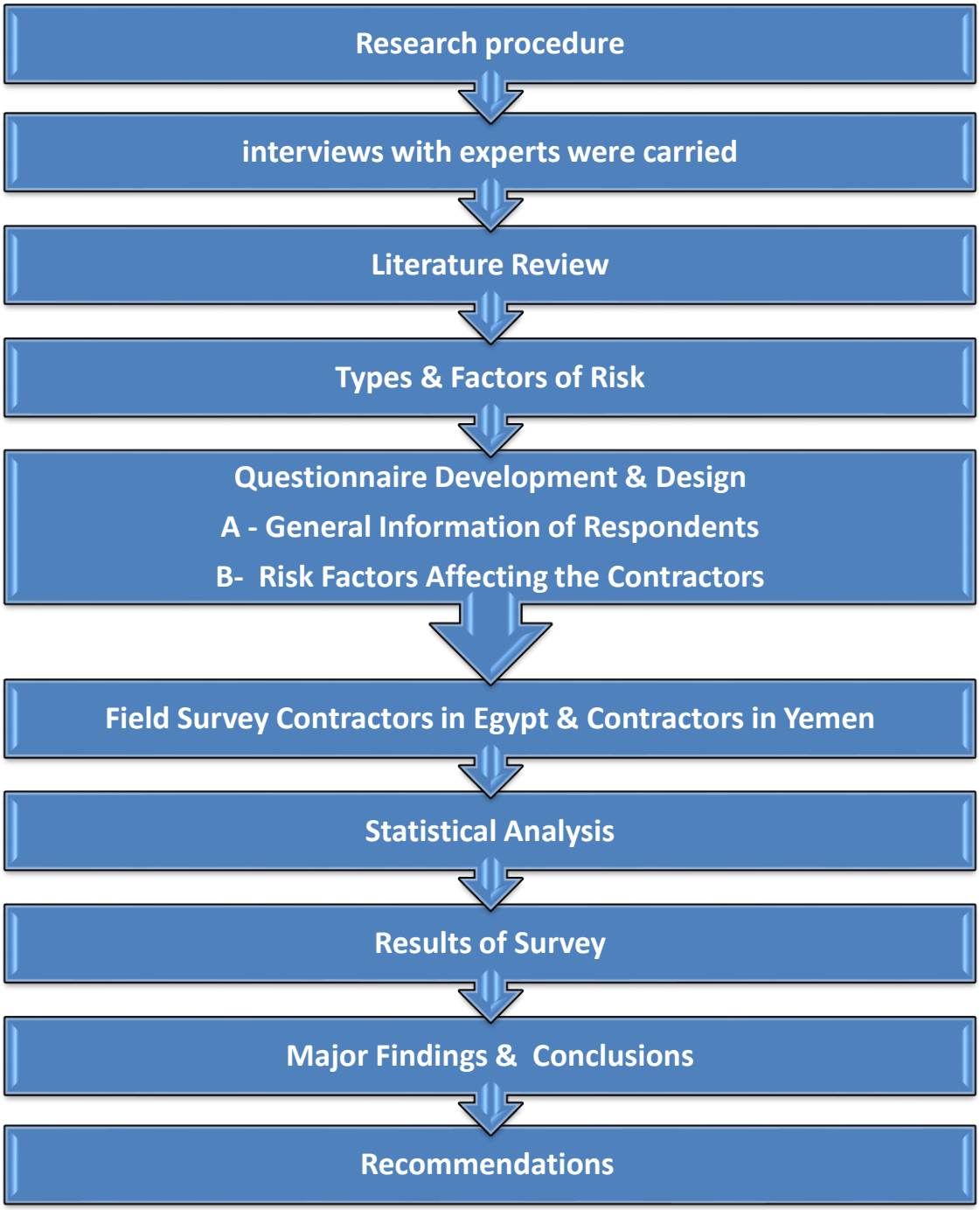


Figure 3.1 Study Approach Diagram

According to this study's objectives, the data required are two types:-

1. Data concerning the identification and description of the various risk factors affecting the construction contractors.
2. Data concerning identification the importance risk factors measured by their probability of occurrence and impact of degree.

The first types of data will be gathered through a review of literature dealing with risk management in construction projects. The second types of data will be obtained by a field survey for probability of occurrence and impact of the risk factors identified in the literature review to determine the importance of the risk factors.

3.3 SURVEY RESEARCH

3.3.1 Questionnaire Survey Approach

Due to the non-availability of organized information relating to risk analysis and assessment in construction contractors in Egypt and Yemen construction industry, a mail questionnaire survey approach was considered. This approach is well recognized and widely used in both social sciences and management research studies. In the area of construction management, many researchers have used this approach (Assaf et al, 1995; Chan and Kumaraswamy, 1997; Odeh and Battaineh, 2000; Kartam and Kartam, 2001; El-Dash and Monem, 2004; Assaf and Al-Hejji, 2006). Some of the advantages of mail questionnaire approaches are low cost, greater anonymity, reduction in bias and wider geographic coverage

3.3.2 Questionnaire Development And Design

Questionnaires are extremely critical components of the research process because they identify which information is important and the opinion of the participants about the problem discussed. The design of the questionnaire required very careful consideration. One should aim at formulating the questions such that no misinterpretation is possible. To do this, the following points should be taken into consideration in designing the questionnaire:-

1. Proper introduction to the questionnaire explaining the purpose of
2. Estimate the time needed to Procedure the questionnaire
3. Use words that are simple and direct
4. Study and emphasizing the confidentiality of responses.
5. Questions must give the information required.
6. Questions must be concise and clear.

7. Questions must be presented in the best sequence possible, preferably from simplest to most complex.

The questionnaire was identified from interviews with contractor's construction and through literature review. The survey questionnaire was administered by the means of two different ways. Firstly, through e-mail and fax, and postal questionnaire, and secondly, through distribution by the researcher to the selected contractors (project managers, managing directors, chairmen, head of technical departments) operating in the Egypt and Yemen contractor industry. The personal delivery approach was deliberate to ensure that respondents fully understood the aim of the study and that no part of the questionnaire was ambiguous to any of the respondents.

A questionnaire (Appendix A) was chosen as the principal survey method. The respondents comprise of contractors companies in the Egyptian Federation for Construction & Building Contractors in Egypt in Grade 1 & 2& 3& 4 & 5 in Yemen registering with ministry of public works and highway in Grade 1 & 2& 3&4& 5 . The chosen respondents were initially identified and contacted via personal relationships and reputation. Direct contact confirmed their willingness to assist in this study.

Questionnaire was distributed to contractors within the defined scope limitations of this study in Egypt (Cairo & Alexandria& Ismailia) and Yemen (Sana'a&Aden&Taiz&Ibb).

A questionnaire was developed to assess the perceptions of consultants, and contractors on the relative importance of risk analysis and assessment for contractors industry. The questionnaire consists of two parts. Part (A) is related to general information about the contractors. The respondents were requested to answer general information (for e.g. work experience, organization, annual volume of construction work) . Part (B) includes the list of the potential risk factors facing the contractors during construction projects. It contains seventy-one risk factors, for each risk factor there are two main questions, one for measuring the probability of occurrence and the other for measuring the degree of impact of each factor when it will occur. Both the probability of occurrence and impact of degree are based on a five-point scale. These five points are (very high), (high), (moderate), (low), and

(very low) for probability of occurrence and also for degree of impacts. (PMBOK 2000)[4].

3.4 STATISTICAL SAMPLING

3.4.1 Sample Selection

The total population of the study is all the classified construction contractors in Egypt and Yemen. A sample is selected to represent the whole population. Three conditions are maintained in order to ensure that the sample is representation of the population:

1. Equal chance: -

This means that every element in the population has the same chance of being selected. In order to satisfy this condition, the sample was randomly selected.

2. Appropriateness: -

This means that the selected sample should precisely reflect the characteristics of the whole population. The sample subjects should have characteristics similar to those of the population.

3. Independence: -

Although thesis not a problem when the sample is randomly selected, but it should be emphasized that the selection of one subject is totally independent from the selection of other subjects. bassem(2005)[22]

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. By carefully considering the research theme from different angles and to avoid any possible conflict and discrepancies in the collected data, only construction contractors were selected. The sample survey was selected from the Egyptian Federation for Construction & Building Contractors in Egypt , from ministry of public works and highway in Yemen

In The Egyptian Federation for Construction & Building Contractors in Egypt classified the contractors from first grade to seventh grade. But the ministry of public works and highway in Yemen classified the contractors from first grade to

sixth grade. This classification in both countries depend on the Capital , business volume, the contractor's annual business, experience of contractors, technical staff, financial staff, number of permanent employees, the value of equipment owned, legal & management staff…etc.

3.4.2 Sample size

The sample size that would represent the population for the survey was calculated based on the following formula (Kish, 1995)[7]

$$n = \frac{n^0}{1 + \left(\frac{n^0}{N}\right)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

$$n^0 = \frac{p*q}{v} \quad \ldots\ldots\ldots\ldots\ldots\ldots 2$$

Where:

n^o= First estimate of sample size

p = the proportion of the characteristic being measured in the target population

q = l-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 5%.

3.4.2.1 Sample Size in Egypt

According to the Egyptian Federation for Construction & Building Contractors in Egypt in 2012 AD[48], the approximately number of contractors in Cairo and Alexandria and Ismailia and Suez without the contractors having the seventh grade is 12500 contractors[49],which is the whole population. The size of the sample is determined by using the equation (3.1).

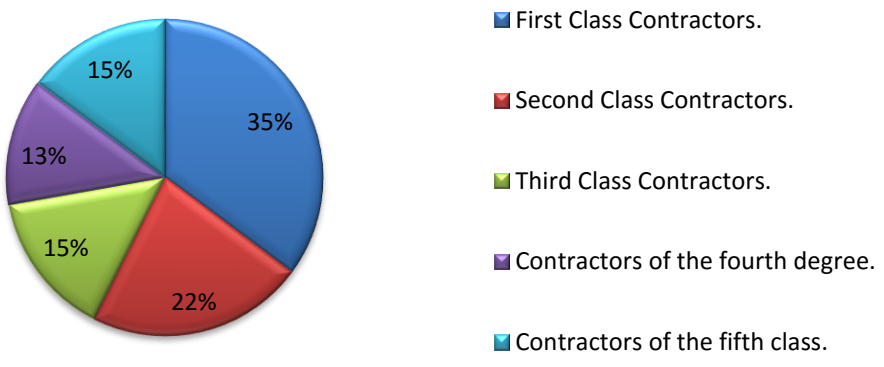
In this study, the contractors in Egypt have been divided into five classes according to the classified the Egyptian Federation for Construction & Building Contractors in Egypt in 2012 AD .

- First Class Contractors (38 contractors)
- Second Class Contractors (24 contractors)
- Third Class Contractors (16 contractors)
- Contractors of the fourth degree (14 contractors)
- Contractors of the fifth class (16 contractors)

The contractors having sixth, seventh grade are removed and neglected from this study because they are considered low experience in the construction industry, and their works are very small compared with the top rated companies.

Out of 150 questionnaires sent, 108 responses were received out of which 5 were incomplete and discarded. The response rate of 72% percent is considered to be very good for this kind of a Field survey. The reliability of the survey results is expected to be high because all the respondents are engineers and top-level experienced management officials in their companies. The summary of the survey responses is given in figure 3.2

figure 3.2 Sample Size in Egypt



3.4.2.2 Sample Size in Yemen

According to the Ministry of Public Work and highway in Yemen in 2012 AD, the approximately number of contractors in Sana'a and Aden and Taiz and Ibb is 555 contractors, which is the whole population. The size of the sample is determined by using the equation (3.1),

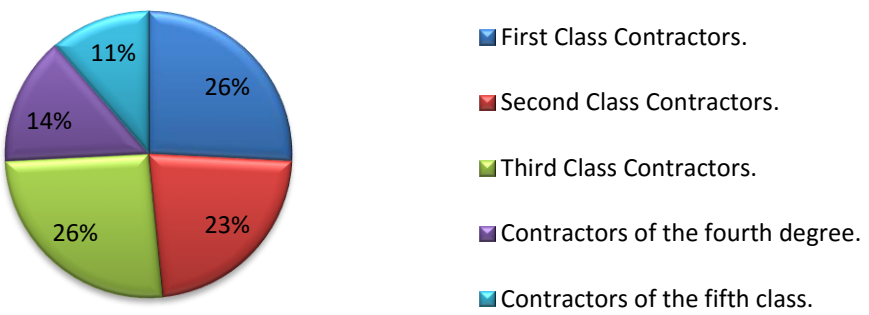
In this study, the contractors in Yemen have been divided into five classes according to the classified the Ministry of Public Work and highway in Yemen in 2012 AD .

- First Class Contractors (32 contractors)
- Second Class Contractors (28 contractors)
- Third Class Contractors(32 contractors)
- Contractors of the fourth degree(18 contractors)
- Contractors of the fifth class(14 contractors)

The contractors sixth , seventh grade are removed and neglected from this study because they are considered low experience in the construction industry , and their works are very small compared with the top rated companies.

Out of 150 questionnaires sent, 124 responses were received out of which 5 were incomplete and discarded. The response rate of 82.67% percent is considered to be very good for this kind of a Field survey. The reliability of the survey results is expected to be high because all the respondents are the engineers and top-level experienced management officials in their companies. The summary of the survey responses is given in figure 3.3.

figure 3.3 Sample Size in Yemen



CHAPTER 4

DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

In this chapter we discussed the data coming from the questionnaire , that was distributed among the contractors or the data that was collected through the personal interview with the contractors or the workers in the contracting industry , the chapter consists of several parts including the description of the respondents on the question are.) the degree of their c classification , the years of experience) as this chapter contains the analysis of the factors of risks – that may face the contractors – in both of Arab republic of Egypt and the republic of Yemen . (71 risks) in addition to some other risks that the contractors said that they faced and affected on the running of the projects , but the questionnaire did not refer to, also the chapter contains the comparison between the risks that face the Egyptian contractors and the Yemeni .

4.2 DESCRIPTION OF THE RESPONDENTS

In this part it shows accurate description for the respondents of the questionnaire in both of Egypt and Yemen , on terms that the questionnaire contains in Egypt the governorates of (Cairo – Alexandria – sues- Ismailia) in which the classified contracting companies participated in , in addition to the consultation offices , also the questioners included in Yemen the governorates of (Sana'a- Aden – Taiz – Ibb) , the researcher will present the features of the companies and the offices which participated in the question are and its rank according to the degree of classification and the experience in the field of construction and building in each state

4.2.1 Grades of Construction Contractors

When classifying the contractor , there are considerations that must be taken into accounts including the value of the capital – the size of the works – the administrative authority and the technical authority for the company . the size of the equipment's , and the assets owned by the company . there is no difference in classifying the contracting companies in both of Egypt and Yemen, the terms are

one in Egypt as the classification of the contractors into 7 categories but it is in the republic of Yemen the classification is made for 6 categories the following table shows the data related with the ranks of the contractors participating in the question are in both of Egypt and Yemen

Table 4.1 Contractor's Classification in Construction Project in Egypt and The type of projects that have been answered to the questionnaire through which

Classification of Contractors	No of contractor	Public Projects	Private Projects
First Class	38	38	16
Second Class	24	18	12
Third Class	16	14	12
Fourth class	14	14	4
Fifth class	16	14	12
Total	108	98	56

Figure 4.1 : percentage for The type of projects that have been answered to the questionnaire through which in Egypt

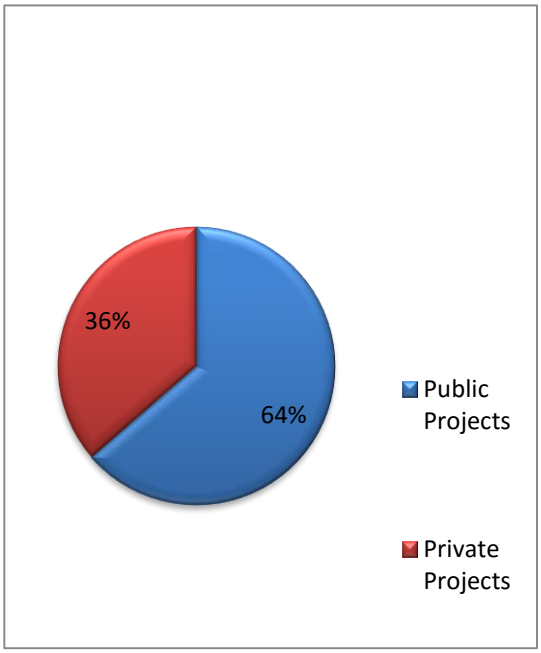
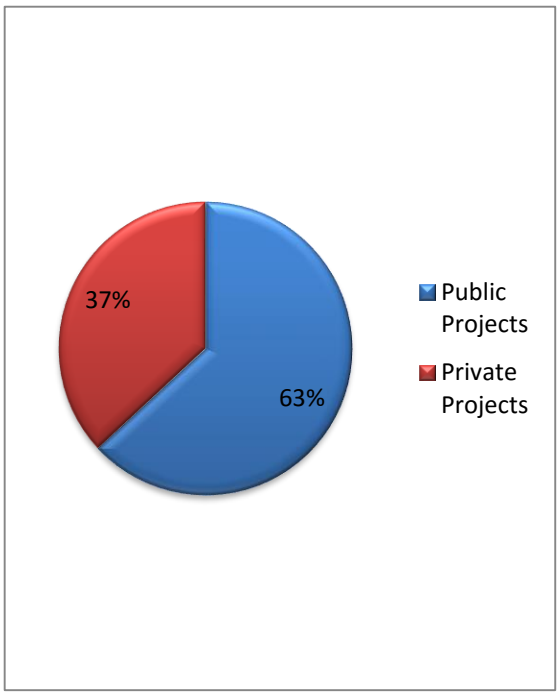


Table 4.2 Contractor's Classification in Construction Project in Yemen and The type of projects that have been answered to the questionnaire through which

Classification of Contractors	No of contractor	Public Projects	Private Projects
First Class	32	32	14
Second Class	28	24	12
Third Class	32	24	18
Fourth class	18	14	10
Fifth class	14	12	8
Total	124	106	62

Figure 4.2 : percentage for The type of projects that have been answered to the questionnaire through which in Yemen



4.2.2 Working Experience

To measure the years of experience in the field of construction and building through the actual number of years which the company of the contracting spent since its establishment , the size of the work , that were achieved during this period , most of those who were included in the question and who spent a long time in the field of construction and building in Egypt (88% in Egypt and 68% in Yemen)

Table 4.3 Contractor's Experience in Construction in Egypt

		Experience in years				
Contractor class		5<	5-10	10-15	>15`	total
First class	No of contractor	0	0	6	32	38
	%	0	0	15.78	84.21	100
Second class	No of contractor	0	6	10	8	24
	%	0	25	41.66	33.33	100
Third class	No of contractor	0	4	4	8	16
	%	0	25	25	50	100
Forth class	No of contractor	4	6	2	2	14
	%	28.57	42.85	14.28	14.28	100
Fifth class	No of contractor	10	0	6		16
	%	62.5	0	37.5	0	100

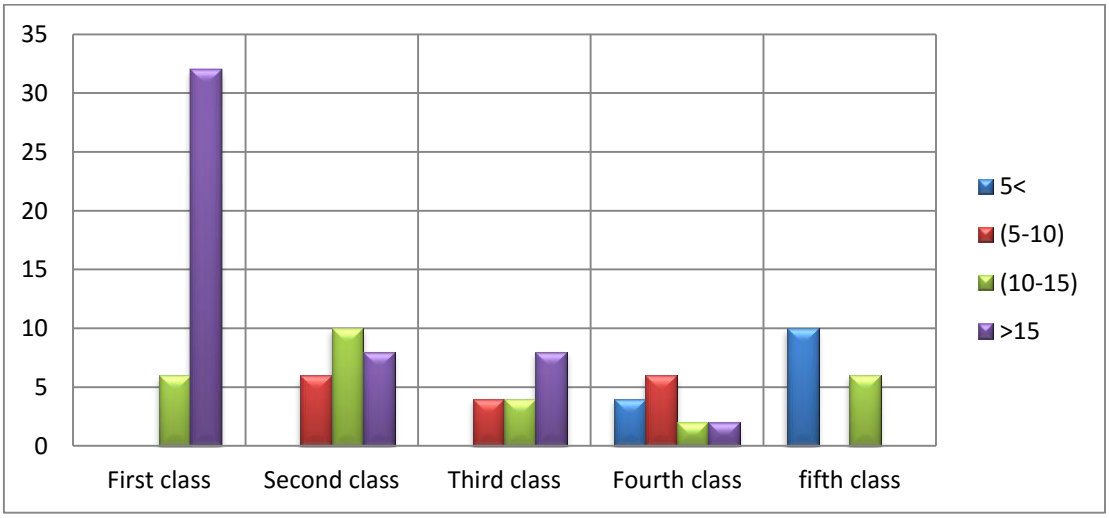


Figure 4.3Contractor's Experience in Construction in Egypt

Table 4.4 Contractor's Experience in Construction in Yemen

		Experience in years				
Contractor class		5<	5-10	10-15	>15`	Total
First class	No of contractor	2	4	4	22	32
	%	6.25	12.5	12.5	68.75	100
Second class	No of contractor	2	6	12	8	28
	%	7.14	21.42	42.85	28.57	100
Third class	No of contractor	4	12	6	10	32
	%	12.5	37.51	18.75	31.25	100
Forth class	No of contractor	2	12	2	2	18
	%	11.11	66.67	11.1	11.1	100
Fifth class	No of contractor	6	4	0	4	14
	%	42.85	28.57	0	28.57	100

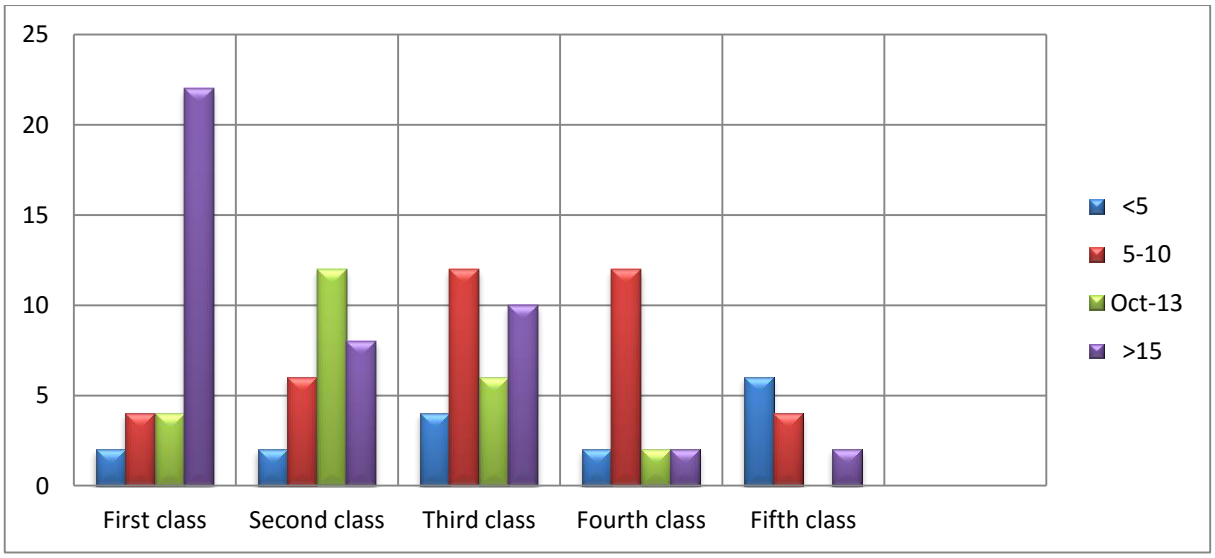


Figure 4.4 Contractor's Experience in Construction in Yemen

4.3 DELAY AND COST OVERRUN IN PROJECTS

In this part I will present the results regarding the cost overrun of the , in addition to the delay in delivering the projects in its limited time and the renewed one as a result for .the exposition of the Egyptian contractors or the Yemeni contractors to different risks that affected on the running of the project and its evaluative costs

4.3.1 Frequency of Delay in Construction Projects

Looking to the answers of the respondents of the contractors for the questionnaire we can find that a big sector of the contracting sector faced delay in some projects that were executed and this delay was due to that the contractors faced several risks , that were not taken into account when setting the plan for the work of the project

The table shows the repetition of the delay in Construction projects in both Yemen and Egypt as the following".

Table 4.5 Frequency of Delay in Construction Projects in Egypt

		Frequency of delay				
Contractor class		Always	Often	Sometimes	Never	total
First class	No of contractor	8	8	20	2	38
	%	21.05	21.05	52.63	5.28	100
Second class	No of contractor	0	14	8	2	24
	%	0	58.3	33.3	8.33	100
Third class	No of contractor	0	10	6	0	16
	%	0	62.5	37.5	0	100
Forth class	No of contractor	2	6	6	0	14
	%	14.28	42.85	42.85	0	100
Fifth class	No of contractor	8	4	4	0	16
	%	50	25	25	0	100

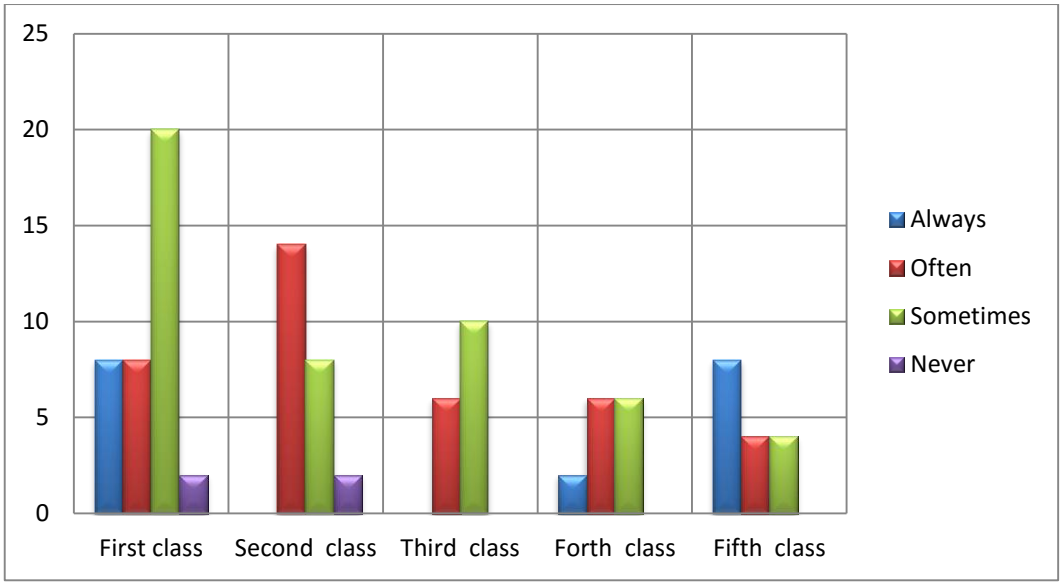


Figure 4.5 Frequency of Delay in Construction Projects in Egypt

Table 4.6 Frequency of Delay in Construction Projects in Yemen

		Frequency of delay				
Contractor class		Always	Often	Sometimes	Never	Total
First class	No of contractor	6	8	18	0	32
	%	18.75	25	56.25	0	100
Second class	No of contractor	0	18	10	0	28
	%	0	64.28	35.71	0	100
Third class	No of contractor	4	14	14	0	32
	%	12.5	43.75	43.75	0	100
Forth class	No of contractor	2	8	8	0	18
	%	11.1	44.7	44.4	0	100
Fifth class	No of contractor	8	2	4	0	14
	%	57.1	14.28	28.57	0	100

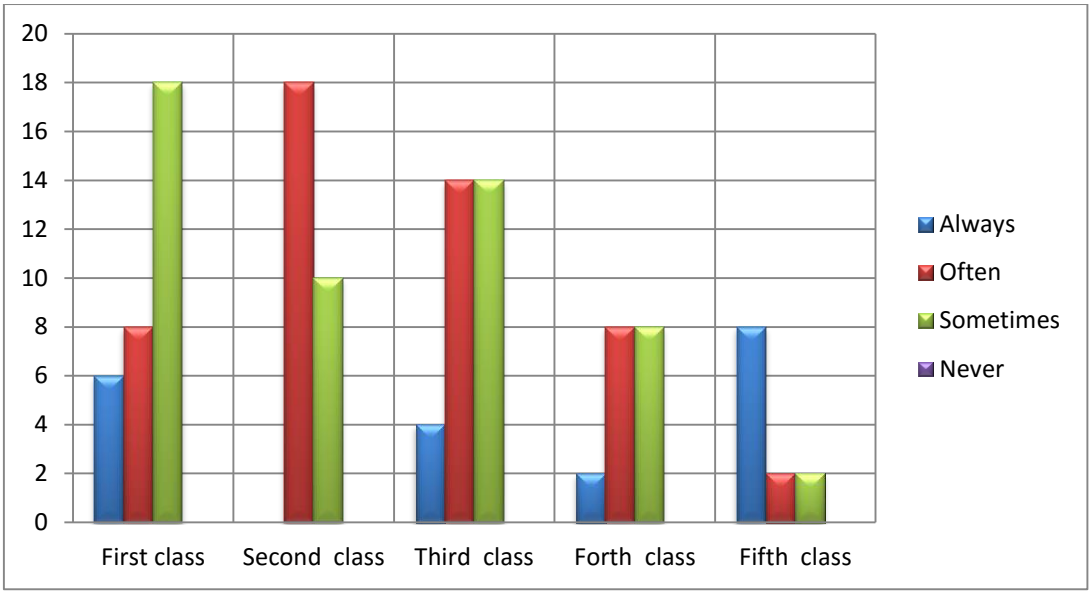


Figure 4.6 Frequency of Delay in Construction Projects in Yemen

4.3.2 Frequency of Cost Overrun in Construction Projects

When checking the respondents of the contractors in both Yemen and Egypt it appeared that most of the contractors said that they exceeded the costs that were estimated as a result for facing several risks construction the building that affected largely on the budget of the project and consequently led to increasing the costs more than what is planned for

Table 4.7 Frequency of Cost Overrun in Construction Projects in Egypt

		Frequency of Cost Overrun				
Contractor class		Always	Often	Sometimes	Never	total
First class	No of contractor	4	12	22	0	38
	%	10.5	31.57	57.89	0	100
Second class	No of contractor	2	10	12	0	24
	%	8.33	41.67	50	0	100
Third class	No of contractor	0	8	8	0	16
	%	0	50	50	0	100
Forth class	No of contractor	4	4	6	0	14
	%	28.57	28.57	42.85	0	100
Fifth class	No of contractor	8	6	2	0	16
	%	50	37.5	12.5	0	100

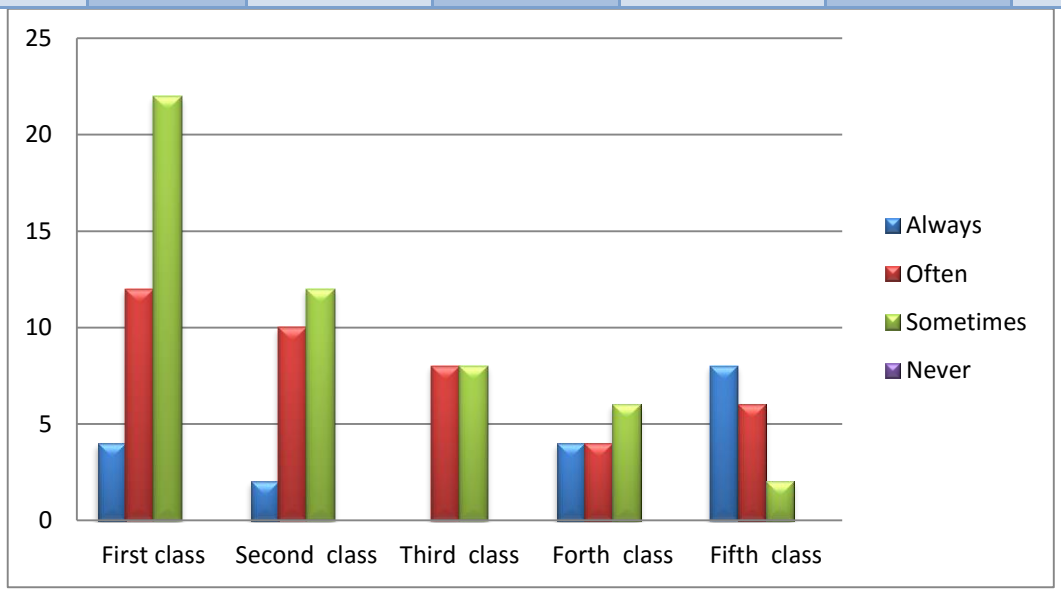


Figure 4.7 Frequency of Cost Overrun in Construction Projects in Egypt

Table 4.8 Frequency of Cost Overrun in Construction Projects in Yemen

		Frequency of Cost Overrun				
Contractor class		Always	Often	Sometimes	Never	total
First class	No of contractor	10	6	16	0	32
	%	31.25	18.75	50	0	100
Second class	No of contractor	8	12	8	0	28
	%	28.57	42.85	28.57	0	100
Third class	No of contractor	4	14	14	0	32
	%	12.5	43.75	43.75	0	100
Forth class	No of contractor	2	10	8	0	18
	%	11.1	55.5	44.4	0	100
Fifth class	No of contractor	10	2	2	0	14
	%	71.42	14.28	14.28	0	100

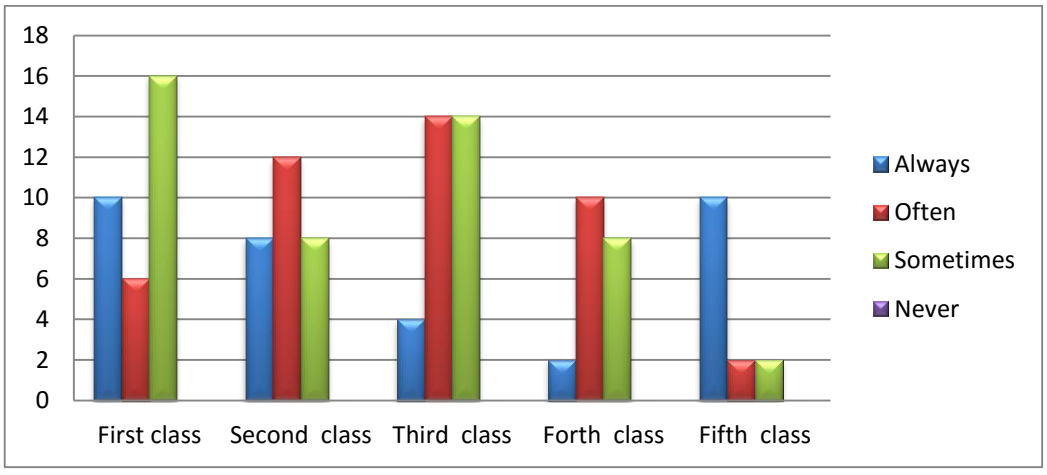


Figure 4.8 Frequency of Cost Overrun in Construction Projects in Yemen

4.4 DATA ANALYSIS

4.4.1 Statistical Technique

This section is intended to explain the statistical concepts will be mentioned in the interpretation of the results of the questionnaire

4.4.1.1. Mean

It is the most widely used measure of central tendency. It is commonly called the average. The mean is sensitive to extremely large or small values.

$$\bar{x} = \frac{1}{n}\Sigma\,(f\,X)n$$

where;

$\bar{x}$ = Average mean for nth observation.

X_n = 0.1, 0.3, 0.5, 0.7 & 0.9 (Scoring scale).

f = Frequency of each observation of each factor.

n = Number of observation for each factor.

4.4.1.2. Standard Deviation

It is shows how much variation or dispersion exists from the average (mean), or expected value. A low standard deviation indicates that the data points tend to be very close to the mean; high standard deviation indicates that the data points are spread out over a large range of values.

$$sn = \sqrt{\frac{1}{n} + \sum_{i=1}^{n} (xi - \bar{x})^2}$$

Where;

Xi = (x1, x2, ..,Xn)

$\bar{x}$ = the mean value

N =stands for the size of the sample

4.4.1.3. The Standard Error of Mean

The standard error of mean is used to describe the deviation of sample means around their population mean.

$$SE = \frac{SN}{\sqrt{N}}$$

Where;

SE= Standard error of mean .

4.4.1.4. chi-square ($CH^{2)}$

The chi-square (chi, the Greek letter pronounced "kye") statistic is a nonparametric statistical technique used to show any discrepancies between the expected results and the actual results.

X2 = Sigma [(O-E)2 / E]

where;

X2= the chi-square statistic

O= the observed frequency

E = the expected frequency

4.4.1.5. significance level (sig)

report for the p-value to tell readers if the result is significant. The P value is a probability which ranges from 0-1. Usually, if Sig is less then 0.05 then the effect is significant.

4.4.1.6. Confidence Interval

4.95% Confidence Interval =$\bar{X}$ +1.96 SE

The confidence coefficient used in this thesis is 95 %. This means that if a large number of probability samples were taken, 95 % of these samples would contain the actual mean of the universe within an interval of +1.96 SE

Mean, standard deviation, Standard error, chi-square and significance level, Confidence Interval were calculated by using statistical program " SPSS".

4.4.2Qualitative Risk Analysis

Process involves determining what impact the identified risks will have on the project objectives and the probability they'll occur. It also ranks the risks in priority order according to their effect on the project objectives. This helps determine if Quantitative Risk Analysis should be performed or if you can skip right to developing response plans.

The Qualitative Risk Analysis process also considers risk tolerance levels, especially as they relate to the project constraints (scope, time, cost, and quality) and the time frames of the potential risk events. pmp[71]

An evaluation of the quality of the available information also helps modify the assessment of the risk. Qualitative risk analysis requires that the probability and consequences of the risks be evaluated using established qualitative-analysis methods and tools.

Tools and Techniques for Qualitative Risk Analysis:

4.4.2.1 Risk probability and impact

Probability: A risk is an event that "may" occur. The probability of it occurring can range anywhere from just above 0 percent to just below 100 percent. (Note: It can't be exactly 100 percent, because then it would be a certainty, not a risk. And it can't be exactly 0 percent, or it wouldn't be a risk.)

Impact: A risk, by its very nature, always has a negative impact. Impact can be assessed in terms of its effect on: Time, Cost, and Quality.

Analysis of risks using probability and consequences helps identify those risks that should be managed aggressively. pmp[71]

4.4.2.2 Probability/impact risk rating matrix.

A probability and impact matrix assigns an overall risk rating to each of the project's identified risks. The combination of probability and impact results in a classification usually expressed as high, medium, or low. According to A Guide to the PMBOK[4] high risks are considered a red condition, medium risks are considered a yellow condition, and low risks are considered a green condition. This

type of ranking is known as an ordinal scale because the values are rank-ordered from high to low.

		impact				
		Trivial	Minor	Moderate	Major	Extreme
Probability	Rare	Low	Low	Low	Medium	Medium
	Unlikely	Low	Low	Medium	Medium	Medium
	Moderate	Low	Medium	Medium	Medium	High
	Likely	Medium	Medium	Medium	High	High
	Very likely	Medium	Medium	High	High	High

figure 4.9 Probability/impact risk rating matrix.PMBOK[4]

A matrix may be constructed that assigns risk ratings (very low, low, moderate, high, and very high) to risk or conditions based on combining probability and impact scales. Risks with high probability and high impact are likely to require further analysis . The risk rating is accomplished using a matrix and risk scales for each risk.

A risks probability scale naturally falls between 0.0 (no probability) and 1.0 (certainty) (shown Table 4.9). An ordinal scale, representing relative probability values from very unlikely to almost certain, could be used. Alternatively, specific probabilities could be assigned by using a general scale (e.g., .1/.3/.5/.7/.9).

A risks impact scale reflects the severity of its effect on the project objective. Impact can be ordinal or cardinal, depending upon the culture of the organization conducting the analysis. Ordinal scales are simply rank-ordered values, such as very low, low, moderate, high, and very high. Cardinal scales assign values to these impacts. These values are usually linear (e.g., .1/.3/.5/.7/.9). shown table 4.9

These scales for probability of occurrence and degree of impact were used for identify sources of risk affecting the contractors in construction project identified

table 4.9 Risk probability and impact . pmp[73]

Scale	Probability	Impact	Weight
Very low	Unlikely to occur	Negligible impact	0.9
Low	May occur occasionally	Minor impact on time, cost or quality	0.7
Medium	Is as likely as not to occur	Notable impact on time, cost or quality	0.5
High	Is likely to occur	Substantial impact on time, cost or quality	0.3
Very high	Is almost certain to occur	Threatens the success of the project	0.1

4.5 SURVEY RESULTS

The Questionnaire is aiming at measuring the sources of risks, which are more significant in the terms of probability of occurrence and degree of effect. For obtaining precise results, based on the Statistical Package for the Social Sciences (SPSS) to perform the analysis process as per the followed statistical standards, represented in the mean, mean rank, and the standard deviation)

4.5.1 Probability of Occurrence In Egypt

This part contains the most important sources of risks, which had occurred to the contractors in Arab Republic of Egypt according to the contractors' answers where the sources of risks are evaluated as per the mean. So the sources of risks, that got more than 3.00, are "Very Important". However, the sources of risks, which evaluation is ranging between 2.5 and 3.00, are considered " Important", but the sources of risks, which values are between 2.00 -2.50 are "Less Important" and the sources of risks, which evaluation is less than 2.00, are considered "Unimportant".

Moreover, this part contains more description for the contractors who are more affected by the sources of risks occurrence whether contractors of first or second degrees to the fifth one as shown in table 4.10.and figure 4.10 .

Table 4.10 The Most Important Risk Factors for Contractors and The contractor classes most affected by this factors in Egypt

N	*Sources of risks*	First grades		Second grade		Third grade		fourth grade		Fifth grade		Mean	St. div	Ch^2.	sig
		N	mean rank	N	mean rank	N	mean rank	N	mean rank	N	mean rank				
1	Loss due to war, civil disorder, revolution.. etc.	38	42.26	24	60.13	16	40.03	14	68.36	16	77.47	3.787	1.360	23.62	0.00
2	Delay in progress payment by the owner.	38	47.96	24	30.56	16	72.19	14	71.72	16	73.53	3.500	1.080	33.44	0.000
3	Loss due to inflation (increase the price of materials, plants, labors.. .. ..etc.).	38	49.38	24	44.27	16	65.27	14	65.07	16	61.72	3.490	1.195	8.506	0.075
4	Devaluation and varying rate of exchange.	38	44.01	24	52.10	16	67.28	14	66.54	16	59.47	3.444	1.186	10.05	0.039
5	Cost overrun due to planning estimation.	38	45.63	24	44.33	16	69.81	14	64.82	16	66.34	3.296	1.043	14.39	0.006
6	Design change by owner or his agent during construction.	38	50.33	24	52.00	16	52.69	14	57.64	16	66.44	3.157	1.033	3.551	0.470
7	Delay of construction project.	38	52.20	24	45.42	16	55.06	14	44.68	16	72.25	3.148	1.039	12.21	0.016
8	Delay in settlement of contractor's claim by the owner.	38	51.82	24	40.56	16	73.63	14	42.04	16	73.56	3.055	0.829	21.73	0.000

9	Cash flow problems faced by the subcontractor.	38	63.57	24	42.27	16	54.64	14	49.00	16	55.44	3.027	0.999	8.10	0.088
10	Delay in approval of contractor submittals by the consultant engineer (sample, tables, planning,... ...etc).	38	58.59	24	44.58	16	58.38	14	56.07	16	54.41	2.981	1.022	3.764	0.439
11	Subcontractor's law credibility.	38	60.71	24	46.71	16	42.00	14	43.61	16	73.47	2.981	1.110	14.02	0.007
12	The conflict between contractor and consultant.	38	54.05	24	58.69	16	41.00	14	47.32	16	69.06	2.953	1.062	8.24	0.083
13	Interference by the owner in construction.	38	59.59	24	46.10	16	51.88	14	55.75	16	56.53	2.870	1.033	3.24	0.518
14	Poor qualification of supervision staff of consultant engineer.	38	55.41	24	51.88	16	58.50	14	64.36	16	42.28	2.861	0.961	4.891	0.299
15	Change in the scope of the project from the owner (quantities of work item, new area, etc.)	38	60.14	24	49.75	16	53.91	14	48.57	16	54.53	2.796	0.944	2.67	0.063
16	Shortage of labor skill & lack of labors' experience.	38	50.96	24	48.94	16	65.75	14	56.18	16	58.53	2.787	0.947	4.05	0.399
17	Excessive bureaucracy in the owner administration.	38	66.54	24	46.00	16	43.44	14	56.46	16	48.00	2.787	1.005	11.12	0.025
18	Delay in performing inspection & testing by the	38	59.13	24	34.41	16	59.66	14	53.59	16	68.47	2.787	0.976	16.037	0.003

	consultant.														
19	Poor labor productivity.	38	51.64	24	45.46	16	60.00	14	58.57	16	65.78	2.768	0.838	6.02	0.198
20	Delay in material delivery.	38	53.62	24	52.33	16	59.28	14	37.43	16	69.56	2.768	0.913	9.100	0.059
21	Cash flow problems and difficulties in financing the project by the contractor.	38	54.14	24	35.10	16	73.41	14	50.21	16	69.28	2.768	1.037	20.391	0.000
22	Shortage in supply of water, gas, electricity ..etc	38	46.46	24	54.96	16	45.19	14	73.25	16	65.81	2.768	1.107	11.91	0.018
23	Late workshop drawing instruction.	38	58.29	24	39.17	16	60.19	14	44.64	16	71.44	2.759	1.057	13.961	0.007
24	Effect of subsurface condition(soil composition, existent utilities, high water table ,.... ...etc.).	38	56.29	24	54.67	16	35.69	14	68.00	16	57.00	2.759	1.252	9.09	0.059
25	Subcontractor problems with main contractor.	38	64.82	24	41.90	16	36.22	14	54.69	16	66.75	2.750	0.876	18.24	0.001
26	Original contract duration is too short from the owner.	38	52.35	24	62.46	16	45.00	14	56.11	16	55.69	2.740	1.105	3.51	0.476
27	Change or differing site condition (access to the site, infrastructure surrounding, existing building.. ...etc.).	38	60.41	24	40.65	16	51.71	14	59.04	16	60.06	2.731	1.055	7.58	0.108

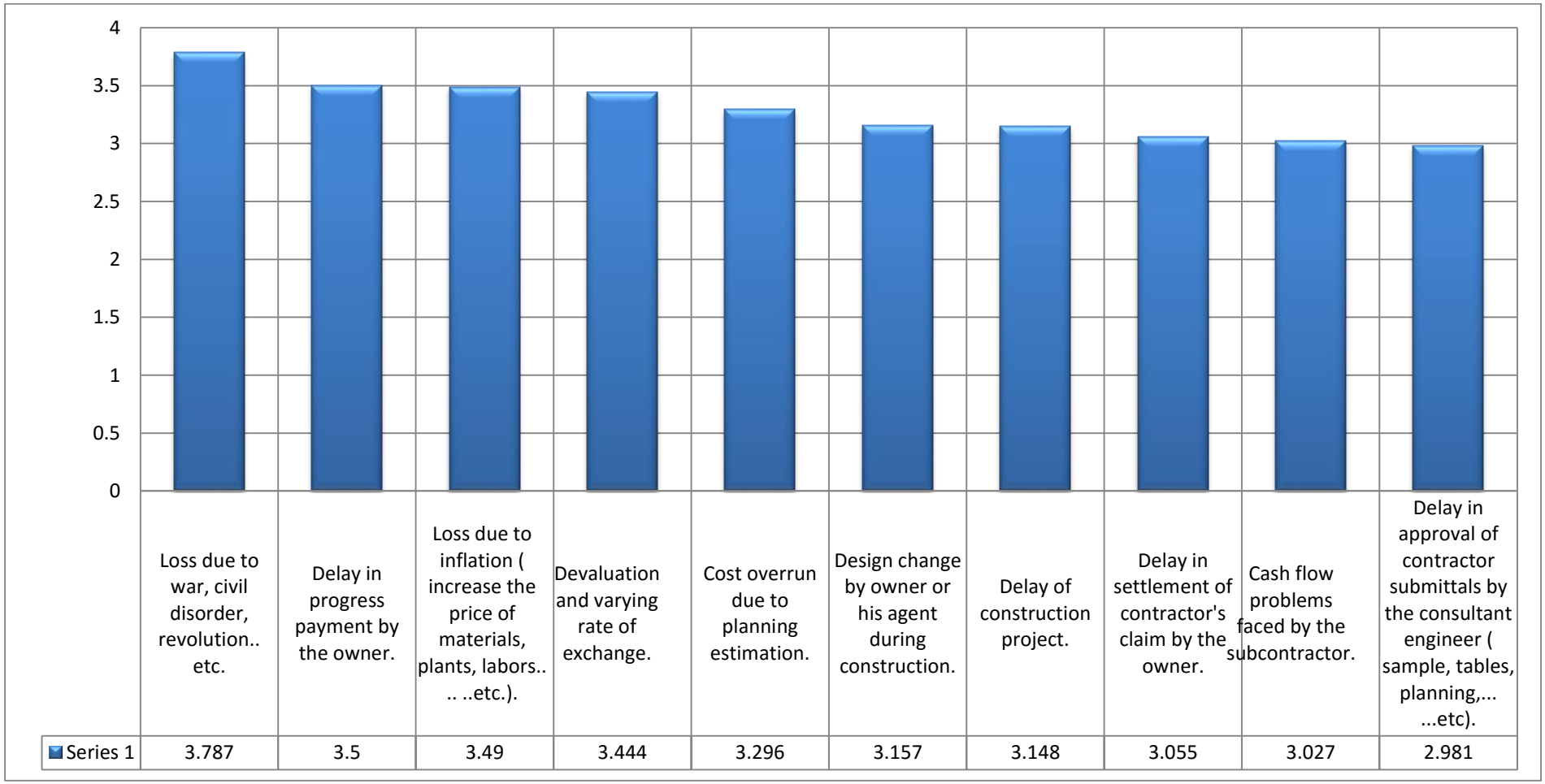
28	Delay in making decisions by the owner within a reasonable time.	38	67.80	24	37.94	16	36.81	14	52.56	16	66.88	2.694	1.008	23.27	0.000
29	Shortage of resources (labor, plant & material).	38	57.00	24	45.06	16	53.13	14	47.14	16	70.53	2.657	1.015	5.124	0.087
30	Increase wastage of material.	38	53.78	24	41.75	16	67.00	14	44.46	16	70.81	2.629	0.982	13.10	0.011
31	Loose safety rules and regulations with the contractor's organization.	38	55.08	24	47.56	16	51.63	14	50.64	16	69.78	2.629	1.098	5.88	0.208
32	Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ...etc.).	38	51.41	24	55.88	16	46.41	14	55.61	16	66.91	2.581	1.024	4.35	0.360
33	Ambiguities, fault, and inconsistency of specification.	38	62.63	24	37.94	16	51.81	14	43.14	16	72.66	2.546	1.008	18.14	0.001
34	Bad accelerate to deliver project by using extra resources.	38	61.58	24	49.71	16	46.31	14	50.57	16	56.50	2.546	0.998	4.27	0.370
35	Failure of equipment.	38	52.16	24	44.08	16	61.75	14	44.36	16	77.31	2.542	0.865	15.76	0.003
36	Poor equipment productivity.	38	62.04	24	40.65	16	51.63	14	40.54	16	72.47	2.537	0.847	17.24	0.002
37	Uncooperative owner with contractor.	38	60.52	24	43.63	16	44.16	14	65.21	16	57.25	2.518	1.009	8.59	0.072

38	Delay in furnishing and delivering the site to the contractor.	38	63.57	24	43.42	16	42.14	14	54.00	16	57.97	2.490	1.080	9.85	0.043
39	Delay to get on legal right.	38	44.64	24	57.18	16	57.81	14	57.46	16	67.94	2.472	0.775	8.43	0.077
40	Shortage of subcontractors.	38	65.76	24	44.14	16	36.34	14	52.86	16	62.81	2.463	1.017	15.44	0.004
41	Incomplete in design and availability of information.	38	61.20	24	35.54	16	61.41	14	43.74	16	69.50	2.425	0.475	18.57	0.001
42	Difficulties in obtaining work permits from the authorities.	38	58.12	24	48.48	16	48.38	14	49.57	16	65.38	2.407	0.907	4.76	0.312
43	Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)	38	57.66	24	57.92	16	44.34	14	42.75	16	62.31	2.407	z	5.91	0.206
44	Difficulty the design, then difficulty in construction.	38	64.74	24	38.10	16	46.19	14	45.57	16	70.41	2.398	1.031	18.843	0.001
45	Design errors.	38	55.22	24	38.83	16	56.47	14	56.39	16	72.66	2.379	1.002	12.655	0.013
46	Pay liquidate damage.	38	57.66	24	43.38	16	55.75	14	46.14	16	69.75	2.370	1.257	8.88	0.064
47	Difficult to arrive to the site of project.	38	58.21	24	51.83	16	44.84	14	52.57	16	61.03	2.361	0.961	3.33	0.504
48	Defective work.	38	52.82	24	42.25	16	55.84	14	56.79	16	76.53	2.342	1.128	10.71	0.030

49	Labor dispute and strike.	38	44.86	24	49.21	16	68.50	14	49.57	16	63.63	2.324	0.915	7.22	0.125
50	Legal disputes between various parties in the project.	38	56.09	24	46.73	16	49.34	14	44.32	16	76.44	2.320	0.905	13.09	0.110
51	Change in key staffing throughout the project.	38	64.36	24	37.44	16	57.59	14	41.32	16	65.13	2.314	0.922	17.31	0.002
52	Ineffective planning and scheduling of project by the contractor.	38	69.53	24	29.67	16	49.00	14	44.71	16	71.13	2.305	1.071	32.04	0.000
53	Accident on site & disease of labor.	38	52.91	24	41.71	16	67.69	14	50.36	16	67.91	2.287	0.927	11.19	0.024
54	Poor quality.	38	50.37	24	50.13	16	53.84	14	51.84	16	74.14	2.287	1.032	8.31	0.081
55	Poor communication and coordination between all parties.	38	66.67	24	33.29	16	45.64	14	42.36	16	72.09	2.287	1.023	29.53	0.000
56	Happening the theft in the site of project.	38	57.37	24	45.29	16	57.81	14	46.86	16	64.88	2.287	1.044	5.67	0.225
57	Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.	38	64.47	24	40.29	16	57.00	14	45.07	16	57.88	2.277	1.030	11.33	0.230
58	Stoppage of working.	38	54.37	24	47.42	16	44.56	14	55.71	16	74.31	2.251	0.901	10.45	0.033
59	Improper technical study of project in the	38	57.16	24	39.75	16	50.64	14	67.29	16	62.94	2.240	0.984	10.32	0.350

	bidding stage.														
60	Shortage of contractor's administrative personnel	38	60.54	24	39.13	16	54.03	14	58.07	16	60.56	2.231	1.073	9.05	0.060
61	Suspension of work by the owner.	38	59.95	24	35.38	16	46.66	14	65.46	16	68.06	2.231	0.982	17.89	0.001
62	Effect of social and cultural condition.	38	54.20	24	58.88	16	48.94	14	51.61	16	56.61	2.222	1.270	1.28	0.864
63	Shortcoming of the measure and value process.	38	56.01	24	41.56	16	67.47	14	51.43	16	59.59	2.120	0.934	8.264	0.082
64	Delay in mobilization to start the project and survey late or survey in error by the contractor.	38	60.32	24	35.19	16	57.59	14	52.43	16	68.38	2.083	0.750	17.303	0.002
65	Inadequate project organization structure.	38	62.14	24	43.00	16	52.16	14	49.71	16	60.13	2.055	0.984	7.10	0.130
66	Improper selection of project type and location	38	58.03	24	45.17	16	42.09	14	55.25	16	71.88	2.015	1.041	11.297	0.023
67	Damage to structure during construction	38	52.28	24	50.69	16	42.38	14	53.75	16	71.41	1.925	1.065	10.67	0.030
68	Happening the fire in the site of project.	38	54.36	24	47.54	16	43.34	14	55.50	16	75.56	1.833	0.952	12.19	0.016
69	Happening the floods and flowages.	38	59.24	24	53.88	16	51.38	14	45.14	16	55.50	1.629	1.037	3.14	0.525
70	Happening the earthquake.	38	6.3.55	24	50.50	16	49.06	14	47.14	16	50.82	1.379	0.872	9.85	0.043
71	Happening the volcanic.	38	55.28	24	54.25	16	53.25	14	50.57	16	57.72	1.296	0.867	1.21	0.875

Figure 4.10 The Most Important Risk Factors for Contractors in Egypt



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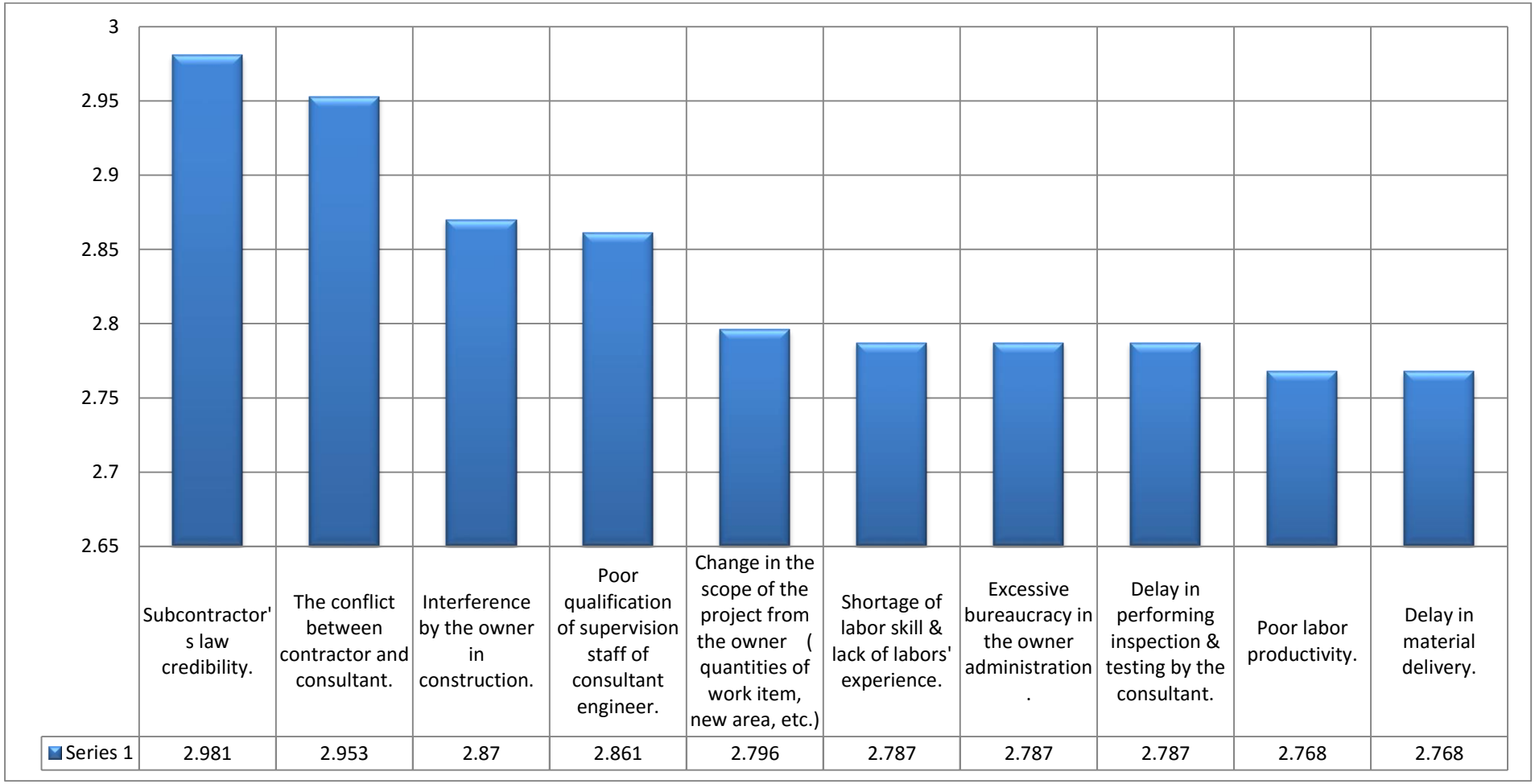

	Subcontractor's law credibility.	The conflict between contractor and consultant.	Interference by the owner in construction.	Poor qualification of supervision staff of consultant engineer.	Change in the scope of the project from the owner (quantities of work item, new area, etc.)	Shortage of labor skill & lack of labors' experience.	Excessive bureaucracy in the owner administration .	Delay in performing inspection & testing by the consultant.	Poor labor productivity.	Delay in material delivery.
Series 1	2.981	2.953	2.87	2.861	2.796	2.787	2.787	2.787	2.768	2.768

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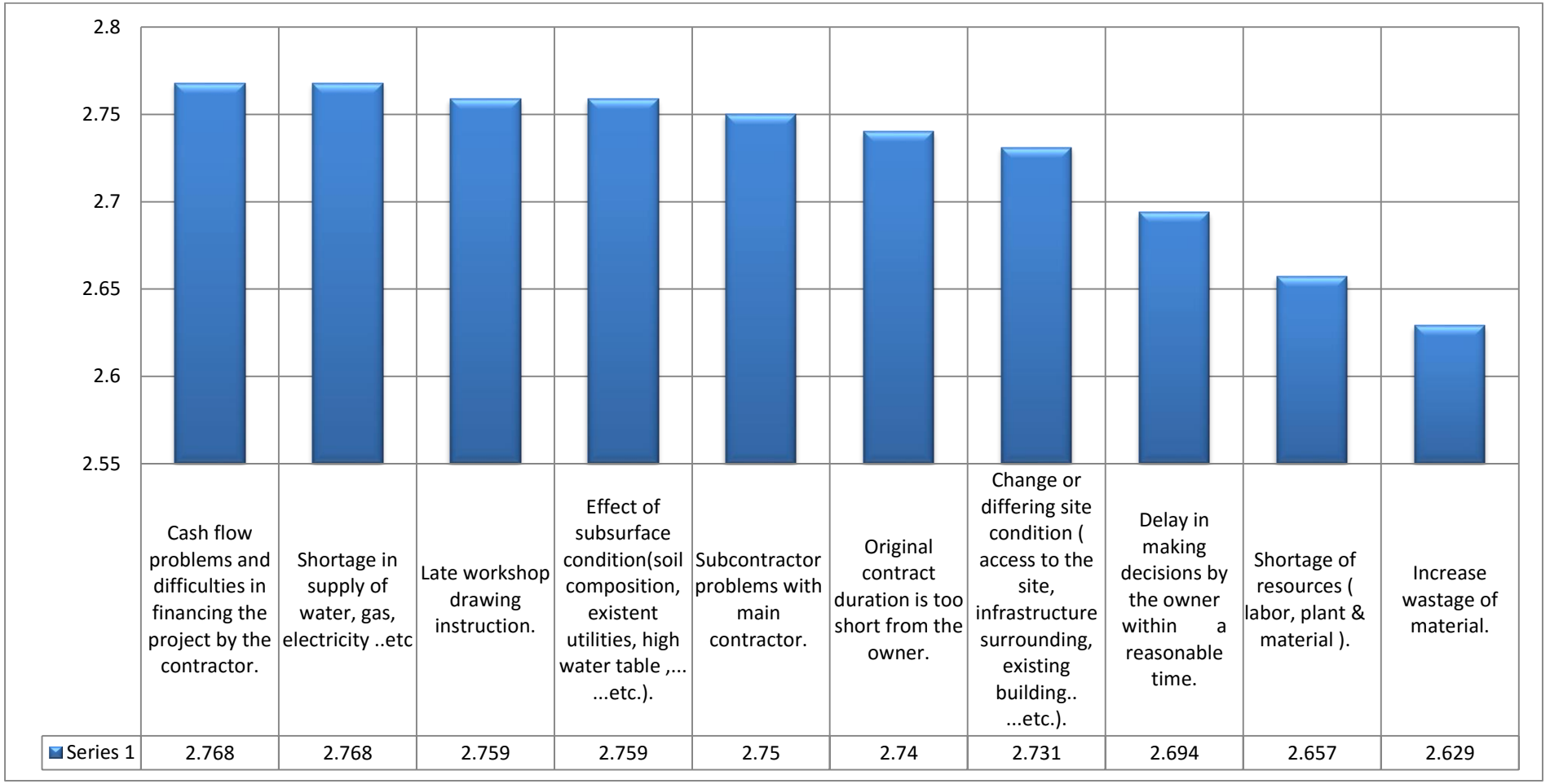
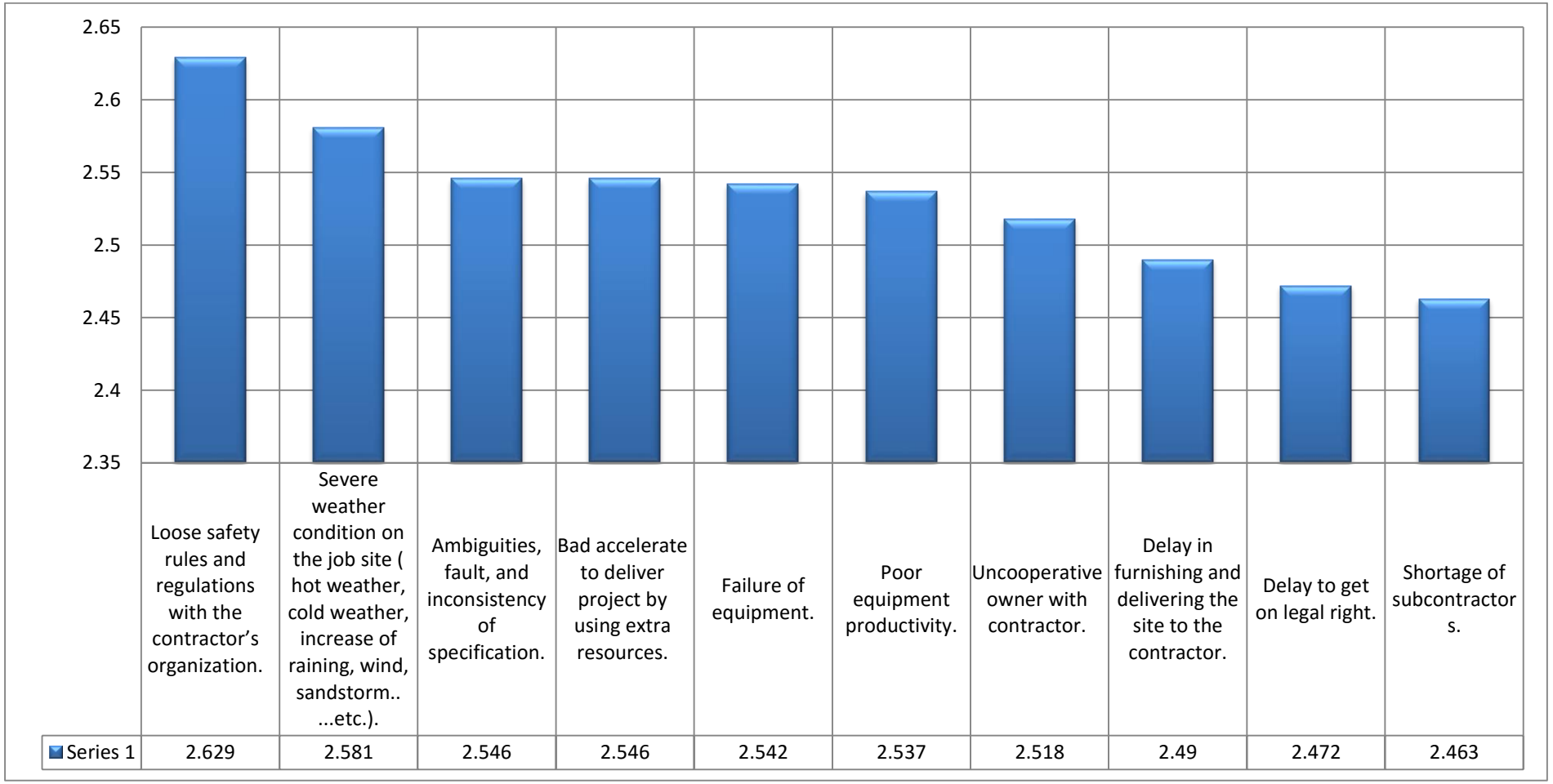
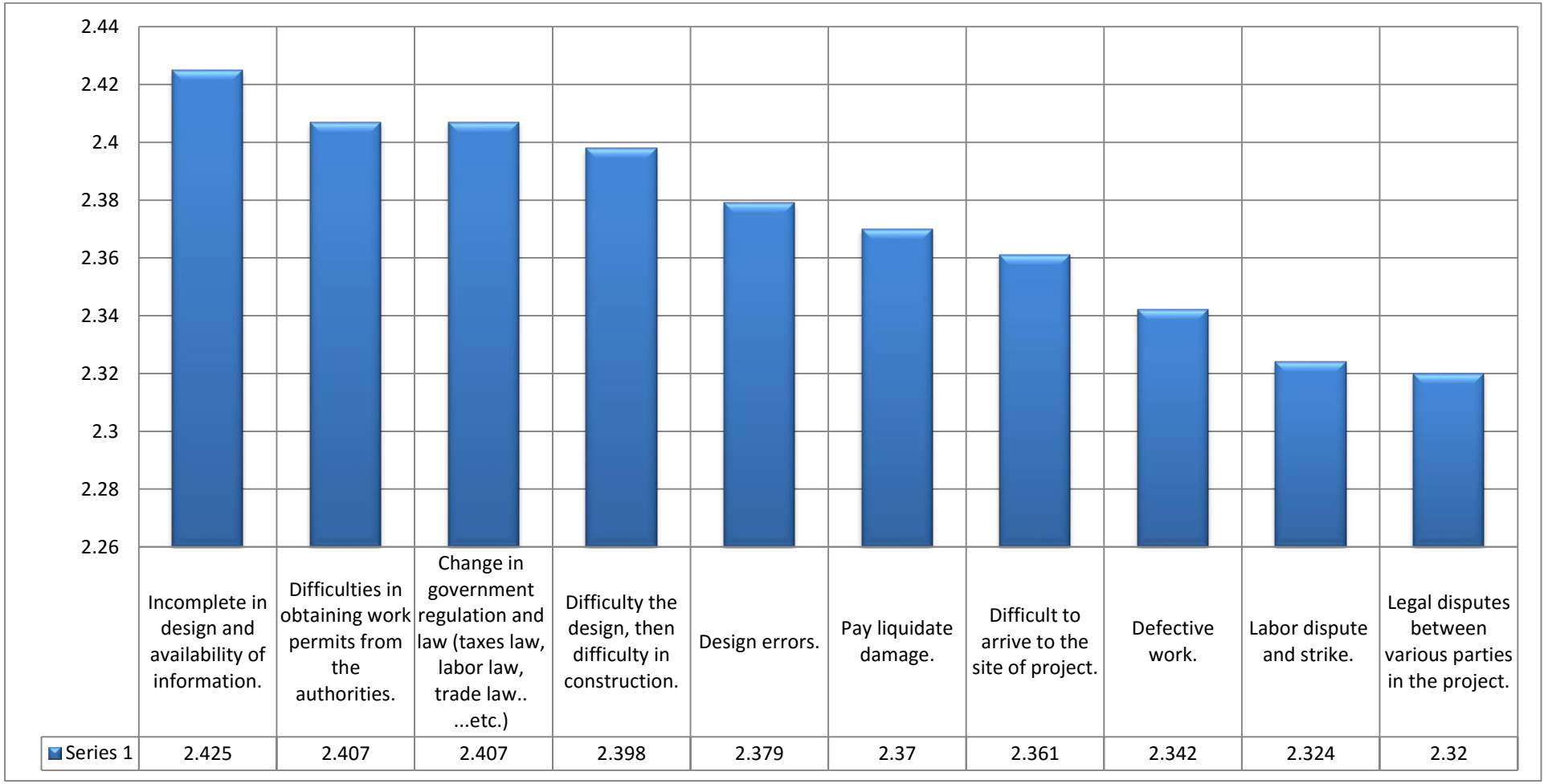

2.8
2.75
2.7
2.65
2.6
2.55
Cash flow problems and difficulties in financing the project by the contractor.
Shortage in supply of water, gas, electricity ..etc
Late workshop drawing instruction.
Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).
Subcontractor problems with main contractor.
Original contract duration is too short from the owner.
Change or differing site condition (access to the site, infrastructure surrounding, existing building.. ...etc.).
Delay in making decisions by the owner within a reasonable time.
Shortage of resources (labor, plant & material).
Increase wastage of material.
Series 1
2.768
2.768
2.759
2.759
2.75
2.74
2.731
2.694
2.657
2.629

Continued…

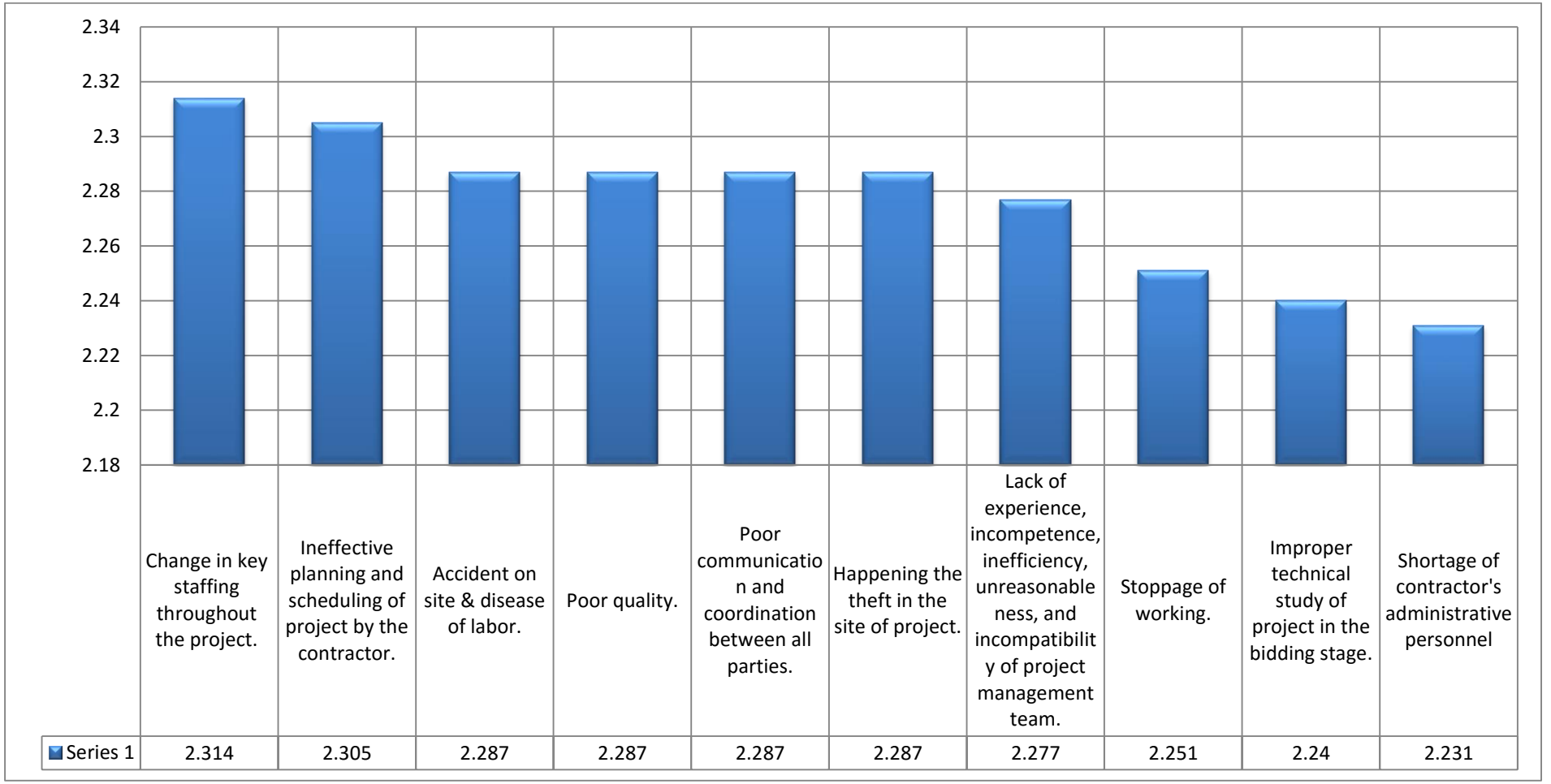

2.65
2.6
2.55
2.5
2.45
2.4
2.35
Loose safety rules and regulations with the contractor's organization.
Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ...etc.).
Ambiguities, fault, and inconsistency of specification.
Bad accelerate to deliver project by using extra resources.
Failure of equipment.
Poor equipment productivity.
Uncooperative owner with contractor.
Delay in furnishing and delivering the site to the contractor.
Delay to get on legal right.
Shortage of subcontractor s.
Series 1
2.629
2.581
2.546
2.546
2.542
2.537
2.518
2.49
2.472
2.463

Continued…

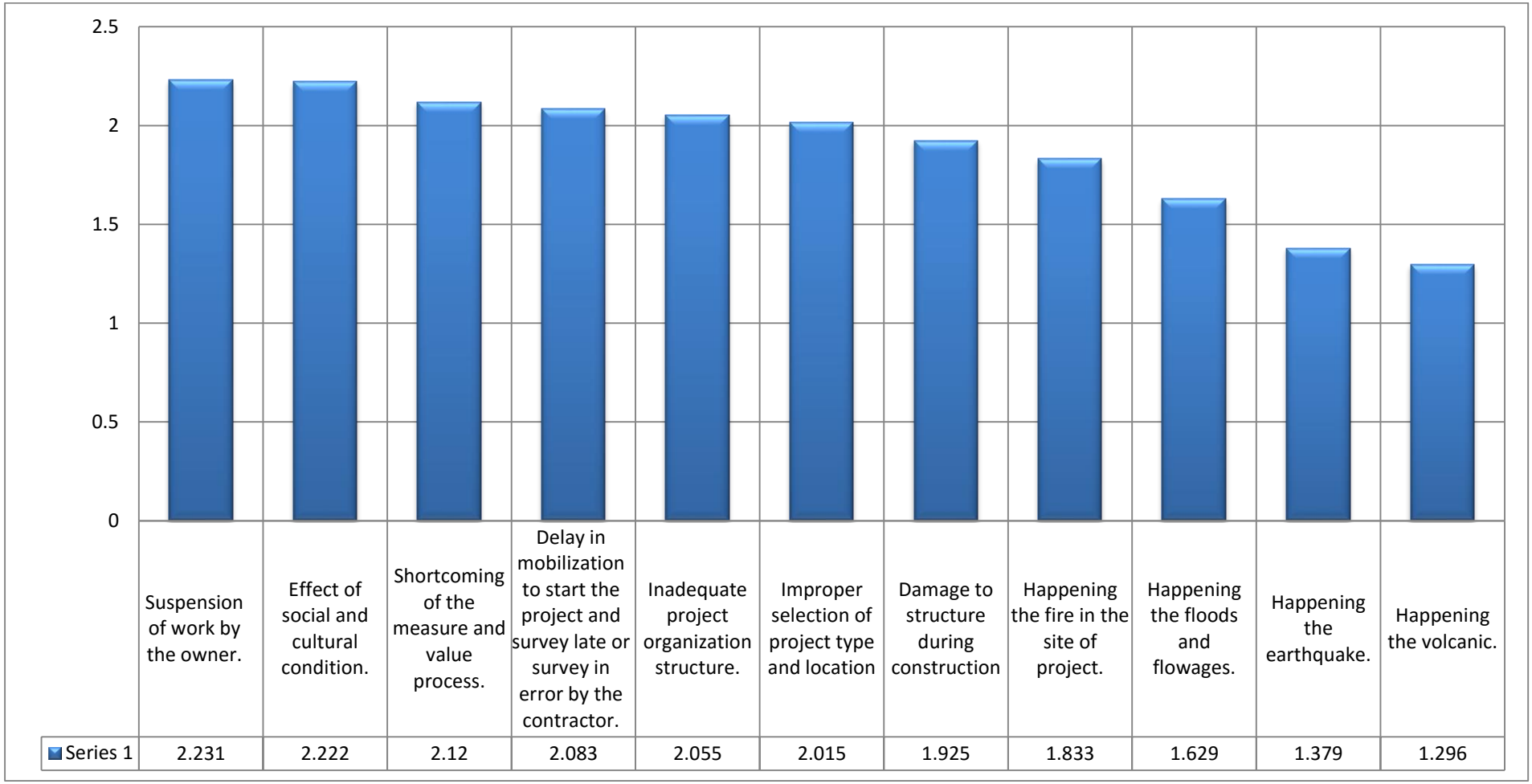


	Incomplete in design and availability of information.	Difficulties in obtaining work permits from the authorities.	Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)	Difficulty the design, then difficulty in construction.	Design errors.	Pay liquidate damage.	Difficult to arrive to the site of project.	Defective work.	Labor dispute and strike.	Legal disputes between various parties in the project.
Series 1	2.425	2.407	2.407	2.398	2.379	2.37	2.361	2.342	2.324	2.32

Continued…


2.34
2.32
2.3
2.28
2.26
2.24
2.22
2.2
2.18
Change in key staffing throughout the project.
Ineffective planning and scheduling of project by the contractor.
Accident on site & disease of labor.
Poor quality.
Poor communication and coordination between all parties.
Happening the theft in the site of project.
Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.
Stoppage of working.
Improper technical study of project in the bidding stage.
Shortage of contractor's administrative personnel
Series 1
2.314
2.305
2.287
2.287
2.287
2.287
2.277
2.251
2.24
2.231

Continued…


2.5
2
1.5
1
0.5
0
Suspension of work by the owner.
Effect of social and cultural condition.
Shortcoming of the measure and value process.
Delay in mobilization to start the project and survey late or survey in error by the contractor.
Inadequate project organization structure.
Improper selection of project type and location
Damage to structure during construction
Happening the fire in the site of project.
Happening the floods and flowages.
Happening the earthquake.
Happening the volcanic.
Series 1
2.231
2.222
2.12
2.083
2.055
2.015
1.925
1.833
1.629
1.379
1.296

Done.

4.5.2 Degree Of impact In Egypt

This part contains a description for the sources of risks of more impact if it occurred for the contractors in Arab Republic of Egypt, where the most important sources of risks are evaluated according to the mean. So the sources of risks, that got more than 4.00, are "Very Important". However, the sources of risks, which values are ranging between 03.5 to 4.00, are "Important". As well as the sources of risks, which values are between 3.00 -3.50 are "less important", but the sources of risks of less than 3.00, are considered "Unimportant".

In addition, this part contains an analysis for the most influenced contractors by the source of risk if it happened as shown in table 4.11 and Figure 4.11

Table 4.11 The Most Important Risk Factors for Contractors (in terms Degree Of impact) and relation between various classes contractors (The most affected in Egypt)

N	*Sources of risks*	First grades		Second grade		Third grade		fourth grade		Fifth grade		Mean	St. div	Ch^2.	Sig
		N	mean rank	N	mean rank	N	mean rank	N	mean rank	N	mean rank				
1	Loss due to war, civil disorder, revolution.. etc.	38	49.99	24	57.63	16	47.78	14	56.82	16	65.22	4.504	0.754	5.11	0.276
2	Delay of construction project.	38	48.61	24	51.33	16	72.00	14	65.21	16	46.38	4.148	0.707	11.45	0.022
3	Defective work.	38	43.09	24	66.77	16	56.19	14	57.64	16	58.75	4.111	0.988	10.46	0.033

4	Delay in progress payment by the owner.	38	48.61	24	46.46	16	50.75	14	66.00	16	74.25	4.101	0.864	13.16	0.011
5	Cost overrun due to planning estimation.	38	50.47	24	45.67	16	51.44	14	72.32	16	67.78	4.055	0.955	10.03	0.040
6	Loss due to inflation (increase the price of materials, plants, labors.. .. ..etc.).	38	41.44	24	54.79	16	57.81	14	61.61	16	75.44	4.000	0.947	16.72	0.002
7	Happening the volcanic.	38	56.69	24	47.46	16	52.78	14	53.00	16	61.66	3.990	1.397	2.64	0.620
8	Poor quality.	38	53.45	24	68.92	16	36.63	14	49.21	16	57.88	3.963	0.696	14.20	0.007
9	Stoppage of working.	38	53.95	24	44.14	16	54.19	14	58.68	16	60.44	3.925	0.850	1.73	0.754
10	Happening the earthquake.	38	56.18	24	49.98	16	51.72	14	53.91	16	61.56	3.925	1.431	1.96	0.743
11	Damage to structure during construction.	38	52.18	24	50.83	16	64.77	14	52.61	16	56.94	3.916	1.051	2.74	0.602
12	Devaluation and varying rate of exchange.	38	43.55	24	61.10	16	47.75	14	71.32	16	62.63	3.907	1.123	12.88	0.012
13	Shortage of resources (labor, plant & material).	38	51.87	24	57.96	16	54.00	14	44.14	16	65.13	3.870	0.843	4.41	0.353
14	Cash flow problems and difficulties in financing the project by the contractor.	38	52.44	24	42.56	16	60.63	14	55.00	16	70.63	3.850	0.802	10.54	0.032
15	Happening the floods and flowages.	38	52.58	24	44.90	16	51.91	14	59.00	16	64.63	3.824	1.386	3.05	0.549

16	Happening the fire in the site of project.	38	53.72	24	49.06	16	54.28	14	45.43	16	72.16	3.759	1.471	7.53	0.110
17	Improper technical study of project in the bidding stage.	38	52.16	24	53.23	16	49.41	14	40.29	16	60.63	3.740	1.053	2.03	0.730
18	Shortcoming of the measure and value process.	38	46.62	24	54.71	16	47.59	14	76.00	16	61.00	3.731	1.010	11.62	0.020
19	Subcontractor's law credibility.	38	50.64	24	63.15	16	43.41	14	48.57	16	66.47	3.703	0.864	8.01	0.091
20	Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).	38	49.17	24	57.71	16	52.78	14	68.61	16	51.72	3.701	1.0614	4.76	0.313
21	Pay liquidate damage.	38	52.91	24	41.96	16	68.19	14	45.75	16	71.03	3.667	0.474	13.97	0.008
22	Design errors.	38	55.83	24	45.33	16	64.50	14	47.54	16	61.14	3.666	0.959	5.71	0.221
23	Shortage of labor skill & lack of labors' experience.	38	45.72	24	57.73	16	69.75	14	55.54	16	54.34	3.657	0.884	8.23	0.083
24	Delay in material delivery.	38	54.6	24	57.47	16	60.00	14	32.30	16	63.76	3.648	0.875	10.49	0.033
25	Improper selection of project type and location	38	55.42	24	45.54	16	53.00	14	50.43	16	70.81	3.648	1.104	7.22	0.124

26	Original contract duration is too short from the owner.	38	63.43	24	44.33	16	36.54	14	58.21	16	62.90	3.620	0.850	8.92	0.008
27	Poor qualification of supervision staff of consultant engineer.	38	58.53	24	53.54	16	37.47	14	56.54	16	61.13	3.601	0.966	6.74	0.147
28	Happening the theft in the site of project.	38	51.08	24	60.81	16	50.19	14	45.65	16	64.19	3.592	0.947	5.18	0.269
29	Failure of equipment.	38	51.62	24	66.60	16	54.00	14	28.68	16	66.28	3.583	0.844	18.52	0.001
30	Delay in settlement of contractor's claim by the owner.	38	59.04	24	52.44	16	47.00	14	52.68	16	55.91	3.574	1.043	2.07	0.723
31	Delay in approval of contractor submittals by the consultant engineer (sample, tables, planning,... ...etc).	38	56.21	24	51.15	16	38.14	14	58.68	16	67.41	3.564	0.875	8.428	0.063
32	Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ...etc.).	38	54.62	24	57.33	16	45.91	14	56.54	16	56.31	3.564	1.087	1.63	0.802
33	Uncooperative owner with contractor.	38	62.11	24	51.54	16	43.50	14	46.93	16	58.50	3.556	0.960	3.73	0.187
34	Poor equipment productivity.	38	51.41	24	66.40	16	50.50	14	32.36	16	66.19	3.555	0.740	16.25	0.003
35	Increase wastage of material.	38	45.57	24	62.54	16	71.50	14	41.29	16	58.22	3.527	0.911	14.47	0.006

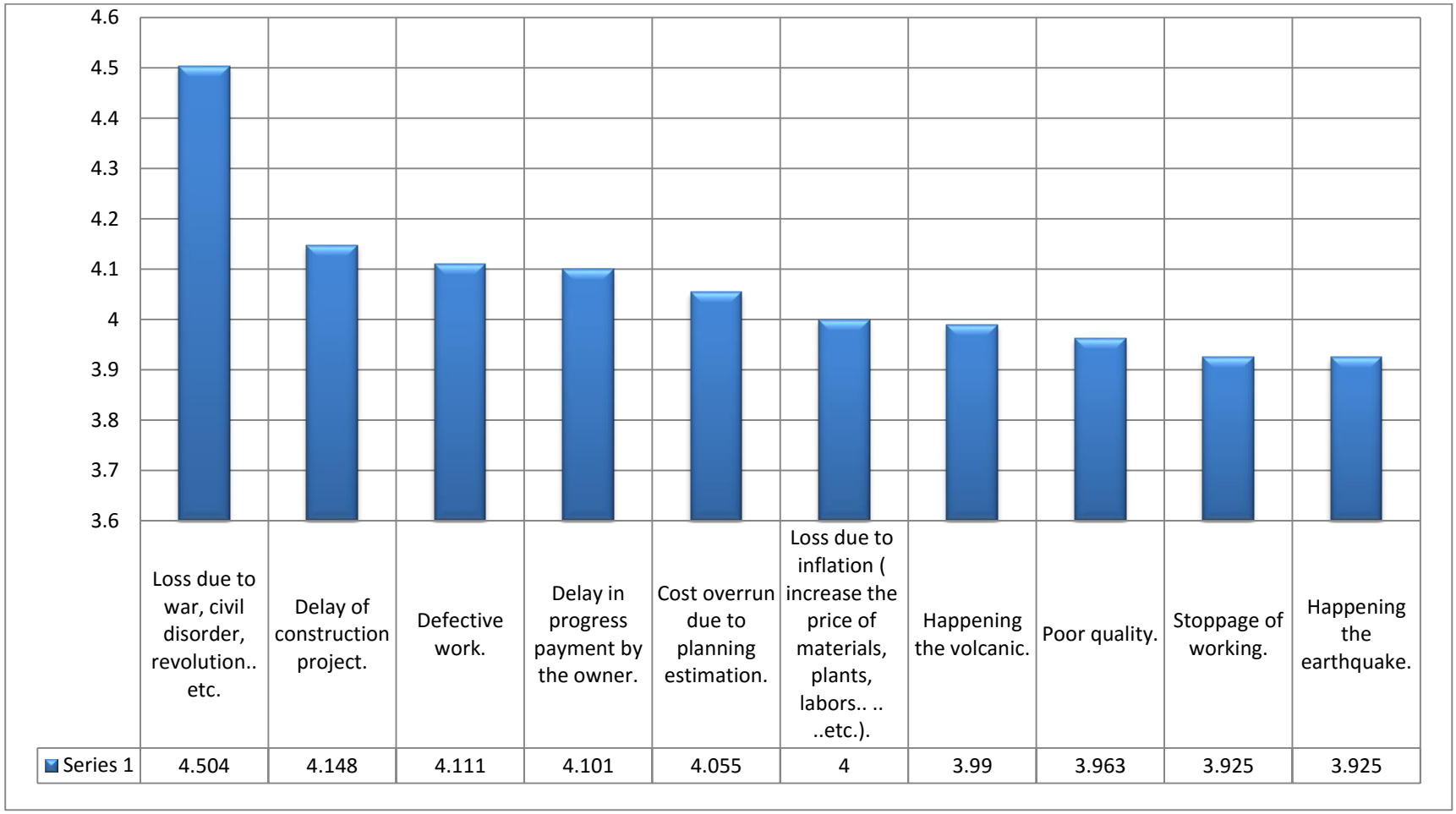
36	Ineffective planning and scheduling of project by the contractor.	38	60.83	24	45.56	16	42.50	14	51.21	16	67.75	3.518	0.901	10.08	0.094
37	Suspension of work by the owner.	38	63.18	24	46.38	16	55.19	14	54.93	16	45.00	3.518	1.134	10.50	0.169
38	Subcontractor problems with main contractor.	38	54.88	24	50.52	16	45.94	14	47.36	16	74.38	3.518	0.859	10.05	0.039
39	Incomplete in design and availability of information.	38	63.201	24	48.21	16	47.66	14	41.04	16	61.69	3.500	0.932	9.09	0.059
40	Design change by owner or his agent during construction.	38	55.38	24	49.38	16	55.56	14	56.14	16	57.59	3.490	0.922	1.00	0.904
41	Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.	38	59.82	24	47.46	16	50.49	14	48.54	16	61.47	3.490	0.859	4.44	0.343
42	Bad accelerate to deliver project by using extra resources.	38	59.57	24	54.73	16	44.28	14	47.57	16	69.56	3.490	0.870	4.15	0.385
43	The conflict between contractor and consultant.	38	46.63	24	63.10	16	44.34	14	44.46	16	72.09	3.490	0.990	11.99	0.017

44	Delay in making decisions by the owner within a reasonable time.	38	63.66	24	50.40	16	35.50	14	57.64	16	55.16	3.481	0.951	10.92	0.029
45	Delay in performing inspection & testing by the consultant.	38	48.59	24	52.69	16	47.28	14	54.75	16	78.25	3.481	0.971	12.87	0.012
46	Cash flow problems faced by the subcontractor.	38	53.83	24	66.58	16	33.09	14	45.00	16	67.69	3.472	0.858	17.26	0.002
47	Shortage in supply of water, gas, electricity ..etc	38	53.22	24	61.35	16	35.84	14	50.43	16	69.47	3.472	0.890	12.09	0.017
48	Poor labor productivity.	38	51.46	24	53.23	16	57.94	14	44.25	16	69.16	3.463	0.775	6.73	0.151
49	Delay in mobilization to start the project and survey late or survey in error by the contractor.	38	49.26	24	50.65	16	58.97	14	56.36	16	66.63	3.435	0.888	4.77	0.311
50	Excessive bureaucracy in the owner administration.	38	60.82	24	55.69	16	50.56	14	48.00	16	47.34	3.435	0.587	13.87	0.443
51	Interference by the owner in construction.	38	54.25	24	64.60	16	33.75	14	55.56	16	59.50	3.398	1.0932	6.16	0.027
52	Shortage of subcontractors.	38	57.03	24	57.25	16	40.25	14	41.64	16	69.88	3.388	1.041	11.02	0.026
53	Ambiguities, fault, and inconsistency of	38	57.88	24	52.23	16	44.09	14	44.07	16	69.41	3.379	0.843	8.49	0.075

	specification.														
54	Difficult to arrive to the site of project.	38	48.13	24	64.08	16	43.64	14	70.00	16	52.50	3.351	0.985	10.16	0.038
55	Delay to get on legal right.	38	51.76	24	60.13	16	48.88	14	57.64	16	55.44	3.342	0.958	1.92	0.750
56	Accident on site & disease of labor.	38	50.47	24	54.88	16	72.34	14	36.86	16	61.09	3.324	1.012	12.11	0.017
57	Difficulty the design, then difficulty in construction.	38	57.24	24	52.02	16	52.44	14	41.59	16	64.69	3.314	0.996	5.11	0.271
58	Poor communication and coordination between all parties.	38	66.25	24	37.46	16	40.94	14	41.68	16	79.16	3.287	1.050	27.34	0.000
59	Change in the scope of the project from the owner (quantities of work item, new area, etc.)	38	51.36	24	54.24	16	52.16	14	54.93	16	64.25	3.287	0.947	6.74	0.676
60	Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)	38	50.39	24	56.15	16	43.41	14	55.71	16	71.81	3.268	0.933	8.560	0.073
61	Late workshop drawing instruction.	38	52.57	24	48.81	16	53.56	14	51.07	16	71.56	3.259	0.950	6.52	0.163
62	Difficulties in obtaining work permits from the authorities.	38	55.97	24	46.33	16	50.47	14	49.93	16	71.28	3.250	0.957	7.715	0.103

63	Change in key staffing throughout the project.	38	65.62	24	50.21	16	31.50	14	47.57	16	69.56	3.240	1.057	21.48	0.000
64	Loose safety rules and regulations with the contractor's organization.	38	59.08	24	46.88	16	56.03	14	49.69	16	57.50	3.231	1.250	2.82	0.582
65	Change or differing site condition (access to the site, infrastructure surrounding, existing building.. ...etc.).	38	59.66	24	60.48	16	39.34	14	.42.22	16	58.34	3.213	0.907	9.35	0.053
66	Legal disputes between various parties in the project.	38	57.01	24	49.94	16	52.38	14	55.61	16	56.53	3.185	0.938	1.02	0.907
67	Labor dispute and strike.	38	52.64	24	58.52	16	53.71	14	50.79	16	56.88	3.166	1.054	0.84	0.925
68	Inadequate project organization structure	38	63.99	24	58.48	16	31.38	14	44.43	16	57.94	3.148	0.925	16.76	0.002
69	Delay in furnishing and delivering the site to the contractor.	38	63.51	24	49.38	16	41.59	14	37.61	16	68.47	3.101	0.956	15.10	0.004
70	Shortage of contractor's administrative personnel	38	58.57	24	48.40	16	45.00	14	53.00	16	64.09	3.083	1.103	5.00	0.286
71	Effect of social and cultural condition.	38	50.74	24	58.02	16	53.88	14	64.00	16	50.47	2.915	1.368	2.51	0.641

Figure 4.11 The Most Important Risk Factors for Contractors (in terms Degree Of impact) in Egypt



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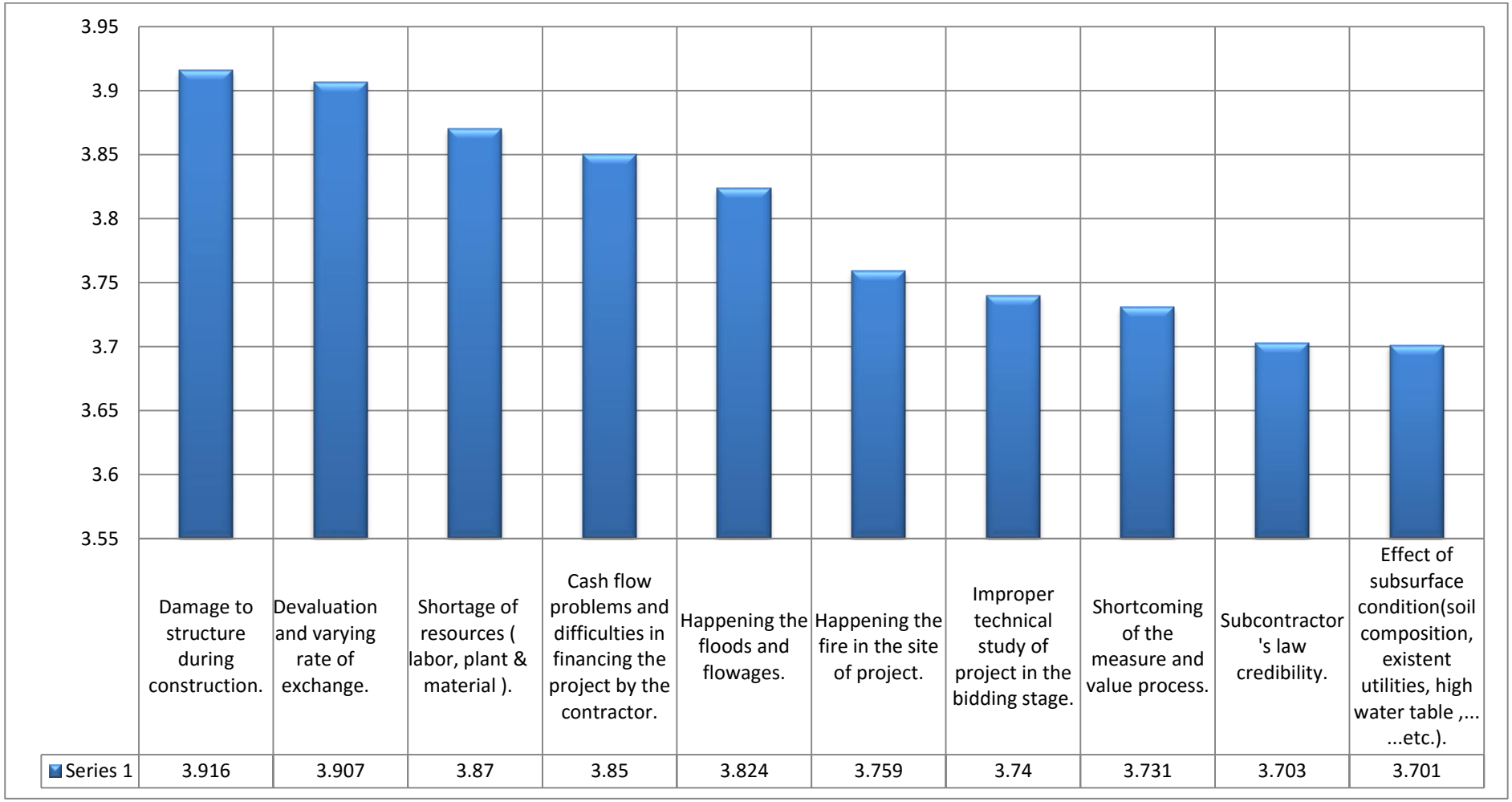
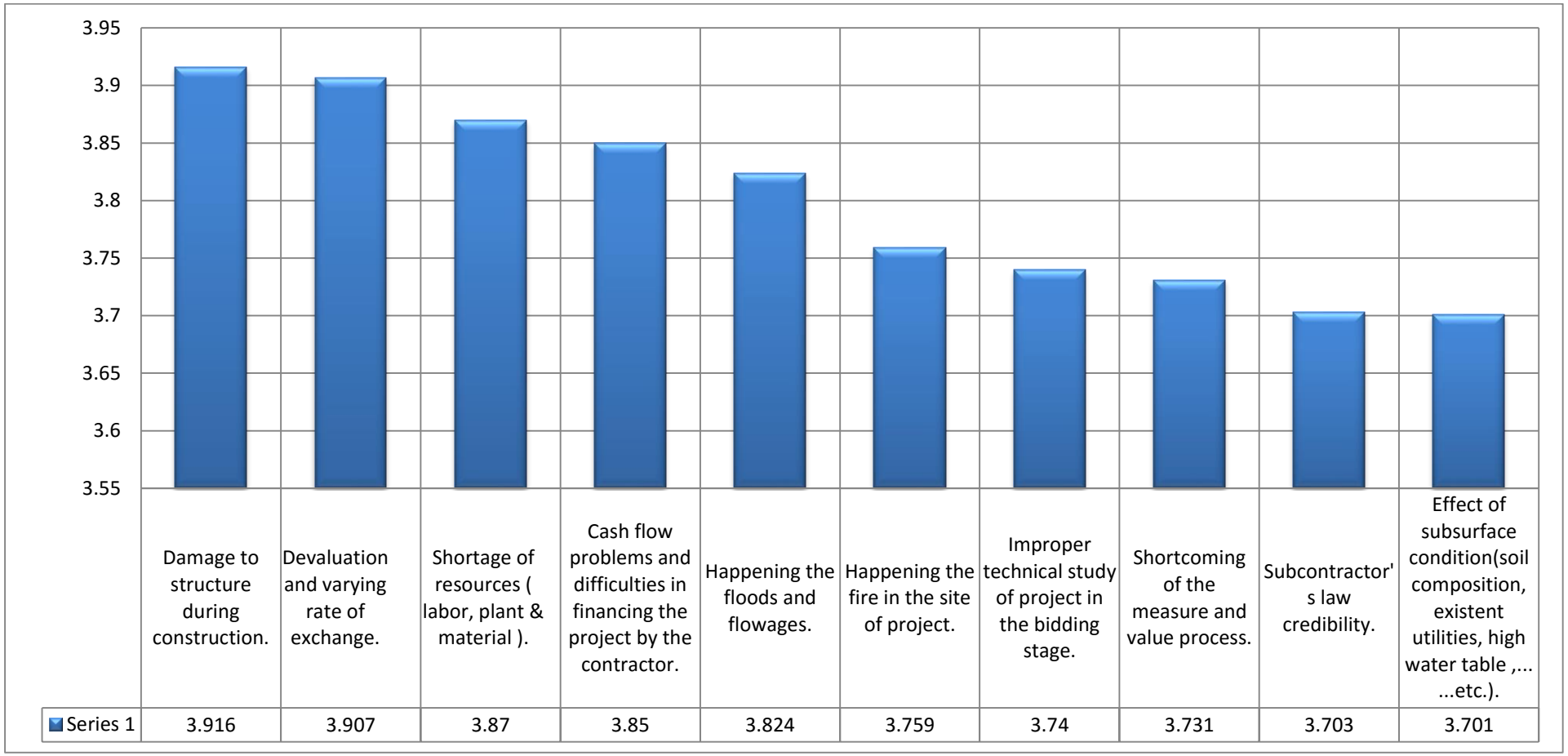
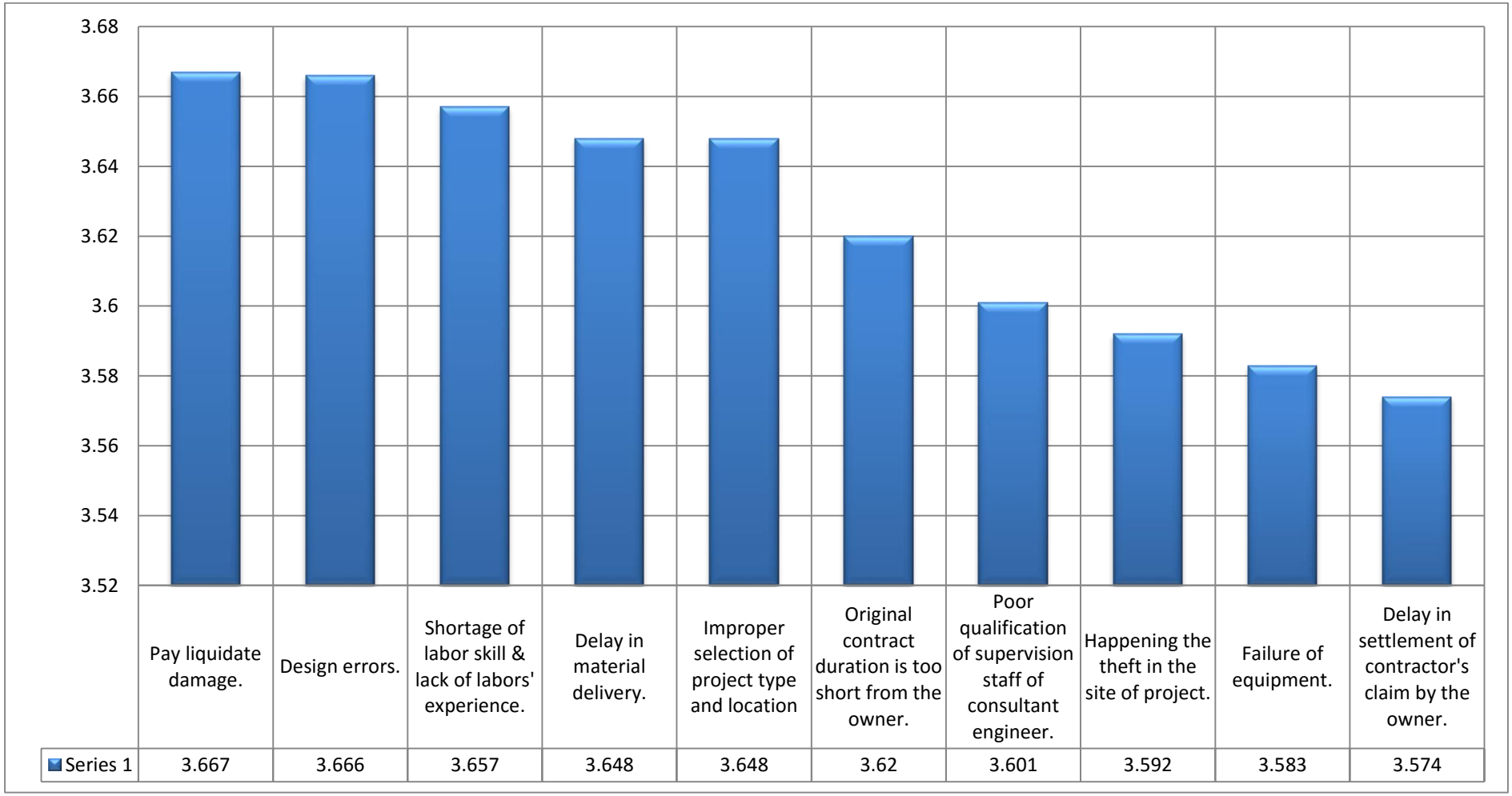

3.95
3.9
3.85
3.8
3.75
3.7
3.65
3.6
3.55
Damage to structure during construction.
Devaluation and varying rate of exchange.
Shortage of resources (labor, plant & material).
Cash flow problems and difficulties in financing the project by the contractor.
Happening the floods and flowages.
Happening the fire in the site of project.
Improper technical study of project in the bidding stage.
Shortcoming of the measure and value process.
Subcontractor 's law credibility.
Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).
Series 1
3.916
3.907
3.87
3.85
3.824
3.759
3.74
3.731
3.703
3.701

Continued…

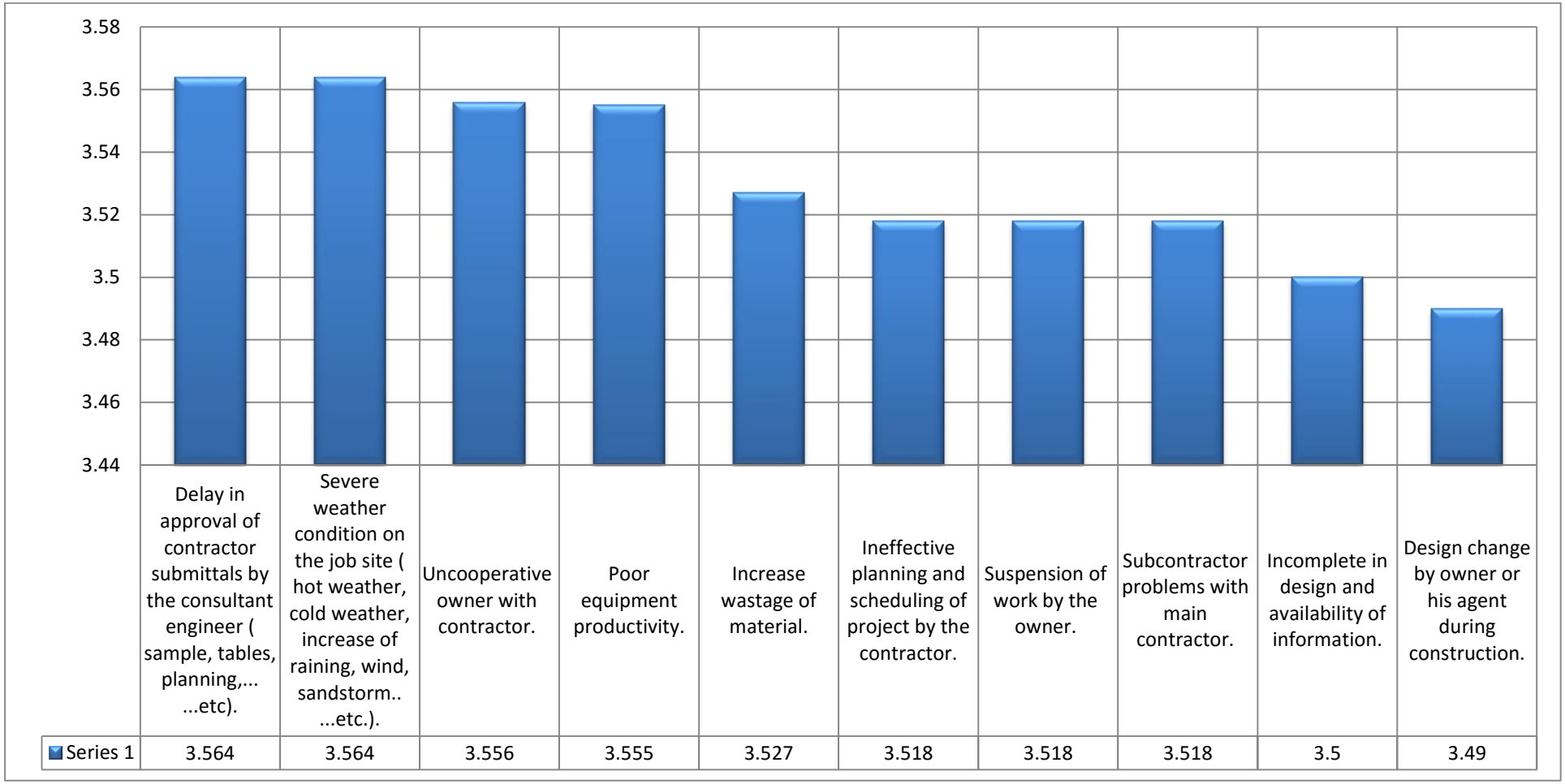


	Damage to structure during construction.	Devaluation and varying rate of exchange.	Shortage of resources (labor, plant & material).	Cash flow problems and difficulties in financing the project by the contractor.	Happening the floods and flowages.	Happening the fire in the site of project.	Improper technical study of project in the bidding stage.	Shortcoming of the measure and value process.	Subcontractor's law credibility.	Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).
Series 1	3.916	3.907	3.87	3.85	3.824	3.759	3.74	3.731	3.703	3.701

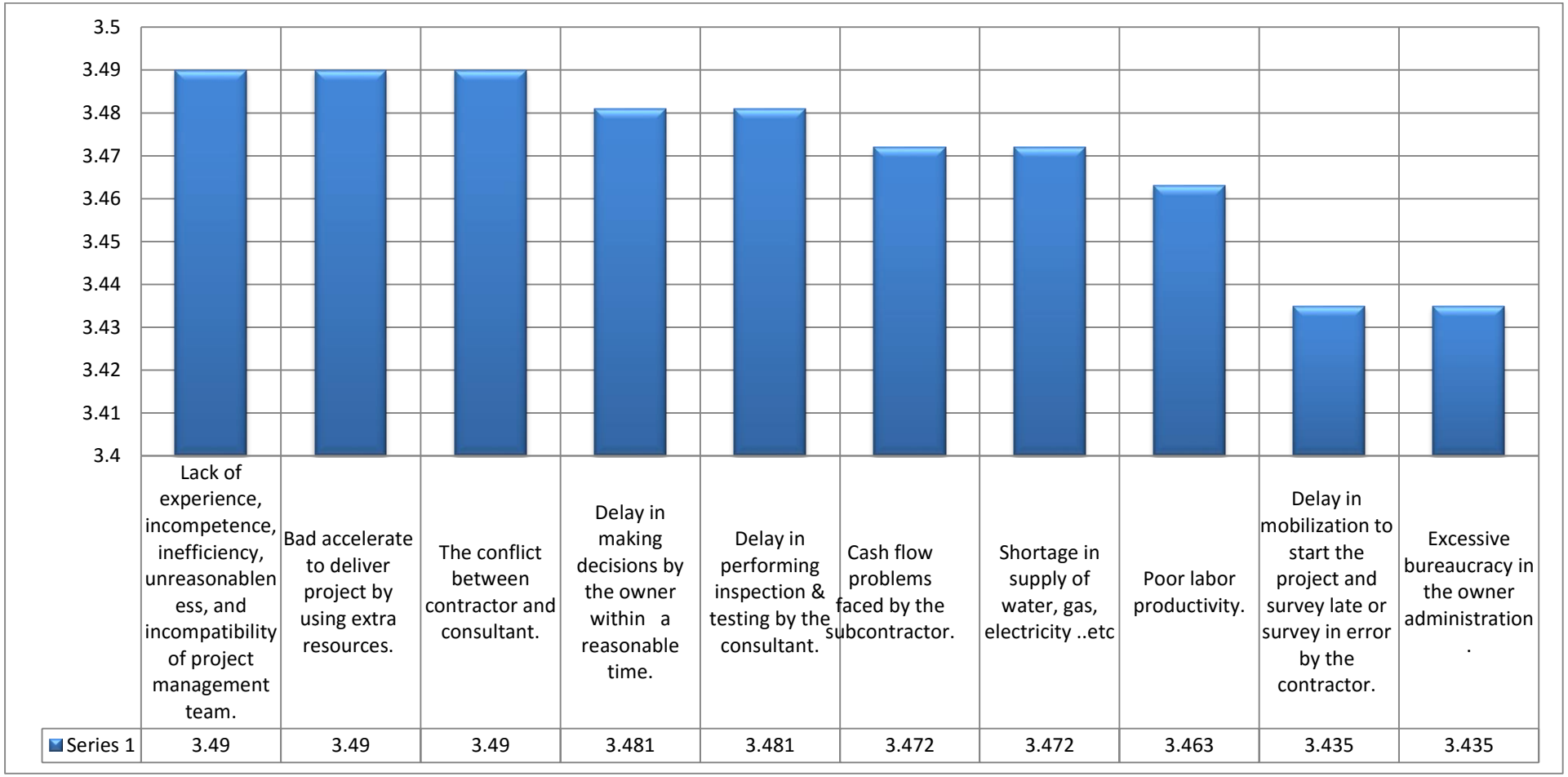
Continued…


3.68
3.66
3.64
3.62
3.6
3.58
3.56
3.54
3.52
Pay liquidate damage.
Design errors.
Shortage of labor skill & lack of labors' experience.
Delay in material delivery.
Improper selection of project type and location
Original contract duration is too short from the owner.
Poor qualification of supervision staff of consultant engineer.
Happening the theft in the site of project.
Failure of equipment.
Delay in settlement of contractor's claim by the owner.
Series 1
3.667
3.666
3.657
3.648
3.648
3.62
3.601
3.592
3.583
3.574

Continued…

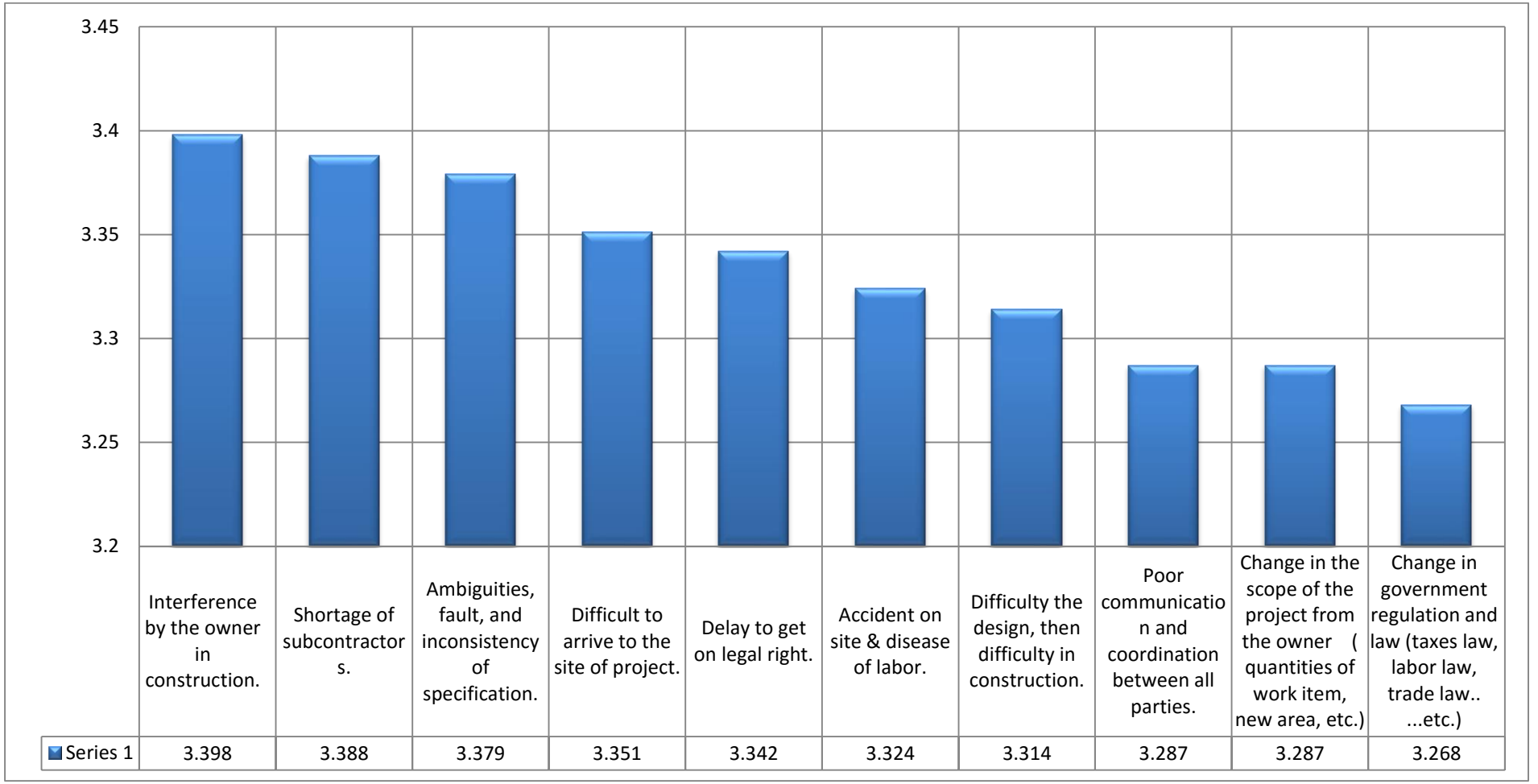

3.58
3.56
3.54
3.52
3.5
3.48
3.46
3.44
Delay in approval of contractor submittals by the consultant engineer (sample, tables, planning,... ...etc).
Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ...etc.).
Uncooperative owner with contractor.
Poor equipment productivity.
Increase wastage of material.
Ineffective planning and scheduling of project by the contractor.
Suspension of work by the owner.
Subcontractor problems with main contractor.
Incomplete in design and availability of information.
Design change by owner or his agent during construction.
Series 1
3.564
3.564
3.556
3.555
3.527
3.518
3.518
3.518
3.5
3.49

Continued…

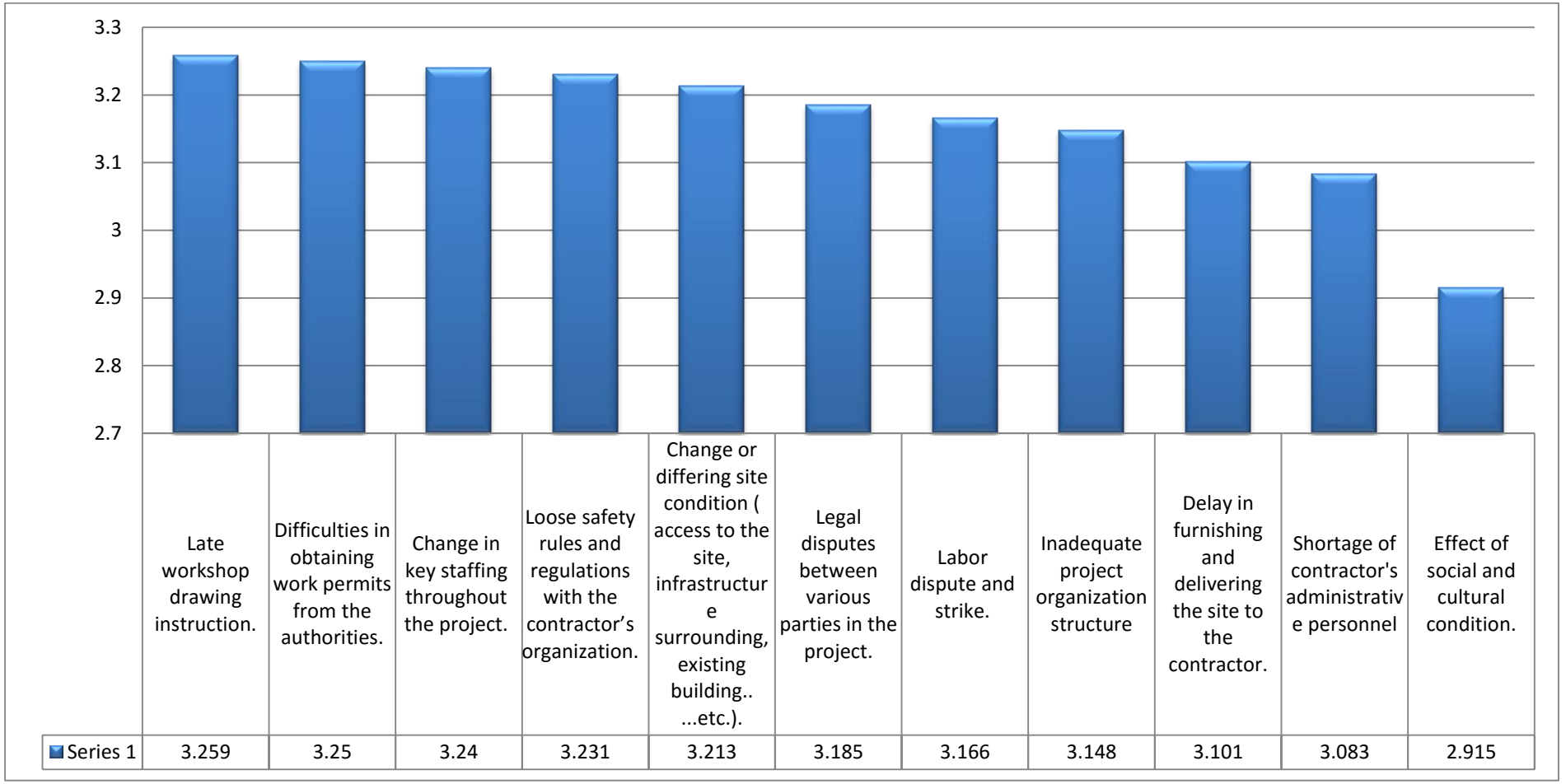


	Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.	Bad accelerate to deliver project by using extra resources.	The conflict between contractor and consultant.	Delay in making decisions by the owner within a reasonable time.	Delay in performing inspection & testing by the consultant.	Cash flow problems faced by the subcontractor.	Shortage in supply of water, gas, electricity ..etc	Poor labor productivity.	Delay in mobilization to start the project and survey late or survey in error by the contractor.	Excessive bureaucracy in the owner administration .
Series 1	3.49	3.49	3.49	3.481	3.481	3.472	3.472	3.463	3.435	3.435

Continued…


3.45
3.4
3.35
3.3
3.25
3.2
Interference by the owner in construction.
Shortage of subcontractors.
Ambiguities, fault, and inconsistency of specification.
Difficult to arrive to the site of project.
Delay to get on legal right.
Accident on site & disease of labor.
Difficulty the design, then difficulty in construction.
Poor communication and coordination between all parties.
Change in the scope of the project from the owner (quantities of work item, new area, etc.)
Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)
Series 1
3.398
3.388
3.379
3.351
3.342
3.324
3.314
3.287
3.287
3.268

Continued…


3.3
3.2
3.1
3
2.9
2.8
2.7
Late workshop drawing instruction.
Difficulties in obtaining work permits from the authorities.
Change in key staffing throughout the project.
Loose safety rules and regulations with the contractor’s organization.
Change or differing site condition (access to the site, infrastructure surrounding, existing building.. ...etc.).
Legal disputes between various parties in the project.
Labor dispute and strike.
Inadequate project organization structure
Delay in furnishing and delivering the site to the contractor.
Shortage of contractor's administrative personnel
Effect of social and cultural condition.
Series 1
3.259
3.25
3.24
3.231
3.213
3.185
3.166
3.148
3.101
3.083
2.915

Done.

4.5.3 Probability of Occurrence In Yemen

This part contains the most important sources of risks, which had occurred to the contractors in Republic of Yemen according to the contractors' answers where the sources of risks are evaluated as per the mean. So the sources of risks,.that got more than 3.00, are "Very Important". However, the sources of risks, which evaluation is ranging between 2.5 and 3.00, are considered " Important", but the sources of risks, which values are between 2.00 -2.50 are "Less Important" and the sources of risks, which evaluation is less than 2.00, are considered "Unimportant".

Moreover, this part contains more description for the contractors who are more affected by the sources of risks occurrence whether contractors of first or second degrees to the fifth one as shown in table 4.12 and figure 4.12

Table 4.12 The Most Important Risk Factors for Contractors and The contractor classes most affected by this factors in Yemen

N	*Sources of risks*	First grades		Second grade		Third grade		fourth grade		Fifth grade		Mean	St. div	Ch+.	Sig
		N	mean rank	N	mean rank	N	mean rank	N	mean rank	N	mean rank				
1	Loss due to inflation (increase the price of materials, plants, labors .etc.).	32	59.25	28	65.63	32	70.02	18	43.03	14	71.54	3.741	1.042	8.85	0.065
2	Devaluation and varying rate of exchange.	32	63.34	28	63.41	32	63.16	18	63.08	14	56.50	3.701	1.133	0.490	0.975
3	Delay in progress payment by the owner.	32	49.17	28	62.04	32	77.02	18	62.11	14	61.21	3.685	1.099	10.88	0.028
4	Loss due to war, civil disorder, revolution..	32	76.56	28	56.00	32	64.11	18	42.22	14	65.75	3.532	1.225	12.51	0.014

	etc.														
5	Increase wastage of material.	32	68.80	28	68.68	32	46.23	18	75.79	14	55.86	3.508	1.016	12.41	0.015
6	Cost overrun due to planning estimation.	32	61.05	28	69.61	32	61.59	18	48.82	14	71.79	3.427	1.169	5.30	0.258
7	Interference by the owner in construction.	32	71.34	28	69.29	32	64.77	18	51.89	14	37.18	3.314	1.015	12.66	0.013
8	Shortage in supply of water, gas, electricity ..etc	32	60.04	28	60.69	32	68.55	18	51.67	14	71.75	3.233	0.407	3.92	0.407
9	Delay of construction project.	32	55.00	28	62.84	32	68.75	18	68.77	14	56.61	3.193	0.959	3.60	0.461
10	Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).	32	75.14	28	67.00	32	60.19	18	37.61	14	61.89	3.179	0.007	13.95	0.007
11	Cash flow problems faced by the subcontractor.	32	72.23	28	51.43	32	60.63	18	67.50	14	59.25	3.161	1.171	5.67	0.225
12	Original contract duration is too short from the owner.	32	68.53	28	62.46	32	62.36	18	55.71	14	57.82	3.104	0.977	1.95	0.745
13	Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ...etc.).	32	70.03	28	70.68	32	60.66	18	48.72	14	50.86	3.096	1.192	7.50	0.111

14	Shortage of labor skill & lack of labors' experience.	32	44.30	28	80.36	32	60.23	18	73.42	14	59.54	3.056	1.287	17.84	0.001
15	Stoppage of working.	32	51.77	28	73.98	32	71.78	18	58.06	14	48.57	3.048	1.026	11.13	0.025
16	Cash flow problems and difficulties in financing the project by the contractor.	32	44.98	28	54.27	32	72.81	18	77.78	14	75.79	3.048	1.188	17.84	0.001
17	Design change by owner or his agent during construction.	32	65.60	28	70.07	32	63.50	18	50.44	14	54.71	3.032	1.058	4.41	0.350
18	Delay in approval of contractor submittals by the consultantengineer (sample, tables,planning,.etc).	32	59.38	28	63.50	32	68.69	18	52.31	14	66.61	3.024	1.031	3.09	0.542
19	Subcontractor's law credibility.	32	65.56	28	62.05	32	60.08	18	60.75	14	64.18	3.024	1.007	0.50	0.973
20	Delay in settlement of contractor's claim by the owner.	32	69.93	28	50.82	32	74.03	18	58.84	14	47.84	3.008	0.466	11.11	0.025
21	Change in the scope of the project from the owner (quantities of work item, new area, etc.)	32	67.19	28	67.25	32	68.41	18	48.58	14	46.74	3.000	0.919	8.22	0.084
22	Loose safety rules and regulations with the	32	51.38	28	66.05	32	64.06	18	70.39	14	67.11	2.991	1.239	4.73	0.316

	contractor's organization.														
23	Change or differing site condition (access to the site, infrastructure surrounding, existing building.etc)	32	63.28	28	69.06	32	63.56	18	47.53	14	64.43	2.991	0.038	4.45	0.349
24	Delay in making decisions by the owner within a reasonable time.	32	53.59	28	62.69	32	63.06	18	83.75	14	53.32	2.983	1.229	10.01	0.040
25	Subcontractor problems with main contractor.	32	73.64	28	56.54	32	68.33	18	49.08	14	52.79	2.959	1.150	8.76	0.067
26	Excessive bureaucracy in the owner administration.	32	63.98	28	56.41	32	67.17	18	62.33	14	59.82	2.943	1.106	1.44	0.836
27	Effect of social and cultural condition.	32	63.77	28	68.38	32	70.11	18	48.03	14	49.07	2.932	7.44	7.44	0.114
28	Poor labor productivity.	32	46.03	28	61.79	32	66.52	18	69.58	14	83.29	2.915	1.095	13.43	0.009
29	The conflict between contractor and consultant.	32	64.77	28	61.25	32	62.14	18	58.84	14	65.29	2.903	1.007	0.48	0.976
30	Difficult to arrive to the site of project.	32	68.39	28	62.44	32	66.14	18	47.53	14	60.04	2.879	0.328	4.62	0.328
31	Delay in performing inspection & testing by the consultant.	32	62.94	28	57.34	32	64.38	18	61.89	14	68.32	2.871	1.043	1.138	0.888

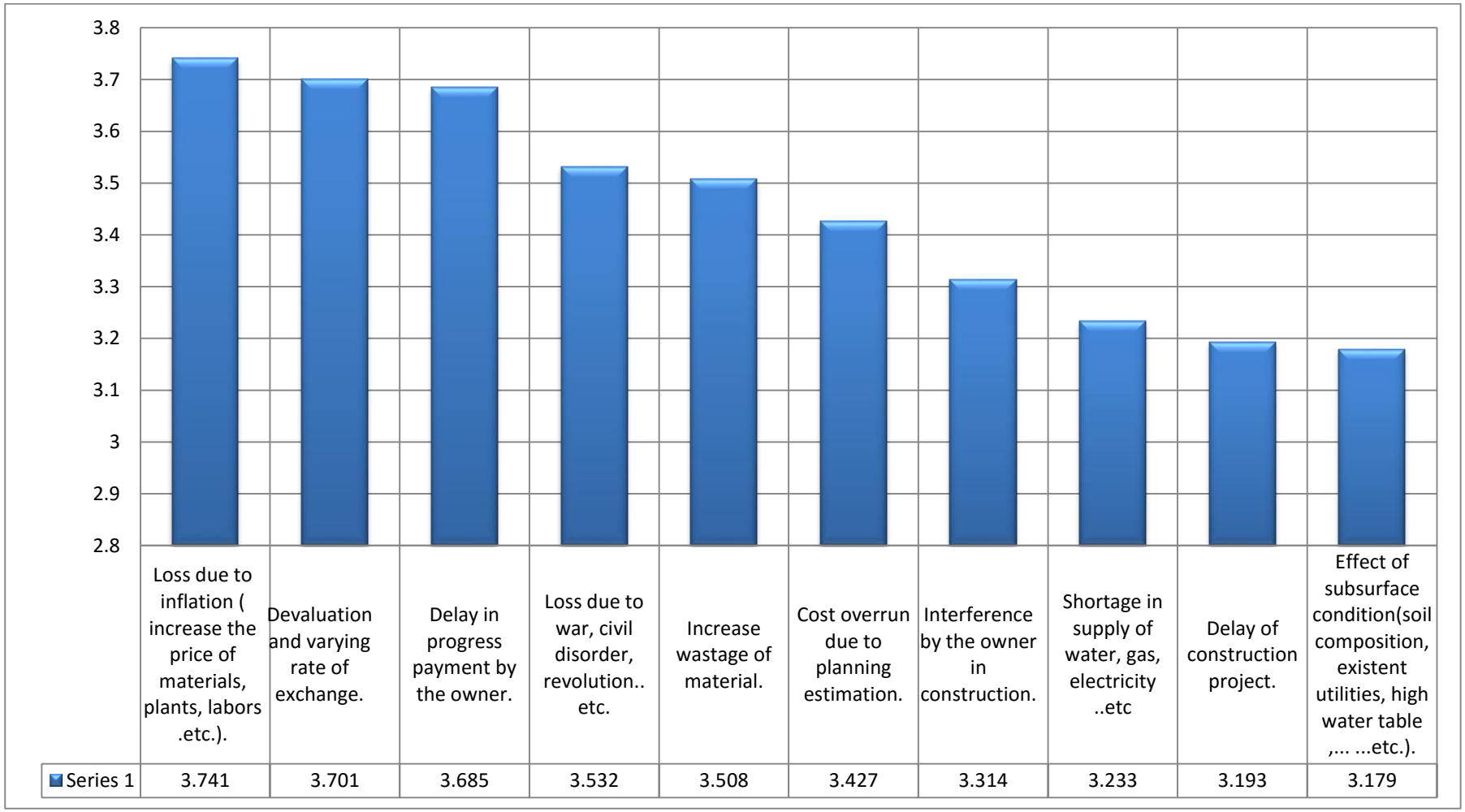
32	Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.	32	55.64	28	70.89	32	59.91	18	62.56	14	67.14	2.806	1.041	3.37	0.498
33	Ineffective planning and scheduling of project by the contractor.	32	49.34	28	69.25	32	63.40	18	62.14	14	77.39	2.798	1.255	8.12	0.087
34	Poor qualification of supervision staff of consultant engineer.	32	46.13	28	70.41	32	65.95	18	64.92	14	73.11	2.790	0.998	10.51	0.033
35	Suspension of work by the owner.	32	51.48	28	55.55	32	68.38	18	72.08	14	74.68	2.750	0.925	8.51	0.074
36	Happening the floods and flowages.	32	72.89	28	54.80	32	71.61	18	42.53	14	59.00	2.733	1.525	12.34	0.015
37	Improper technical study of project in the bidding stage.	32	47.78	28	63.14	32	67.47	18	69.33	14	74.71	2.725	1.099	9.20	0.056
38	Delay in material delivery.	32	53.59	28	81.04	32	57.64	18	53.44	14	67.86	2.717	1.108	12.26	0.016
39	Ambiguities, fault, and inconsistency of specification.	32	46.30	28	60.36	32	74.73	18	64.67	14	73.07	2.704	1.102	12.50	0.014
40	Incomplete in design and availability of information.	32	50.20	28	64.05	32	79.25	18	60.72	14	51.50	2.701	1.084	13.82	0.010

41	Uncooperative owner with contractor.	32	59.63	28	52.86	32	69.50	18	64.17	14	70.21	2.693	0.947	4.44	0.338
42	Change in key staffing throughout the project.	32	62.55	28	60.18	32	65.72	18	60.75	14	61.93	2.661	0.995	0.478	0.976
43	Legal disputes between various parties in the project.	32	58.75	28	65.24	32	66.16	18	54.72	14	67.07	2.661	1.011	2.09	0.719
44	Poor communication and coordination between all parties.	32	66.33	28	48.07	32	65.25	18	63.61	14	74.89	2.645	1.045	7.32	0.120
45	Late workshop drawing instruction.	32	48.38	28	66.79	32	70.75	18	61.39	14	68.79	2.612	1.159	7.95	0.093
46	Design errors.	32	51.92	28	52.54	32	79.02	18	64.22	14	66.64	2.604	1.102	12.82	0.012
47	Poor equipment productivity.	32	53.50	28	70.09	32	59.14	18	67.06	14	69.71	2.596	1.154	4.78	0.310
48	Difficulties in obtaining work permits from the authorities.	32	51.64	28	66.70	32	66.41	18	55.34	14	79.07	2.580	1.052	8.08	0.089
49	Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)	32	61.23	28	62.55	32	69.69	18	42.11	14	75.07	2.572	0.997	9.79	0.044
50	Improper selection of project type and location	32	52.28	28	55.66	32	70.73	18	69.11	14	72.21	2.548	0.957	7.73	0.102

51	Inadequate project organization structure	32	47.17	28	71.43	32	61.64	18	72.14	14	68.14	2.524	1.143	10.05	0.039
52	Delay in mobilization to start the project and survey late or survey in error by the contractor.	32	60.63	28	63.71	32	60.77	18	58.58	14	73.36	2.500	1.039	1.85	0.762
53	Shortage of subcontractors.	32	64.14	28	62.00	32	68.50	18	57.72	14	52.07	2.488	1.107	2.64	0.614
54	Shortcoming of the measure and value process.	32	54.80	28	61.30	32	65.16	18	71.56	14	64.75	2.483	1.083	3.09	0.542
55	Bad accelerate to deliver project by using extra resources.	32	61.97	28	63.21	32	62.47	18	51.39	14	75.50	2.481	1.016	3.88	0.422
56	Failure of equipment.	32	64.53	28	70.84	32	66.11	18	52.03	14	46.24	2.459	1.069	7.00	0.136
57	Pay liquidate damage.	32	51.31	28	54.95	32	78.09	18	74.69	14	51.86	2.443	1.257	14.53	0.006
58	Shortage of contractor's administrative personnel	32	53.78	28	65.07	32	64.31	18	58.00	14	78.43	2.419	1.245	5.64	0.223
59	Shortage of resources (labor, plant & material).	32	56.34	28	75.43	32	54.64	18	64.69	14	64.75	2.403	1.248	6.91	0.140
60	Poor quality.	32	47.75	28	62.46	32	71.31	18	67.25	14	69.96	2.387	1.044	8.92	0.063

61	Happening the theft in the site of project.	32	58.63	28	67.38	32	59.20	18	56.67	14	76.64	2.362	0.990	4.16	0.384
62	Defective work.	32	44.67	28	58.48	32	80.16	18	52.89	14	83.24	2.346	1.182	23.61	0.000
63	Delay in furnishing and delivering the site to the contractor.	32	59.47	28	56.25	32	74.44	18	65.33	14	49.86	2.298	0.962	7.64	0.103
64	Damage to structure during construction.	32	50.98	28	59.11	32	69.11	18	73.31	14	66.61	2.264	1.247	7.07	0.132
65	Labor dispute and strike.	32	50.66	28	56.04	32	68.63	18	66.36	14	83.54	2.258	1.042	11.05	0.021
66	Difficulty the design, then difficulty in construction.	32	50.89	28	54.41	32	69.66	18	63.31	14	77.82	2.250	0.0951	8.67	0.070
67	Accident on site & disease ol labor.	32	61.53	28	57.20	32	72.30	18	55.36	14	62.11	2.201	0.936	4.12	0.390
68	Happening the fire in the site of project.	32	57.44	28	61.07	32	69.13	18	61.61	14	62.93	1.983	1.216	2.06	0.724
69	Delay to get on legal right.	32	51.77	28	60.54	32	71.78	18	77.25	14	50.74	1.758	1.038	10.61	0.031
70	Happening the earthquake.	32	60.59	28	70.00	32	65.53	18	42.78	14	70.29	1.750	1.240	10.35	0.035
71	Happening the volcanic.	32	59.56	28	78.55	32	60.25	18	48.00	14	60.89	1.441	1.031	16.17	0.003

Figure 4.12 The Most Important Risk Factors for Contractors in Yemen



	Loss due to inflation (increase the price of materials, plants, labors .etc.).	Devaluation and varying rate of exchange.	Delay in progress payment by the owner.	Loss due to war, civil disorder, revolution.. etc.	Increase wastage of material.	Cost overrun due to planning estimation.	Interference by the owner in construction.	Shortage in supply of water, gas, electricity ..etc	Delay of construction project.	Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).
Series 1	3.741	3.701	3.685	3.532	3.508	3.427	3.314	3.233	3.193	3.179

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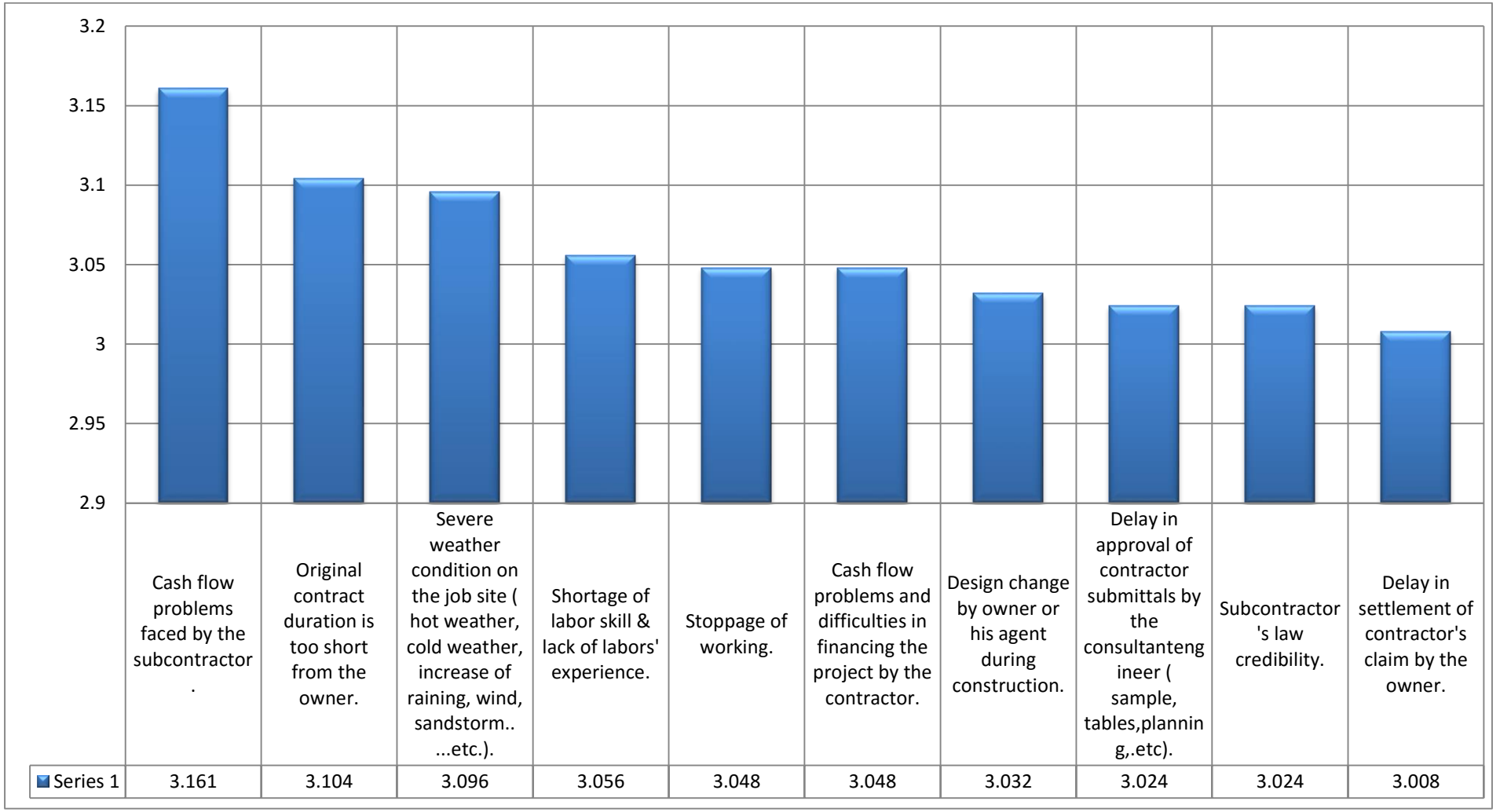
3.2
3.15
3.1
3.05
3
2.95
2.9
Cash flow problems faced by the subcontractor .
Original contract duration is too short from the owner.
Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ...etc.).
Shortage of labor skill & lack of labors' experience.
Stoppage of working.
Cash flow problems and difficulties in financing the project by the contractor.
Design change by owner or his agent during construction.
Delay in approval of contractor submittals by the consultanteng ineer (sample, tables,plannin g,.etc).
Subcontractor 's law credibility.
Delay in settlement of contractor's claim by the owner.
Series 1
3.161
3.104
3.096
3.056
3.048
3.048
3.032
3.024
3.024
3.008

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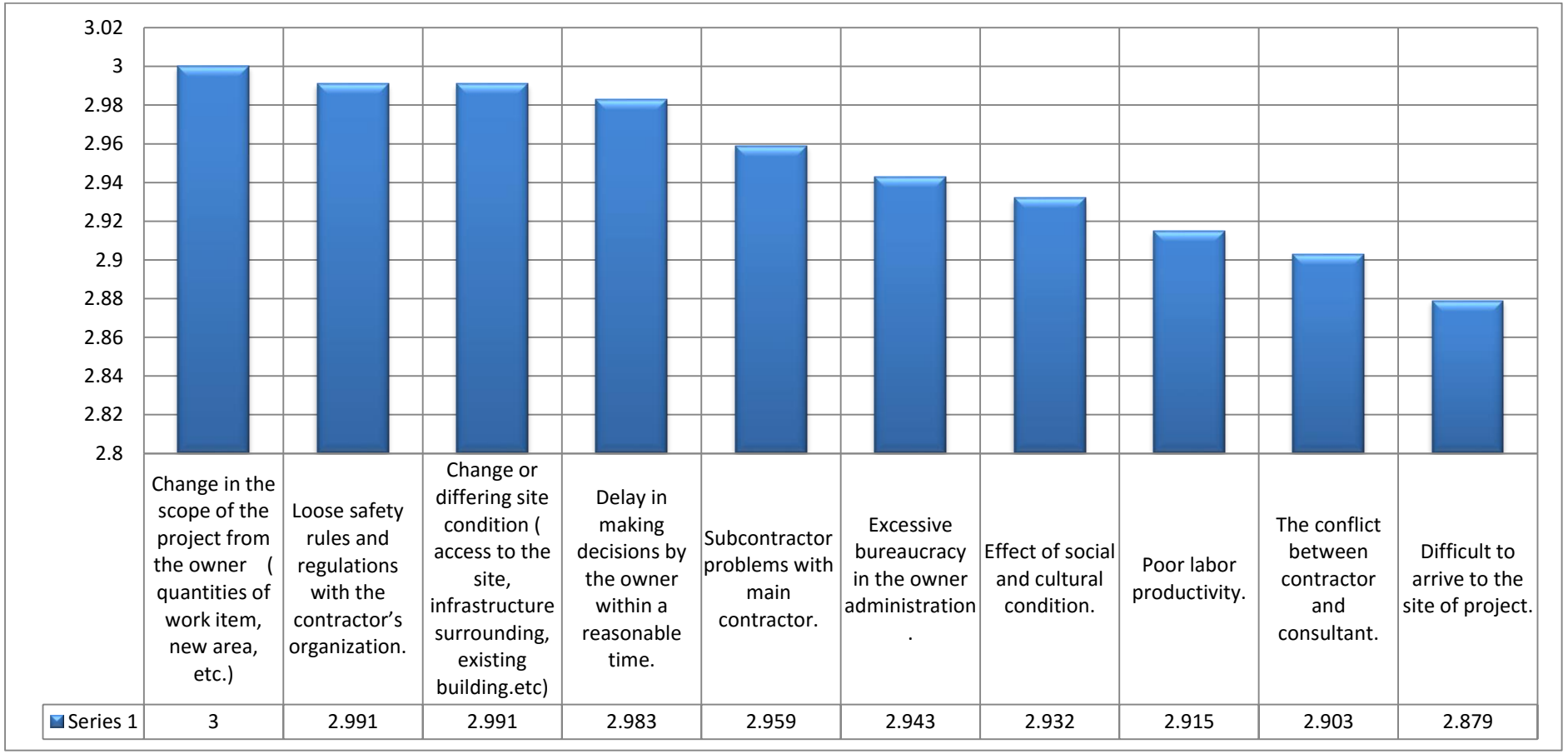
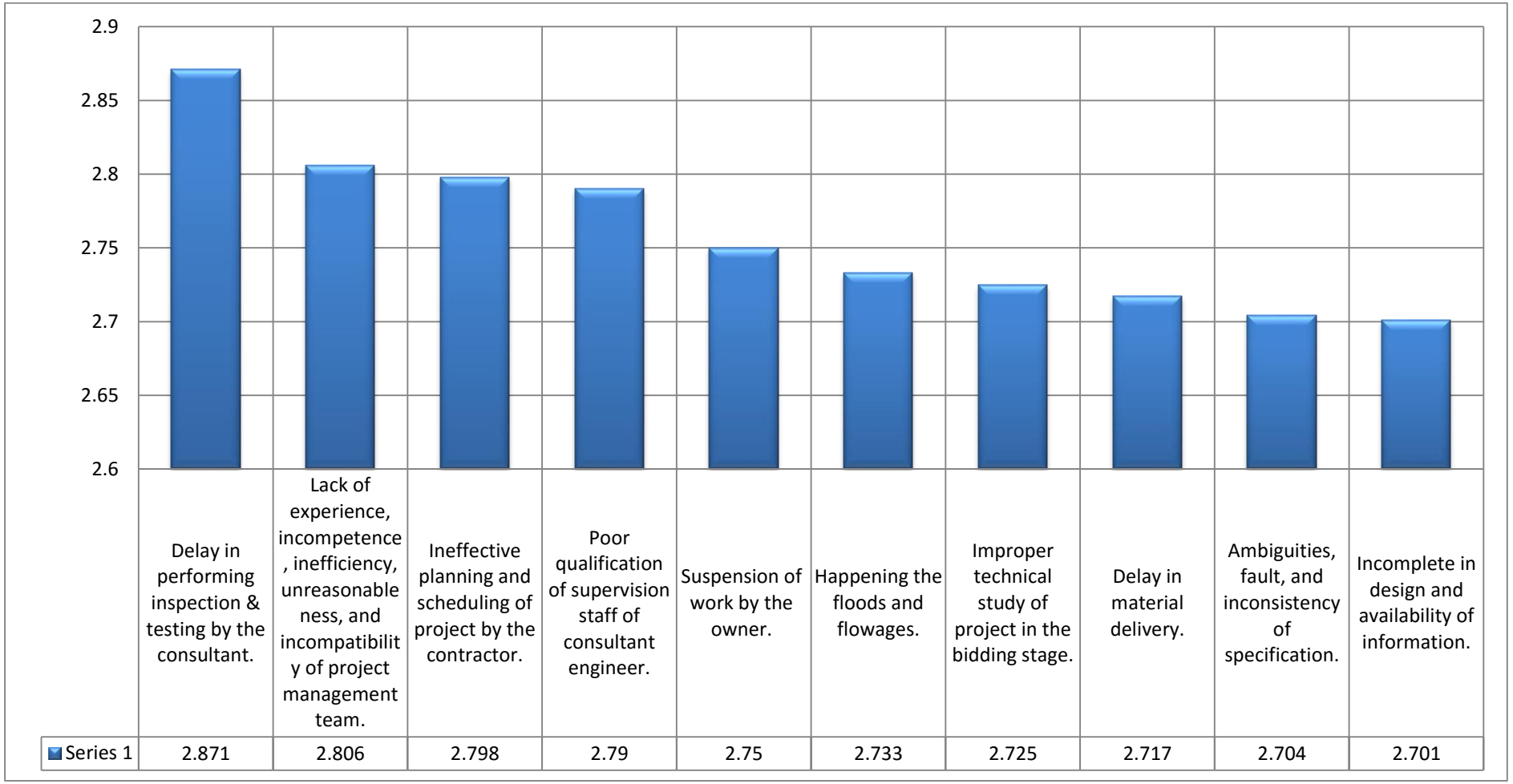
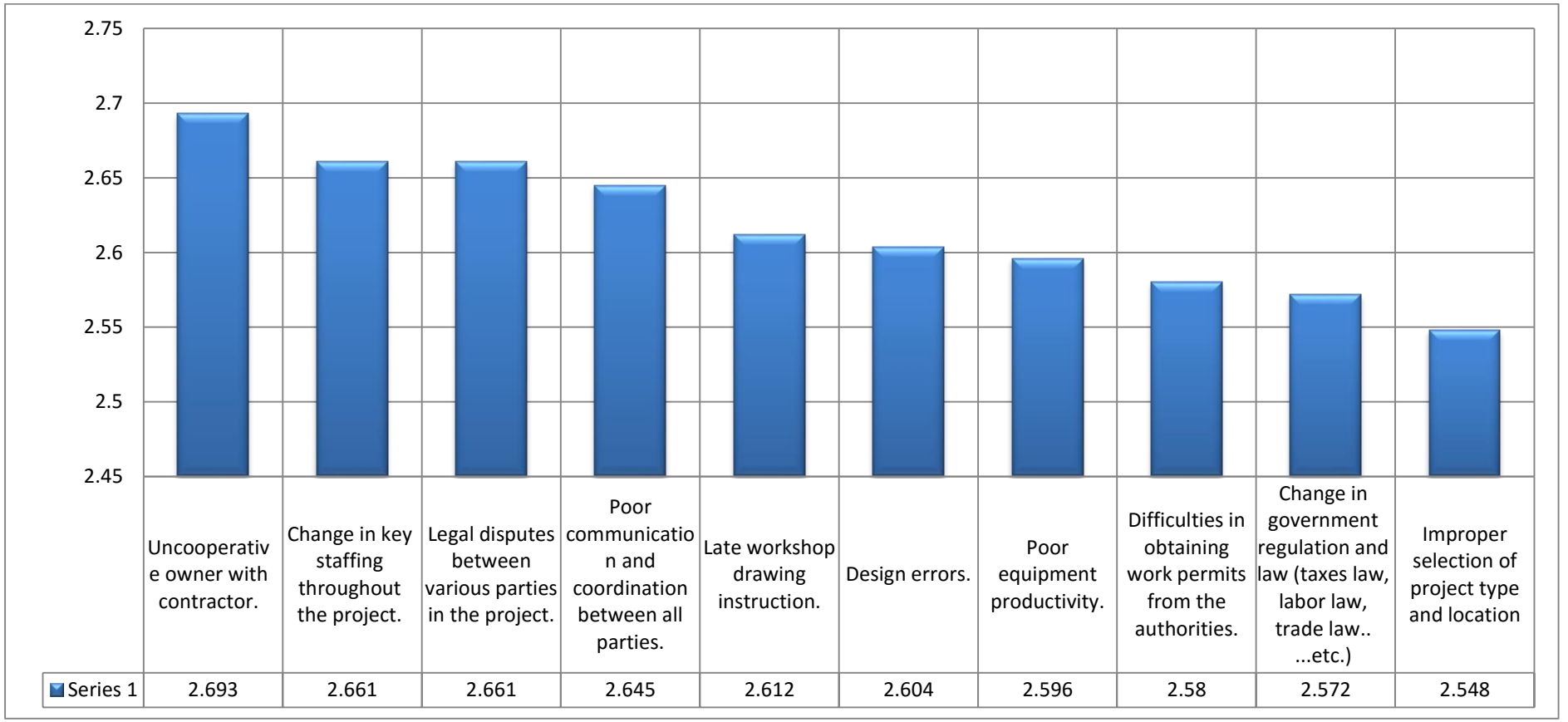


	Change in the scope of the project from the owner (quantities of work item, new area, etc.)	Loose safety rules and regulations with the contractor's organization.	Change or differing site condition (access to the site, infrastructure surrounding, existing building.etc)	Delay in making decisions by the owner within a reasonable time.	Subcontractor problems with main contractor.	Excessive bureaucracy in the owner administration .	Effect of social and cultural condition.	Poor labor productivity.	The conflict between contractor and consultant.	Difficult to arrive to the site of project.
Series 1	3	2.991	2.991	2.983	2.959	2.943	2.932	2.915	2.903	2.879

Continued…


2.9
2.85
2.8
2.75
2.7
2.65
2.6
Delay in performing inspection & testing by the consultant.
Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.
Ineffective planning and scheduling of project by the contractor.
Poor qualification of supervision staff of consultant engineer.
Suspension of work by the owner.
Happening the floods and flowages.
Improper technical study of project in the bidding stage.
Delay in material delivery.
Ambiguities, fault, and inconsistency of specification.
Incomplete in design and availability of information.
Series 1
2.871
2.806
2.798
2.79
2.75
2.733
2.725
2.717
2.704
2.701

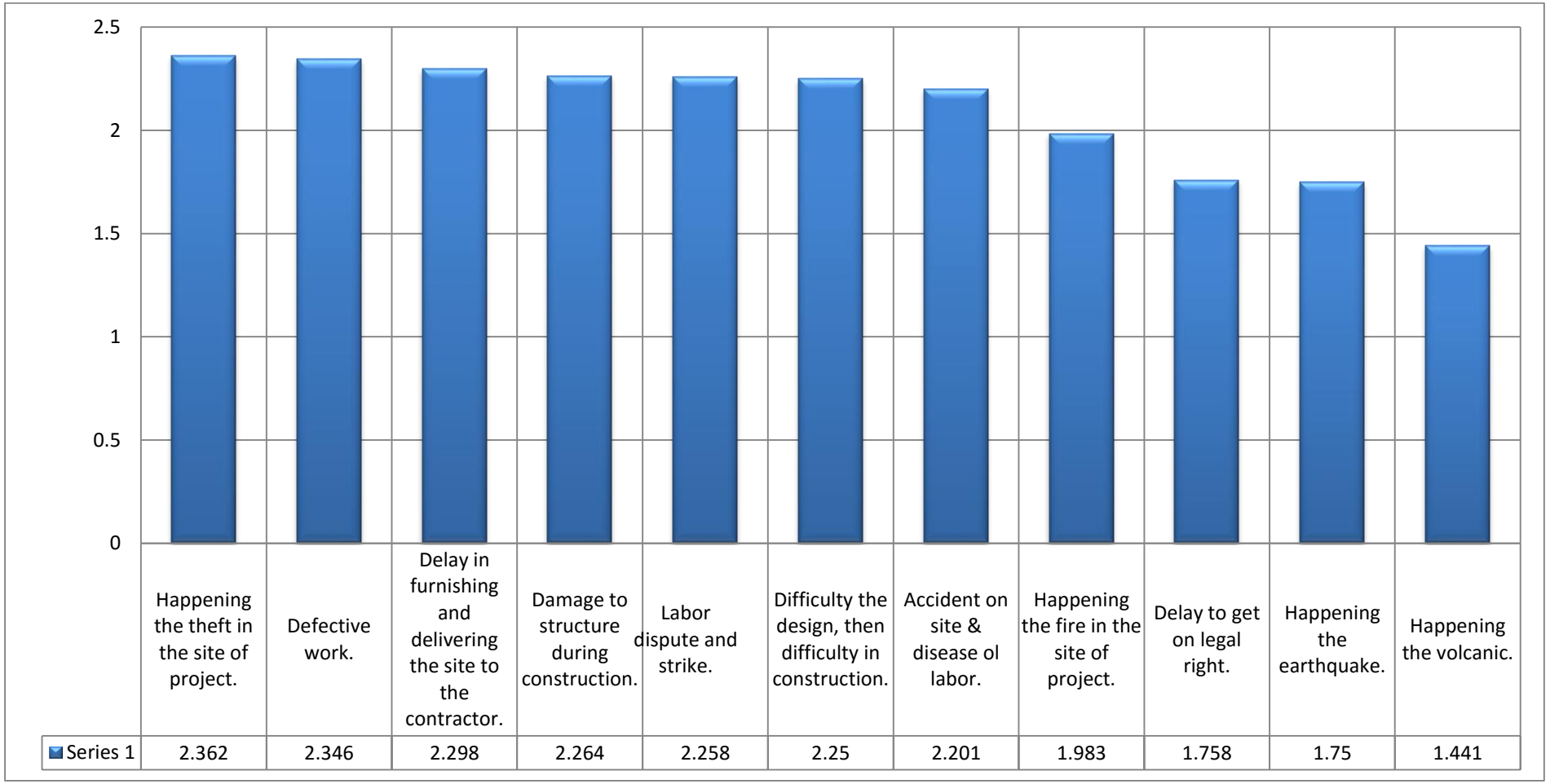
Continued…


2.75
2.7
2.65
2.6
2.55
2.5
2.45
Uncooperative owner with contractor.
Change in key staffing throughout the project.
Legal disputes between various parties in the project.
Poor communication and coordination between all parties.
Late workshop drawing instruction.
Design errors.
Poor equipment productivity.
Difficulties in obtaining work permits from the authorities.
Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)
Improper selection of project type and location
Series 1
2.693
2.661
2.661
2.645
2.612
2.604
2.596
2.58
2.572
2.548

Continued…


2.55
2.5
2.45
2.4
2.35
2.3
Inadequate project organization structure
Delay in mobilization to start the project and survey late or survey in error by the contractor.
Shortage of subcontractor s.
Shortcoming of the measure and value process.
Bad accelerate to deliver project by using extra resources.
Failure of equipment.
Pay liquidate damage.
Shortage of contractor's administrative personnel
Shortage of resources (labor, plant & material).
Poor quality.
Series 1
2.524
2.5
2.488
2.483
2.481
2.459
2.443
2.419
2.403
2.387

Continued…


2.5
2
1.5
1
0.5
0
Happening the theft in the site of project.
Defective work.
Delay in furnishing and delivering the site to the contractor.
Damage to structure during construction.
Labor dispute and strike.
Difficulty the design, then difficulty in construction.
Accident on site & disease ol labor.
Happening the fire in the site of project.
Delay to get on legal right.
Happening the earthquake.
Happening the volcanic.
Series 1
2.362
2.346
2.298
2.264
2.258
2.25
2.201
1.983
1.758
1.75
1.441

Done .

4.5.4 Degree Of impact In YEMEN

This part contains a description for the sources of risks of more impact if it occurred for the contractors in Republic of Yemen, where the most important sources of risks are evaluated according to the mean. So the sources of risks, that got more than 4.00, are "Very Important". However, the sources of risks, which values are ranging between 3.50 to 4.00, are "Important". As well as the sources of risks, which values are between 3.00 -3.50 are "less important", but the sources of risks of less than 3.00, are considered "Unimportant".

In addition, this part contains an analysis for the most influenced contractors by the source of risk if it happened as shown in table 4.13and Figure 4.13

table 4.13 The Most Important Risk Factors for Contractors (in terms Degree Of impact) and relation between various classes contractors(The most affected in Yemen)

-N	Risk factor	First grades		Second grade		Third grade		fourth grade		Fifth grade		Mean	St. div	Ch^2.	sig
		N	mean rank	N	mean rank	N	mean rank	N	mean rank	N	mean rank				
1	Loss due to war, civil disorder, revolution.. etc.	32	64.52	28	60.86	32	65.16	18	48.56	14	73.04	4.266	1.082	5.34	0.254
2	Loss due to inflation (increase the price of materials, plants, labors...etc	32	63.39	28	63.50	32	64.45	18	60.72	14	56.24	4.201	0.901	0.96	0.951
3	Delay in progress payment by the	32	65.63	28	61.41	32	67.83	18	44.76	14	68.14	4.137	0.858	6.55	0.161

	owner.														
4	Devaluation and varying rate of exchange.	32	68.33	28	62.96	32	58.54	18	50.84	14	72.101	4.108	0.917	4.70	0.319
5	Stoppage of working.	32	68.23	28	61.66	32	60.11	18	57.67	14	62.75	3.838	1.023	1.42	0.840
6	Happening the floods and flowages.	32	73.23	28	68.59	32	59.08	18	42.42	14	58.82	3.830	1.145	10.72	0.030
7	Happening the volcanic.	32	57.58	28	73.46	32	54.86	18	56.56	14	76.93	3.830	1.302	7.97	0.092
8	Delay of construction project	32	64.54	28	62.63	32	63.92	18	58.72	14	59.07	3.790	1.030	0.54	0.696
9	Cost overrun due to planning estimation.	32	60.66	28	70.80	32	59.45	18	49.42	14	73.25	3.790	1.061	6.00	0.199
10	Cash flow problems and difficulties in financing the project by the contractor.	32	57.92	28	62.96	32	62.73	18	62.00	14	72.14	3.733	0.996	1.69	0.791
11	Happening the earthquake.	32	59.77	28	70.16	32	56.50	18	55.40	14	76.25	3.693	1.269	5.48	0.241
12	Shortage in supply of water, gas, electricity ..etc	32	49.16	28	62.00	32	75.47	18	56.78	14	71.71	3.653	1.012	10.95	0.027
13	Defective work.	32	61.27	28	77.05	32	58.88	18	59.08	14	51.46	3.645	1.160	7.16	0.128

14	Poor quality.	32	64.27	28	71.20	32	52.58	18	63.06	14	63.04	3.629	1.164	4.47	0.346
15	Delay to get on legal right.	32	70.59	28	48.04	32	69.86	18	58.50	14	61.14	3.580	0.893	8.76	0.067
16	Incomplete in design and availability of information.	32	66.83	28	49.77	32	67.33	18	66.58	14	61.79	3.572	0.955	5.28	0.259
17	Subcontractor's law credibility.	32	74.28	28	52.04	32	62.25	18	60.42	14	59.11	3.564	1.083	6.58	0.160
18	Happening the fire in the site of project.	32	60.75	28	78.88	32	53..34	18	53.17	14	66.68	3.556	1.250	10.01	0.040
19	Cash flow problems faced by the subcontractor.	32	74.05	28	55.41	32	61.16	18	58.33	14	58.71	3.548	0.967	5.24	0.258
20	Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).	32	66.00	28	61.27	32	65.77	18	53.06	14	61.64	3.548	1.143	2.00	0.735
21	Improper technical study of project in the bidding stage.	32	70.45	28	64.79	32	59.53	18	59.50	14	50.39	3.516	1.086	3.88	0.422
22	Difficult to arrive to the site of project.	32	66.64	28	61.41	32	65.86	18	63.64	14	46.07	3.500	1.100	4.09	0.393
23	Design change by owner or his agent	32	69.91	28	58.52	32	60.84	18	56.97	14	64.43	3.491	0.958	2.53	0.638

	during construction.													
24	Interference by the owner in construction.	32	74.30	28	52.91	32	59.06	18	53.22	14	69.93	3.483	1.047	13.08	0.011
25	Ineffective planning and scheduling of project by the contractor.	32	69.00	28	57.71	32	59.33	18	61.61	14	65.61	3.467	1.143	2.056	0.726
26	Delay in settlement of contractor's claim by the owner.	32	69.98	28	66.70	32	59.94	18	45.56	14	64.64	3.467	0.949	6.69	0.153
27	Ambiguities, fault, and inconsistency of specification.	32	61.09	28	52.25	32	62.38	18	59.95	14	83.74	3.451	0.998	6.78	0.148
28	Change or differing site condition (access to the site, infrastructure surrounding, existing building.. ...etc.).	32	70.56	28	54.61	32	61.98	18	56.33	14	68.91	3.451	0.998	4.33	0.362
29	Shortage of labor skill & lack of labors' experience.	32	63.45	28	69.57	32	52.84	18	62.22	14	68.61	3.443	0.998	4.25	0.372
30	Design errors.	32	73.13	28	53.91	32	68.00	18	46.75	14	63.07	3.443	1.069	9.43	0.051
31	Original contract duration is too short	32	66.30	28	65.09	32	71.84	18	50.17	14	43.14	3.443	0.965	9.71	0.043

	from the owner.														
32	Damage to structure during construction.	32	66.63	28	66.11	32	59.66	18	54.00	14	63.29	3.435	1.231	2.03	0.729
33	Subcontractor problems with main contractor.	32	75.00	28	56.04	32	66.58	18	57.78	14	43.61	3.427	1.112	10.15	0.038
34	Legal disputes between various parties in the project.	32	65.27	28	57.55	32	60.17	18	56.72	14	78.82	3.427	0.955	4.74	0.315
35	Suspension of work by the owner.	32	58.02	28	65.93	32	56.95	18	76.44	14	60.64	3.419	1.044	4.85	0.303
36	Shortcoming of the measure and value process.	32	67.77	28	70.16	32	54.63	18	51.67	14	67.14	3.395	1.117	5.76	0.218
37	Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.	32	63.56	28	64.00	32	59.77	18	68.11	14	56.11	3.387	1.025	1.25	0.868
38	The conflict between contractor and consultant.	32	63.47	28	58.57	32	61.14	18	61.67	14	72.21	3.379	1.108	1.55	0.817
39	Delay in making decisions by the	32	53.84	28	56.86	32	58.79	18	89.76	14	67.14	3.346	1.097	15.05	0.005

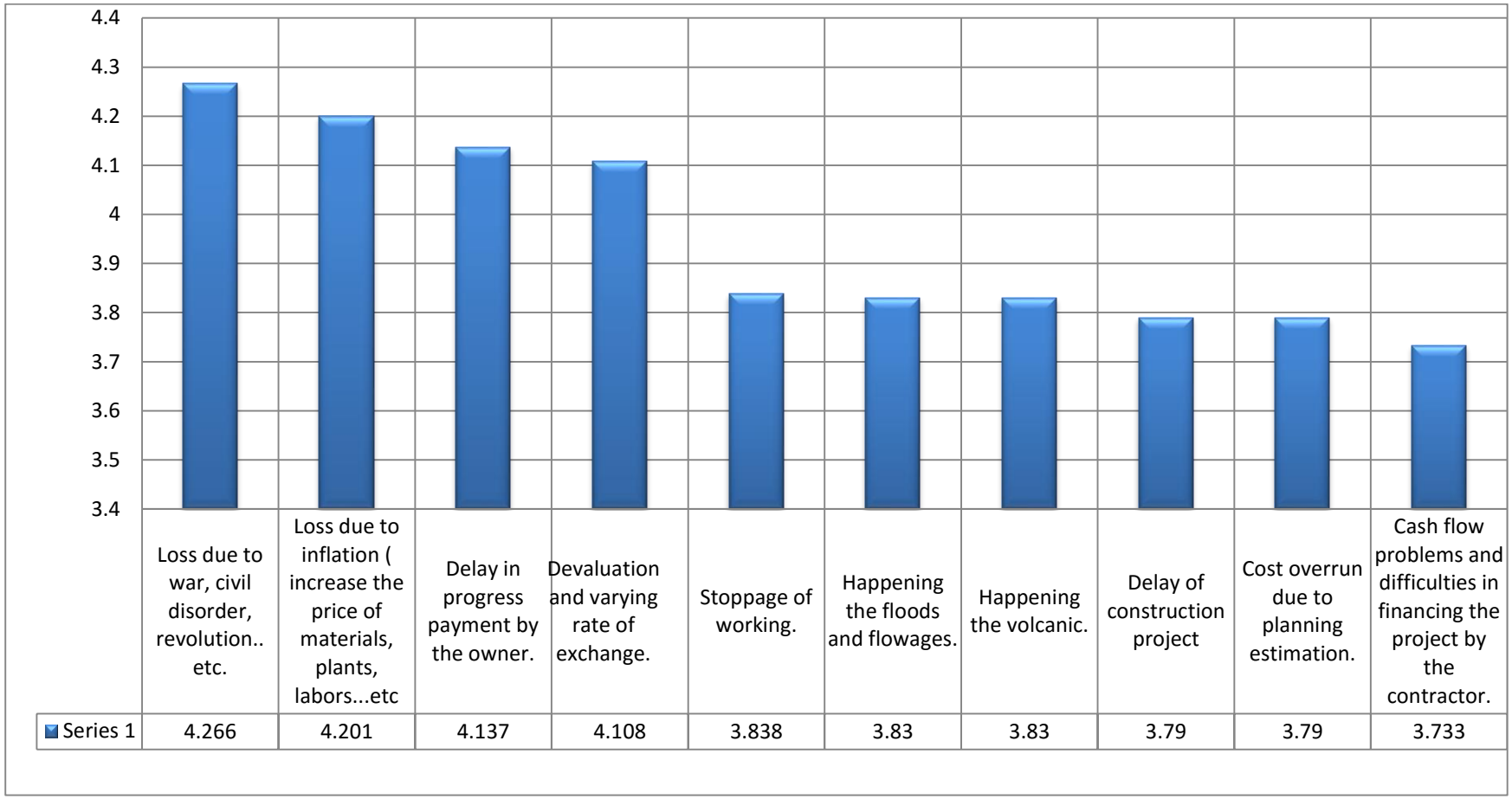
	owner within a reasonable time.														
40	Delay in material delivery.	32	60.95	28	79.59	32	44.89	18	62.42	14	60.79	3.338	1.118	11.21	0.024
41	Delay in performing inspection & testing by the consultant.	32	63.53	28	58.80	32	60.68	18	61.44	14	73.07	3.338	1.088	1.74	0.782
42	Loose safety rules and regulations with the contractor's organization.	32	67.41	28	52.64	32	67.31	18	58.06	14	65.71	3.322	1.158	3.89	0.420
43	Poor qualification of supervision staff of consultant engineer.	32	50.53	28	66.77	32	68.47	18	57.08	14	74.64	3.322	1.048	7.48	0.112
44	Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm .etc.).	32	67.73	28	63.93	32	67.38	18	59.53	14	40.36	3.314	1.218	1.218	0.130
45	Poor labor productivity.	32	51.03	28	60.11	32	67.22	18	67.44	14	75.71	3.274	1.084	6.75	0.147
46	Delay in approval of contractor submittals by the consultant engineer (sample, tables, planning,... ...etc).	32	57.95	28	66.63	32	65.14	18	50.00	14	74.68	3.266	1.112	5.19	0.267
47	Excessive bureaucracy in the owner	32	70.86	28	62.79	32	57.41	18	52.67	14	67.11	3.261	1.028	4.28	0.369

	administration.														
48	Uncooperative owner with contractor.	32	65.72	28	66.45	32	56.47	18	57.31	14	66.57	3.250	1.079	2.06	0.723
49	Improper selection of project type and location	32	53.67	28	75.13	32	59.31	18	61.11	14	66.502	3.225	1.117	6.23	0.182
50	Difficulties in obtaining work permits from the authorities.	32	69.11	28	60.74	32	64.22	18	49.33	14	63.80	3.225	1.195	4.34	0.356
51	Late workshop drawing instruction.	32	73.13	28	59.60	32	57.41	18	59.06	14	59.68	3.217	1.032	4.26	0.375
52	Change in key staffing throughout the project.	32	61.03	28	61.68	32	68.47	18	62.44	14	53.93	3.217	1.020	1.87	0.759
53	Change in the scope of the project from the owner (quantities of work item, new area, etc.).	32	66.28	28	59.16	32	73.86	18	52.50	14	47.43	3.209	1.061	8.23	0.083
54	Effect of social and cultural condition.	32	57.84	28	64.70	32	71.80	18	64.64	14	44.75	3.169	1.329	5.98	0.200
55	Delay in mobilization to start the project and survey late or survey in error by the contractor.	32	59.89	28	73.14	32	56.45	18	54.58	14	69.04	3.145	1.056	5.42	0.246

56	Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)	32	64.56	28	63.25	32	67.72	18	44.94	14	66.93	3.121	1.130	5.71	0.221
57	Increase wastage of material.	32	68.11	28	59.69	32	62.55	18	55.83	14	63.21	3.104	1.073	1.66	0.796
58	Pay liquidate damage.	32	69.31	28	58.75	32	71.13	18	49.67	14	51.21	3.096	1.245	7.42	0.115
59	Poor equipment productivity.	32	66.66	28	68.09	32	54.22	18	63.64	14	59.21	3.088	1.229	3.11	0.538
60	Shortage of contractor's administrative personnel	32	69.53	28	60.09	32	57.91	18	50.56	14	77.11	3.072	1.060	6.66	0.155
61	Bad accelerate to deliver project by using extra resources.	32	63.27	28	76.27	32	57.88	18	50.39	14	59.36	3.064	1.131	7.30	0.121
62	Inadequate project organization structure.	32	71.61	28	59.89	32	57.47	18	63.56	14	57.04	3.048	0.978	3.48	0.481
63	Shortage of resources (labor, plant & material).	32	66.25	28	74.43	32	44.33	18	60.36	14	74.57	3.040	1.219	14.11	0.007
64	Poor communication and coordination between all parties.	32	66.83	28	57.47	32	60.97	18	69.39	14	57.79	3.016	0.995	2.11	0.715
65	Shortage of subcontractors.	32	65.25	28	65.25	32	64.95	18	50.56	14	60.46	3.008	1.008	2.77	0.596
66	Failure of equipment.	32	72.94	28	69.16	32	56.78	18	51.36	14	52.71	2.975	1.122	7.77	0.100
67	Difficulty the design, then difficulty in construction.	32	64.74	28	66.93	32	55.28	18	58.33	14	70.36	2.943	1.030	3.02	0.554

68	Happening the theft in the site of project.	32	61.80	28	76.48	32	54.34	18	59.47	14	58.68	2.929	1.075	7.42	0.115
69	Delay in furnishing and delivering the site to the contractor.	32	60.34	28	63.04	32	66.53	18	63.28	14	56.14	2.830	0.955	1.06	0.900
70	Labor dispute and strike.	32	72.83	28	59.46	32	59.73	18	59.33	14	55.36	2.758	1.238	3.94	0.414
71	Accident on site & disease of labor.	32	62.00	28	70.23	32	62.58	18	48.36	14	66.18	2.693	1.052	4.58	0.333

Figure 4.13 The Most Important Risk Factors for Contractors (in terms Degree Of impact) in Yemen



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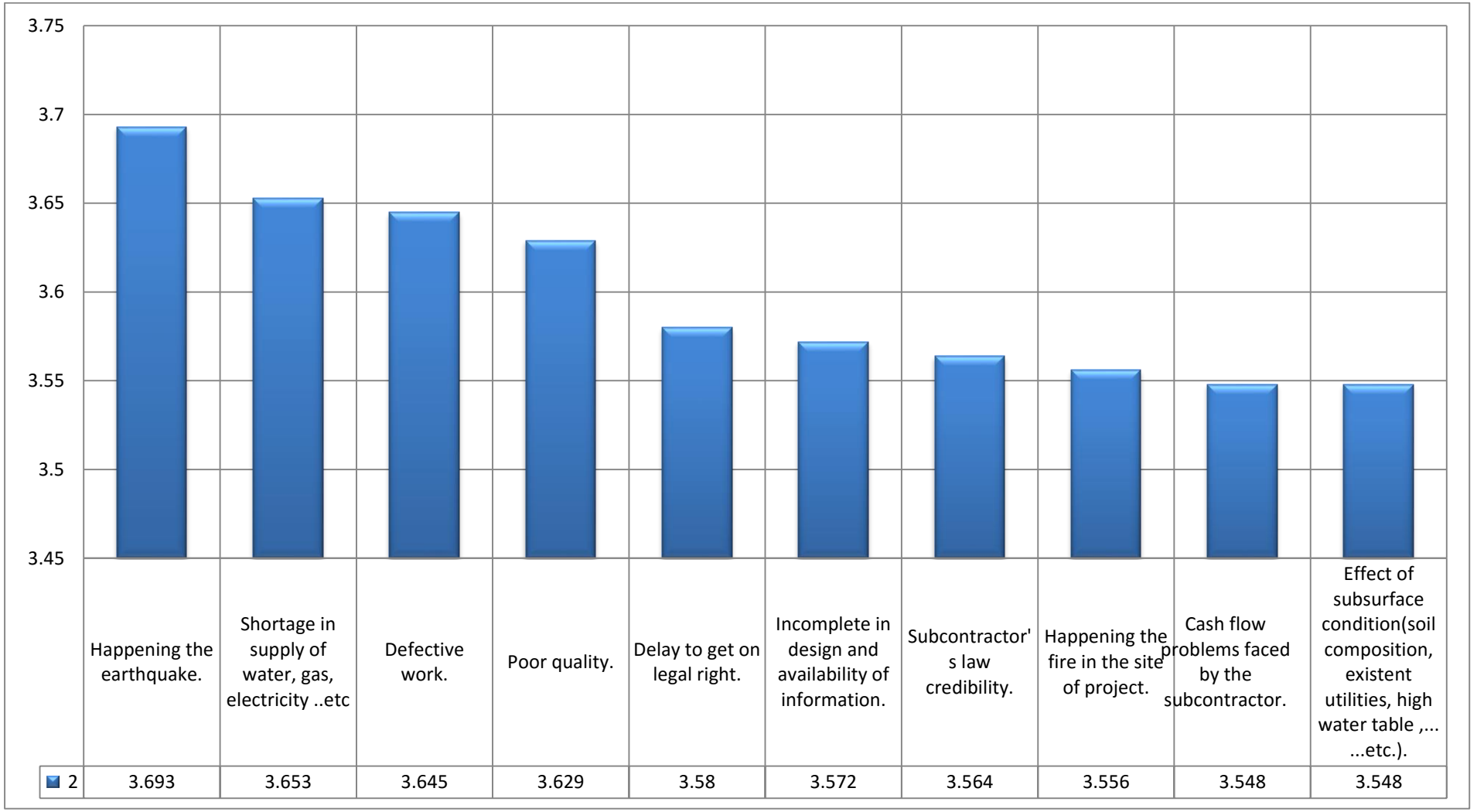
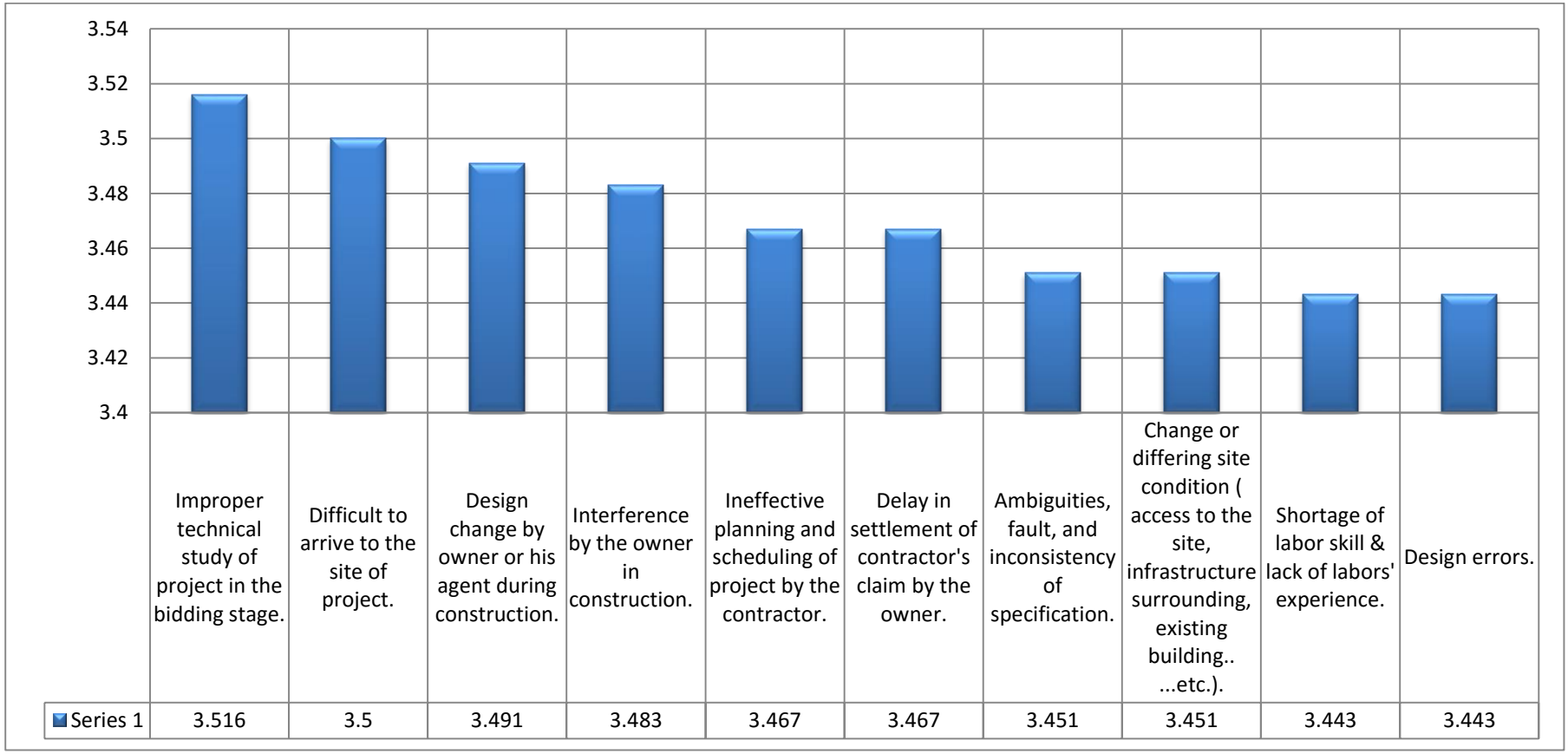
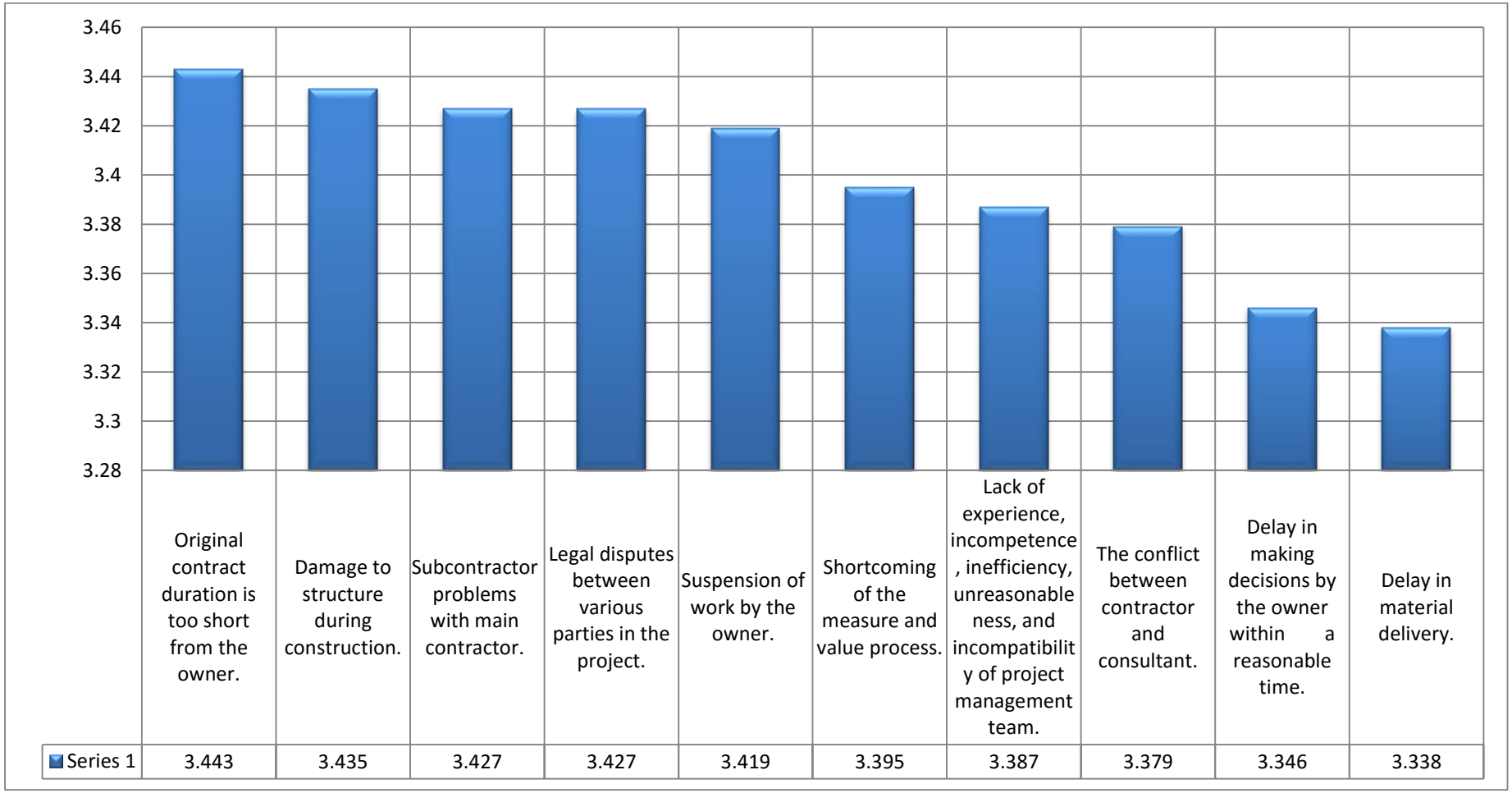

3.75
3.7
3.65
3.6
3.55
3.5
3.45
Happening the earthquake.
Shortage in supply of water, gas, electricity ..etc
Defective work.
Poor quality.
Delay to get on legal right.
Incomplete in design and availability of information.
Subcontractor's law credibility.
Happening the fire in the site of project.
Cash flow problems faced by the subcontractor.
Effect of subsurface condition(soil composition, existent utilities, high water table ,... ...etc.).
2
3.693
3.653
3.645
3.629
3.58
3.572
3.564
3.556
3.548
3.548

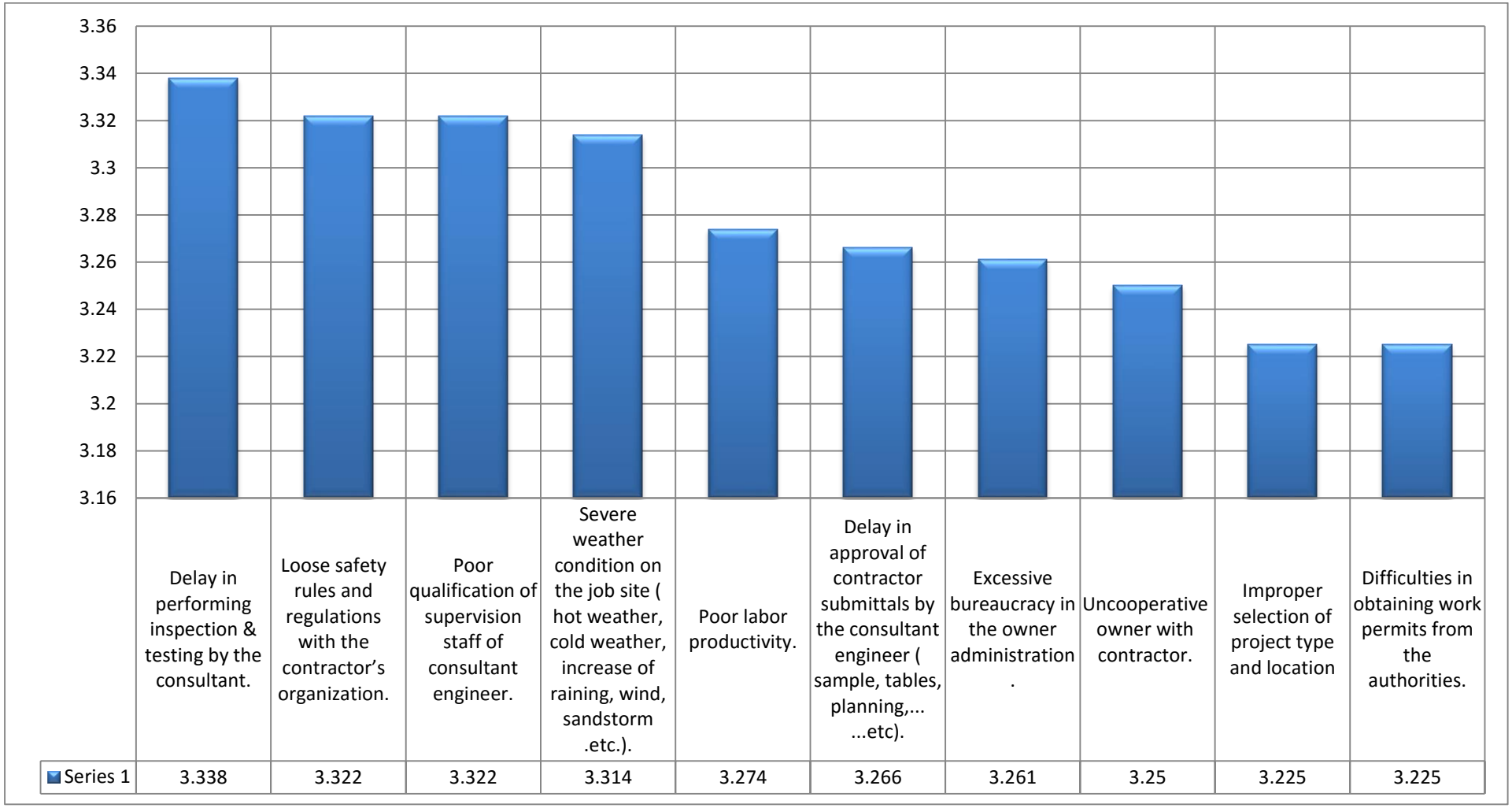
Continued…


3.54
3.52
3.5
3.48
3.46
3.44
3.42
3.4
Improper technical study of project in the bidding stage.
Difficult to arrive to the site of project.
Design change by owner or his agent during construction.
Interference by the owner in construction.
Ineffective planning and scheduling of project by the contractor.
Delay in settlement of contractor's claim by the owner.
Ambiguities, fault, and inconsistency of specification.
Change or differing site condition (access to the site, infrastructure surrounding, existing building.. ...etc.).
Shortage of labor skill & lack of labors' experience.
Design errors.
Series 1
3.516
3.5
3.491
3.483
3.467
3.467
3.451
3.451
3.443
3.443

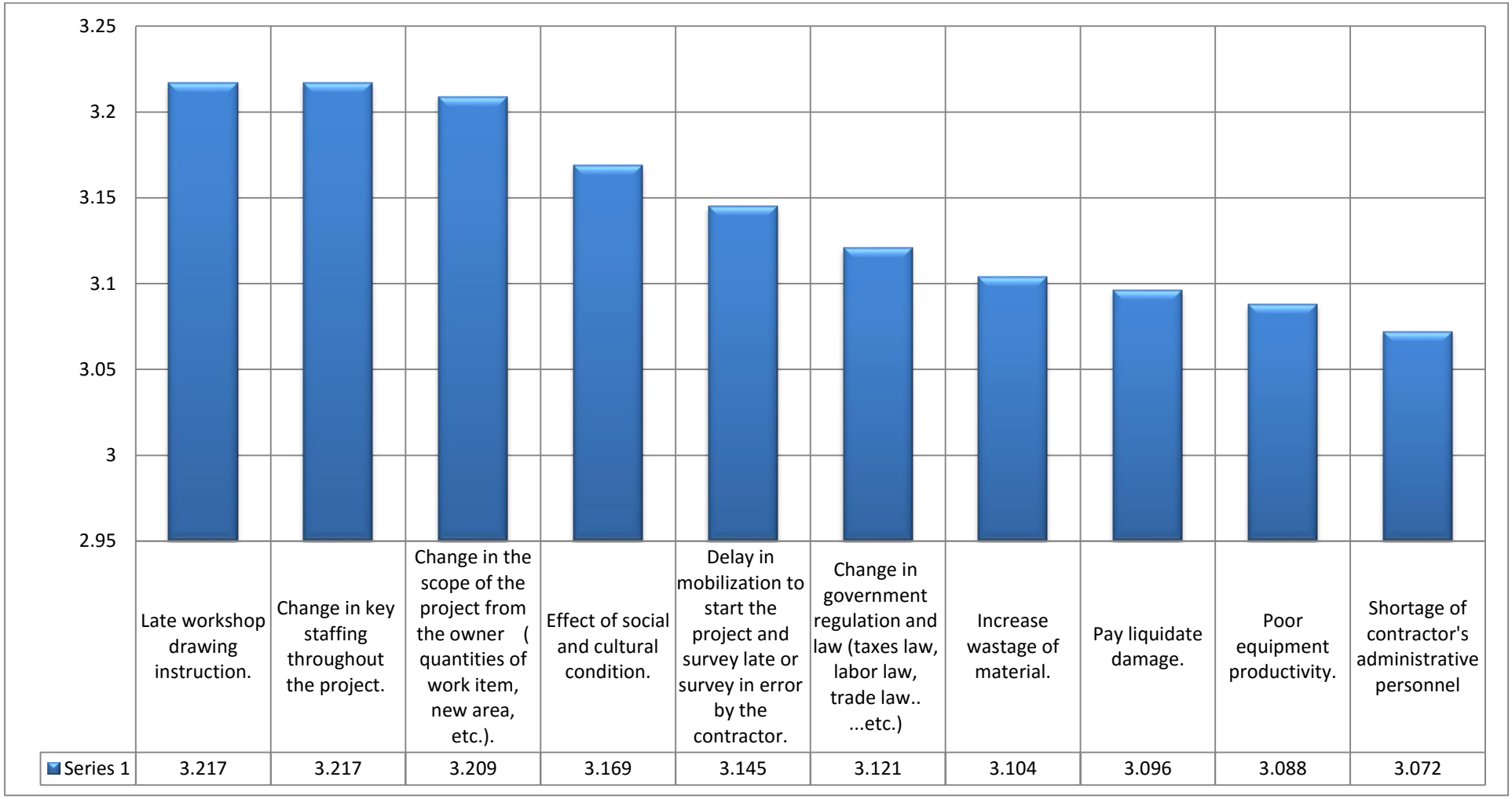
Continued…


3.46
3.44
3.42
3.4
3.38
3.36
3.34
3.32
3.3
3.28
Original contract duration is too short from the owner.
Damage to structure during construction.
Subcontractor problems with main contractor.
Legal disputes between various parties in the project.
Suspension of work by the owner.
Shortcoming of the measure and value process.
Lack of experience, incompetence, inefficiency, unreasonableness, and incompatibility of project management team.
The conflict between contractor and consultant.
Delay in making decisions by the owner within a reasonable time.
Delay in material delivery.
Series 1
3.443
3.435
3.427
3.427
3.419
3.395
3.387
3.379
3.346
3.338

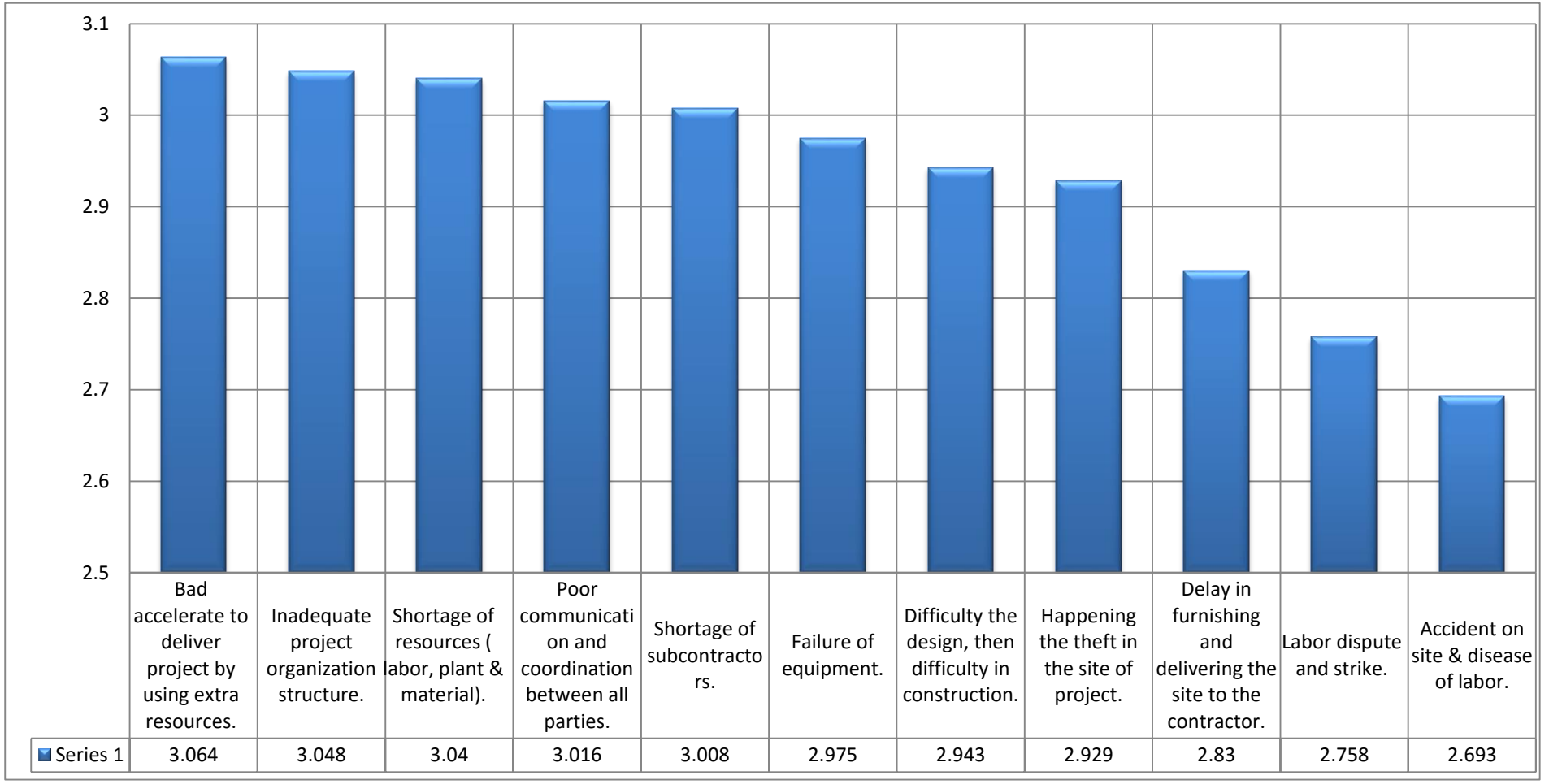
Continued…


3.36
3.34
3.32
3.3
3.28
3.26
3.24
3.22
3.2
3.18
3.16
Delay in performing inspection & testing by the consultant.
Loose safety rules and regulations with the contractor's organization.
Poor qualification of supervision staff of consultant engineer.
Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm .etc.).
Poor labor productivity.
Delay in approval of contractor submittals by the consultant engineer (sample, tables, planning,... ...etc).
Excessive bureaucracy in the owner administration .
Uncooperative owner with contractor.
Improper selection of project type and location
Difficulties in obtaining work permits from the authorities.
Series 1
3.338
3.322
3.322
3.314
3.274
3.266
3.261
3.25
3.225
3.225

Continued…


3.25
3.2
3.15
3.1
3.05
3
2.95
Late workshop drawing instruction.
Change in key staffing throughout the project.
Change in the scope of the project from the owner (quantities of work item, new area, etc.).
Effect of social and cultural condition.
Delay in mobilization to start the project and survey late or survey in error by the contractor.
Change in government regulation and law (taxes law, labor law, trade law.. ...etc.)
Increase wastage of material.
Pay liquidate damage.
Poor equipment productivity.
Shortage of contractor's administrative personnel
Series 1
3.217
3.217
3.209
3.169
3.145
3.121
3.104
3.096
3.088
3.072

Continued…


3.1
3
2.9
2.8
2.7
2.6
2.5
Bad accelerate to deliver project by using extra resources.
Inadequate project organization structure.
Shortage of resources (labor, plant & material).
Poor communication and coordination between all parties.
Shortage of subcontractors.
Failure of equipment.
Difficulty the design, then difficulty in construction.
Happening the theft in the site of project.
Delay in furnishing and delivering the site to the contractor.
Labor dispute and strike.
Accident on site & disease of labor.
Series 1
3.064
3.048
3.04
3.016
3.008
2.975
2.943
2.929
2.83
2.758
2.693

Done .

4.6 CORRELETION

Correlation is a statistical measure that describes the size and direction of a relationship between two or more variables. A correlation between variables, however, does not automatically mean that the change in one variable is the cause of the change in the values of the other variable.

The Correlation In this research it is used to show the degree of agreement or disagreement between the following

- Sources of risk for construction contractors and classification contractors in Egypt
- Sources of risk for construction contractors and classification contractors in Yemen

The value of a correlation coefficient ranges between -1 and 1.

4.6.1 Definition of 'Positive Correlation'

A relationship between two variables in which both variables move in tandem. A positive correlation exists when as one variable decreases, the other variable also decreases and vice versa. In statistics, a perfect positive correlation is represented by the value +1.00, while a 0.00 indicates no correlation and a -1.00 indicates a perfect negative correlation.

4.6.2 Definition of zero Correlation'

If r is close to 0, it means there is no relationship between the variables

4.6.3 Definition of 'Negative Correlation'

A relationship between two variables in which one variable increases as the other decreases, and vice versa. In statistics, a perfect negative correlation is represented by the value -1.00, while a 0.00 indicates no correlation and a +1.00 indicates a perfect positive correlation. A perfect negative correlation means that the relationship that appears to exist between two variables is negative 100% of the time. It is also possible that two variables may be negatively correlated in some, but not all, cases .

4.6.4 The rank correlation coefficient

The rank correlation coefficient is used to provide a numerical index of the relation between two ranks for each class among the respondents. There are several rank

correlation methods suitable for determining the relationship among the classes concerned in this study of which Spearman's Rank Correlation .

4.6.4.1.Spearman's Rank Correlation: -Spearman's Rank correlation coefficient is used to identify and test the strength of a relationship between two sets of data. It is often used as a statistical method to aid with either proving or disproving a hypothesis In statistics, Spearman's rank correlation coefficient or Spearman's rho, named after Charles Spearman and often denoted by the Greek letter (rho) or as , is a non-parametric measure of statistical dependence between two variables. It assesses how well the relationship between two variables can be described using a monotonic function. If there are no repeated data values, a perfect Spearman correlation of +1 or −1 occurs when each of the variables is a perfect monotone function of the other.

Statistical program "SPSS" was used to calculate the Spearman's rank correlation coefficient and these correlations depends on the following equation

$$rab = 1 - 6 \Sigma d2 / (n3 - n). \qquad \text{Eq.5.1}$$

Where ;

rab = Spearman's rank correlation coefficient between the variable (a) and the variable (b), while ignoring the ranking of other variable .

d = The difference between the ranks assigned to the two variables, which is the difference in ranks for each risk factor by the variables.

n = Number of observations = 71

4.6.5 Rank Correlation between Sources of risk for construction contractors and classification contractors in Egypt.

the contractors in Egypt have been divided into five classes according to the classified the Egyptian Federation for Construction & Building Contractors in Egypt in 2012 AD .(r1)

- First Class Contractors (38 contractors)
- Second Class Contractors (24 contractors)
- Third Class Contractors (16 contractors)
- Contractors of the fourth degree (14 contractors)
- Contractors of the fifth class (16 contractors)

the contractors in Yemen have been divided into five classes according to the classified the Ministry of Public Work and highway in Yemen in 2012 AD .

- First Class Contractors (32 contractors)
- Second Class Contractors (28 contractors)
- Third Class Contractors (32 contractors)
- Contractors of the fourth degree (18 contractors)
- Contractors of the fifth class (14 contractors)

the sources are Include : -

1. Construction and job site risks (r2).
2. Design risks (r3).
3. Financial and economic risks (r4)
4. Management risks (r5)
5. Owner risks (r6)
6. Supervision risks (r7)
7. Subcontractor risks (r8)
8. Site conditions risks (r9)
9. Adverse weather and natural risks (r10).
10. Legal risks (r11)
11. Government regulation and policies risks (r12).

Table 4.27 Summary of Correlation Values between Sources of risk for construction contractors and classification contractors in Egypt Classes in Egypt.

-		r1	r2	r3	r4	r5	r6	r7	r8	r9	r10	r11	r12
r 1	Correlation Coefficient	1.000	.204	.061	.335	-.087	-.105	.010	-.146	.049	.070	.170	.148
	Sig. (2-tailed)	.000	.034	.529	.000	.370	.281	.916	.131	.615	.469	.079	.126
r 2	Correlation Coefficient	.204	1.000	.594	.477	.623	.437	.217	.455	.325	.285	.321	.210
	Sig. (2-tailed)	.034	.000	.000	.000	.000	.000	.024	.000	.001	.003	.001	.029
r 3	Correlation Coefficient	.061	.594	1.000	.434	.531	.563	.265	.489	.222	.366	.376	.269
	Sig. (2-tailed)	.529	.000	.000	.000	.000	.000	.006	.000	.021	.000	.000	.005
r 4	Correlation Coefficient	.335	.477	.434	1.000	.480	.408	.391	.280	.300	.245	.384	.161
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.003	.001	.011	.000	.096
r 5	Correlation Coefficient	-.087	.623	.531	.480	1.000	.694	.430	.698	.285	.256	.337	.200
	Sig. (2-tailed)	.370	.000	.000	.000	.000	.000	.000	.000	.003	.007	.000	.038
r 6	Correlation Coefficient	-.105	.437	.563	.408	.694	1.000	.686	.707	.372	.315	.352	.230
	Sig. (2-tailed)	.281	.000	.000	.000	.000	..000	.000	.000	.000	.001	.000	.017
r 7	Correlation Coefficient	.010	.217	.265	.391	.430	.686	1.000	.465	.328	.200	.279	.317
	Sig. (2-tailed)	.916	.024	.006	.000	.000	.000	..000	.000	.001	.038	.003	.001
r 8	Correlation Coefficient	-.146	.455	.489	.280	.698	.707	.465	1.000	.321	.446	.382	.242
	Sig. (2-tailed)	.131	.000	.000	.003	.000	.000	.000	.000	.001	.000	.000	.012
r 9	Correlation Coefficient	.049	.325	.222	.308	.285	.372	.328	.320	1.000	.402	.160	.330
	Sig. (2-tailed	.615	.001	.021	.001	.003	.000	.001	.001	.000	.000	.098	.000

r 10	**Correlation Coefficient**	**.070**	**.285**	**.366**	**.245**	**.256**	**.315**	**.200**	**.446**	**.402**	**1.000**	**.253**	**.247**
	Sig. (2-tailed)	**.469**	**.003**	**.000**	**.011**	**.007**	**.001**	**.038**	**.000**	**.000**	**.000**	**.008**	**.010**
r 11	**Correlation Coefficient**	**.170**	**.321**	**.376**	**.384**	**.337**	**.352**	**.279**	**.382**	**.160**	**.253**	**1.000**	**.507**
	Sig. (2-tailed)	**.079**	**.001**	**.000**	**.000**	**.000**	**.000**	**.003**	**.000**	**.098**	**.008**	**.000**	**.000**
r 12	**Correlation Coefficient**	**.148**	**.210**	**.269**	**.161**	**.200**	**.230**	**.317**	**.242**	**.330**	**.247**	**.507**	**1.000**
	Sig. (2-tailed)	**.126**	**.029**	**.005**	**.096**	**.038**	**.017**	**.001**	**.012**	**.000**	**.010**	**.000**	**.000**

Table 4.27 Summary of Correlation Values between Sources of risk for construction contractors and classification contractors in EgyptClasses in Yemen .

		r1	r2	r3	r4	r5	r6	r7	r8	r9	r10	r11	r12
r 1	Correlation Coefficient	1.000	.217	.183	.176	.181	-.008	.105	-.099	-.151	-.166	.098	-.028
	Sig.	.000	.016	.042	.051	.044	.928	.245	.272	.095	.065	.281	.755
r 2	Correlation Coefficient	.217	1.000	.575	.503	.757	.290	.528	.413	.174	.215	.316	.120
	Sig.	.016	.000	.000	.000	.000	.001	.000	.000	.053	.016	.000	.185
r 3	Correlation Coefficient	.183	.575	1.000	.705	.704	.485	.507	.443	.312	.300	.405	.199
	Sig.	.042	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.027
r 4	Correlation Coefficient	.176	.503	.705	1.000	.601	.645	.511	.605	.532	.394	.468	.148
	Sig.	.051	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.100
r 5	Correlation Coefficient	.181	.757	.704	.601	1.000	.425	.498	.452	.142	.188	.361	.116
	Sig.	.044	.000	.000	.000	.000	.000	.000	.000	.116	.037	.000	.199
r 6	Correlation Coefficient	-.008	.290	.485	.645	.425	1.000	.618	.651	.546	.222	.410	.219
	Sig.	.928	.001	.000	.000	.000	..000	.000	.000	.000	.013	.000	.015
r 7	Correlation Coefficient	.105	.528	.507	.511	.498	.618	1.000	.549	.519	.289	.296	.392
	Sig.	.245	.000	.000	.000	.000	.000	.000	.000	.000	.001	.001	.000
r 8	Correlation Coefficient	-.099	.413	.443	.605	.452	.651	.549	1.000	.609	.315	.417	.361
	Sig.	.272	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
r 9	Correlation Coefficient	-.151	.174	.312	.530	.142	.546	.519	.609	1.000	.495	.280	.364
	Sig.	.095	.053	.000	.000	.116	.000	.000	.000	.000	.000	.002	.000

r 10	**Correlation Coefficient**	**-.166**	**.215**	**.300**	**.394**	**.188**	**.222**	**.289**	**.315**	**.495**	**1.000**	**.430**	**.483**
	Sig.	**.065**	**.016**	**.001**	**.000**	**.037**	**.013**	**.001**	**.000**	**.000**	**.000**	**.000**	**.000**
r 11	**Correlation Coefficient**	**.098**	**.316**	**.405**	**.468**	**.361**	**.410**	**.296**	**.417**	**.280**	**.430**	**1.000**	**.380**
	Sig.	**.281**	**.000**	**.000**	**.000**	**.000**	**.000**	**.001**	**.000**	**.002**	**.000**	**.000**	**.000**
r 12	**Correlation Coefficient**	**-.028**	**.120**	**.199**	**.148**	**.116**	**.219**	**.392**	**.361**	**.364**	**.483**	**.380**	**1.000**
	Sig.	**.755**	**.185**	**.027**	**.100**	**.199**	**.015**	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This Chapter is pointing out the results and conclusions related to the Thesis Goals and the Extent of Thesis Goals Achievement, in addition to some recommendations to those, who are interested into carrying out similar researches in this fertilizing field in future.

5.1 SUMMARY OF THE RESEARCH

This Thesis has discussed the risks, which are confronting the constructions contractors in Arab Republic of Egypt and Republic of Yemen. Where the main sources of risk, which might face the contractors, their effects on contractors, if any, through evaluating the risk. Then making a questionnaire directed to the contractors in both countries. The results, obtained by the thesis, are in line with the pre-determined goals, and they are represented in:

5.1.1 Identify the sources of risk, which confront the construction contractors in building projects.

In order to achieve this objective, I have studied the risks, which faced the constructions contractors, in general, with concentration on the construction contractors in Arab Republic of Egypt and Republic of Yemen. The most significant sources of risks, which have direct effects on the contractors, are determined through reviewing previous studies in this field, in addition by making field visits to the contractors to ask them about the risks that they are facing, whether before, during or after executing the constructions projects. It becomes clear that there are many risks, which are confronting, in general, the contractors and particularly Yemen and Egypt. They are summarized in 71 sources of risks distributed to (11) main groups (building risks, design risks,…etc.). They are explained in Chapter 2 Page (34)

5.1.2 Identify the probability of occurrence of each risk factor.

In order to achieve this objective, I carried out a field survey on the constructions contractors in Egypt and Yemen .According to the Egyptian Federation for Construction & Building Contractors in Egypt in 2012 , which classifies the contracting companies into 7 categories. It has been dealt with five of them and the sixth and seventh categories are ignored due to their experience shortage in building and construction industry. The questionnaire included 108 companies distributed to five categories. However, in Yemen, the field survey based on the classification of Ministry of Public Works and Highways, classifies the contractors into six categories, where five of them are being dealt with and the sixth one is ignored due to its shortage of experience in the field of building and construction industry. The field survey is explained in Chapter 3 page (62)

5.1.3. Identify the importance of the risks which face the construction contractors in Egypt and Yemen and estimate the probability of occurrence and extent of their impact.

In order to achieve this objective, the data was collected separately from the contracting companies in Egypt and Yemen to the Statistical Analysis Program (SPSS) to analyze the data. After that I have sorted the results in terms of "the most important" to "less important" by using the mean and arranged the sources of risks into 71 in terms of which ones occur "higher " to the least, and from the most to the least influencing, each one separately. Then, I have measured the stander division or dispersion, which is explained previously in Chapter 4 page (75)

The questionnaire results are divided into two main sections. The first section is related the contractors' answers for the general questions, but the second one is related to the contractors answers about (71) sources of risks, where the answer of each source is divided into two parts. The first part is related to probability of occurrence and the 2nd part is related to the degree of impact, if the risk occurred.

For the Questionnaire First Section (General Questions), the results are as follows:-

- For years of experience of Companies in constructional projects execution field, it become clear that nearly 46% of contractors in Egypt have more than 15 years of experience, but 25.9% of contractors in Egypt have experience

ranging between 10–15 years of experience, and 14.8% of contractors in Egypt have 5–10 years of experience.

- Whereas, nearly 46% of contractors in Yemen have less than 15 years of experience, but 19% of contractors have experience ranging between 10 – 15 years, and 27.4% of them have experience ranging between 5 – 10 years.
- For the increase in Project period due to contractors' exposal to a risk, it becomes clear that about 98% of them in Egypt delayed in delivering the project on the time agreed upon in different ratios. Where 16.67% of the contractors are always exposed to delay in delivering the project, while 38% of them are often exposed to delay and sometimes 40.7% are exposed to delay in the project period.
- However, in Yemen, all contractors are exposed to delay in the Project period in different percentages, whereas 16.1% of contractors are always exposed to delay, while 40.3 % of them are often exposed to delay and sometimes 43.5% are exposed to delay.
- In respect of cost in the Project overrun the planning estimation due to facing a risk by the contractors, it becomes clear that all contractors in Egypt and Yemen have exposed to cost overrun the planning estimation. The percentages differ from a State to another. However, in Egypt, about 16.6% of contractors are always exposed to increase in the costs, while 37often suffer from increase in the costs, and sometimes 46.3% suffer from costs overrun the planning estimation.
- However, the percentages differ in Yemen, where about 27.46% of contractors are always exposed to increase in the costs, while 35.5 often suffer from increase in the costs and sometimes 38.8 suffer from costs increase.

But for the second section of the questionnaire, the results of contractors answers on showing that the most important sources of risks which occurred to the construction contractors in Egypt are :-

1. We find that Contractors has informed that (Loss due to war, civil disorder, revolution...etc.) comes in the first rank with mean amounted to (3,787) and at a standard deviation of (1.360). Upon a precise analysis for the results is carried out, we see that the contractors classified in fifth

degree, are the most influenced category with mean rank of (77.47). Followed by the contractors classified in fourth degree with mean rank of (86.36) where the contractors, who are classified of third degree, come in the last rank with preponderant average of (40.03). With the knowledge that the questionnaire was distributed in the period, which witnessed occurrence of revolutions in Yemen and Egypt which expresses occupancy of this item the first rank in terms of probability of occurrence.

2. After that the Item related to (Delay in progress payment by the owner) in the second rank in terms of probability of occurrence in mean of (3,500) and a standard deviation of (1.080). It seems to us that the most influenced contractors by this Item are the contractors classified of fifth degree in (73.53) mean rank. The contractors, who are classified of second degree, come in the last rank in terms of probability of occurrence with (30.56) mean rank. This is due to the problems of cash flows to the contractor, where the contractor fails thereafter to pay his due obligations whether to subcontractors, suppliers or others .

3. Regarding to (Loss due to inflation (increase the price of materials, plants, labors……etc), it took the third rank in terms of probability of occurrence with mean of (3,490) and a standard deviation reached to (1.195). It seems to us that the most influenced contractors in this Item are the contractors classified of third degree, with mean rank reached to (65.27). As well as, the contractors, less influenced by this item, are the contractors classified of second degree, where some contractors said that the increase in price is over 30 for some goods in connection with building and this source usually reduces the profit extremely .

4. The Item (Devaluation and varying rate of exchange.) comes at the fourth rank in terms of probability of occurrence with mean of (3,444) and a standard deviation reached to (1.186). Where, it seems to us, through the questionnaire, that the third-degree contractors are the mostly influenced by this item in comparison with the first-degree contractors, who occupy the last rank in terms of probability of occurrence with mean rank reached to (44.01). This is usually subject to economical and political situation in Egypt, where the exchange rate

influenced negatively or positively, by the economic and political situation .

5. The item (Cost overrun due to planning estimation), comes in the fifth rank in terms of probability of occurrence with mean of (3.296) and a standard deviation reached to (1.034). It seems to us, through the contractors' answers, that the third-degree contractors are the most influenced by this item with mean rank reached to (69.81), whereas, second-degree contractors are located in the last rank in terms of probability of occurrence with mean of (44.33). This item is usually subject to many considerations, which contribute to make the costs overrun the planning estimation .
6. (Design change by owner or his agent during construction).is placed in the sixth rank in terms of probability of occurrence in mean reached to (3.157) and a standard deviation reached to (1.033). When viewing the contractors, who are mostly influenced by this item, we find that they are contractors from the 5th degree with mean rank reached to (66.44). As well as, the least influenced by this item are the contractors of first degree with (50.33) mean rank, whereas, sometimes owner insists on making amendments, whether constructional or architectural, during the execution .
7. However, we find that (Delay of construction project.) comes in the seventh rank in terms of importance of occurrence probability by 3.148 mean. We find that the contractors mostly influenced by this item, are contractors of the fifth degree with mean rank reached to (72.52). As well as, the least influenced ones by this item are the contractors of fourth degree with (44.68) mean rank, and this is subject to many considerations, such as subcontractors delay in the determined dates, or financial, administrative or natural problems…etc.
8. Whilst, (Delay in settlement of contractor's claim by the owner.) comes in the eighth rank in terms of importance in occurrence by 3.055 mean and standard deviation reached to (0.829). It seems to us that the most influenced contractors by this Item are contractors classified in the fifth degree, with mean rank reached to (73.56). As well as, the least influenced by this item, are contractors of second degree with mean-rank

reached to 40.56. The contractor's claims include financial or legal claims, and any delay therein, he endeavors to hinder the contractor, and subsequently hinder the Project accordingly .

9. But (Cash flow problems faced by the Subcontractor.) comes in the ninth rank with 3.027 mean and standard deviation reached to (0.999). We find that the first-degree contractors are the most influenced by this Item, with mean rank reached to (63.57). However, the second-degree contractors are the lowest influenced contractors with mean-rank reached to 42.27. Whereas, any delay resulted from the subcontract, he will try harder to delay in handling over the project as per the agreed upon period and subsequently, problems occur to the main contractor.
10. We find that (Delay in approval of contractor submittals by the consultant engineers (sample, tables, planning,.. .. .etc.)), comes in the tenth rank in terms of probability of occurrence in 2.981 mean and standard deviation reached to (1.022). We also find that the first-degree contractors are the most influenced ones by this Item, with mean rank reached to (85.59). However, the second-degree contractors are the lowest influenced by this Item with mean-rank reached to 44.58. Where delay in reply to the contractor submittals will lead to delay in the project period in addition to increase in costs .

Furthermore, the results of contractors' answers on the first part show that the most important sources of risks, faced by the construction contractors in Yemen are-:

1. We find that the contractors said the large risk that they face is (Loss due to inflation (increase the price of materials, plants, labors……etc)), by a mean reached to 3.741) and standard deviation reached to (1.042). It seems through their answers that the most influenced contractors by this risk are the fifth degree contractors, in mean rank reached to (71.54) and the contractors, who are less influenced by this risk, are the fourth degree contractors, , in mean rank reached to (43.03)
2. As well as we find that the risk related to (Devaluation and varying rate of exchange.) is in the second rank in terms of probability of occurrence with mean of (3,701) and a standard deviation reached to (1.133). It seems to us that the second-degree contractors are the mostly influenced contracts

by this risk with mean rank reached to (63.41) and the less influenced contractors by this risk are the fifth-degree contractors.

3. Whereas, the risk related to (Delay in progress payment by the owner.) in mean reached to (3,685) and a standard deviation of (1.099). While the most influenced contractors by this Item are the contractors of third degree in (77.02) mean rank and the less influenced ones by this risk are the first-degree contractors (49.17) mean rank .
4. As well as, the risk related to (Loss due to war, civil disorder, revolution.. ...etc.) comes in the fourth rank from the probability of occurrence with mean amounted to (3,532) and standard deviation of (1.255). However, contractors classified in first degree, were the most influenced category by this risk in mean rank of (42.22.(
5. Furthermore, we find that the risk (Increase wastage of material.) comes in the fifth rank in terms of occurrence probability with mean of (3.508) and standard deviation of (1.016). However, contractors of fourth degree were in mean rank of (75.79), and the contractors, who are the least influenced by this risk, are the third degree contractors with mean rank of (46.23.(
6. The risk, which is in relation to (Cost overrun due to planning estimation.), came in the sixth rank in terms of occurrence probability with mean of (3.427) and standard deviation of (1.169). While the fifth degree contractors were the most influenced by this risk in mean rank of (7571.79), whereas, the 4th degree contractors, are the least influenced by this risk with mean rank of (48.82.(
7. The risk of (Interference by the owner in construction.) came in the seventh rank in terms of occurrence probability with mean of (3.341) and standard deviation of (1.015). While the first-degree contractors came in the first-degree in terms great influenced they had due to this risk in mean rank of (71.34), whereas, the 5th degree contractors are the least influenced by this risk with mean rank of (37.18.(
8. The risk in connection with (Shortage in supply of water, gas, electricity ……etc.) came in the eighth rank in terms of importance of occurrence probability with mean of (3.233) and standard deviation of (0.407). While the fifth-degree contractors are the most affected due to this risk in mean

rank of (71.75), whereas, the 5th degree contractors are the least influenced by this risk with mean rank of (51.67.(

9. The risk related to (Delay of construction project.) came in the ninth rank in terms of occurrence probability with mean of (3.193) and standard deviation of (0.959). While the fourth-degree contractors are the most affected category by this risk in mean rank of (68.77), whereas, the 1st degree contractors had the lowest effect from this risk with mean rank of (55.00 .(
10. The risk related to (Effect of subsurface condition (soil composition, existent utilities, high water table ,....etc.) came in the tenth rank in terms of occurrence probability with mean of (3.179) and standard deviation of (0.007). While the fourth-degree contractors are the most affected category by this risk in mean rank of (75.14), whereas, the 4th degree contractors, who are less affected by this risk, comes at the end with mean rank of (37.61)

5.2 GENERAL RECOMMENDATIONS

- It becomes clear that most contractors in Egypt and Yemen are do not know too much about the risk management techniques. So that it will be more appropriate if introductory seminars are to be held to make awareness for the necessity of risk management to the contractors under supervision of the Egyptian Federation for Construction & Building Contractors in Egypt and Ministry of Public Works and Highways in Yemen or Engineers Syndicate in each of the two countries because they are the responsible authorities for the contractors. Of course, these recommendations will be useful on the long-term, where they represent the first step in the right direction .
- In case of civil or public disorders or war occurred, it is advisable to stop the work until the circumstances become stable and a daily evaluation shall be made after pursuing the events in progress in order to maintain the laborers and machineries, in addition to maintain what has been accomplished especially in the tension foci .
- The contractors are recommended, before entering into a tender, to study the Owner Economic Situation (whether the financing is governmental or

private), his capability to finance the project phases to the end, and study the previous works of owner, if any .

- The contractors are recommended to be transfer some risks to subcontractors or suppliers in case prices inflation is expected to occur so that long-terms contracts shall be signed to guarantee that there is no rise in prices for all included in the tender's items .
- It is advisable to follow-up the State's economic and political situation and the effect of dollar exchange rate on it whether positively or negatively. When estimating the tender's exchange rate, the last rate of dollar shall be considered and taking into considerations of devaluation and varying rate of exchange
- It is recommended to follow up the project works in progress periodically at the same time with control of cost and quality through the project manager or by assignment of a responsible person for the quality and cost control, or by assigning the project manager therein if the project volume is small. So that will guarantee that there is no raise in the project period and cost in addition to no existence of depreciation in material .
- On the owner demand or any amendments on designs whether constructional or architectural, in increase or decrease, shall be registered in an official minutes to avoid holding or any responsibility in consequence thereof in addition to proving a longer period of time to make the owner's changes if required .
- The contractor should find different sources of income to avoid any impeding might occur to the contractor during the project execution because of owner does not fulfill his financial commitments as per the previously stated date .
- Prior to concluding a contract with subcontractors, a previous study should be made for their previous works and for the extent of contractors undertaking to deliver the items, which are authorized to them to be executed according to the contract duration and cost agreed upon and they are in conformity with the specifications to make sure of the subcontractors credibility .
- The Owner is recommended to study the project well prior to execution thereof, and granting sufficient time to study and design the project, and to

appoint qualified consultant to takeover thereof. Furthermore, the consultant should be aware of the owner's requirements in order to take them into consideration before the project designing. It is recommended to improve the relation between the owner and the consultant on one hand and the contractor from the other hand, and to avoid any conflicts that might be occurred .

- Upon pricing the tender, it is recommended to study the site, make sure of basic services availability such as water, electricity, roads, and what are the increase in cost would be if they were not unavailable.
- The contractor should study the subsurface before bidding and make sure that the owner has made the sufficient sessions to avoid any problems might be occurred during the execution or inconvenience with consultant report with the different site conditions .

5.3 Recommended Future Work

This part contains recommendations for anyone who is interested to make researches similar to this one in future and the recommendations are:-

- Effect of Arabic Spring on the Contracting sector in Egypt and Yemen,
- Risks management techniques as per scientific basics and attempt to find methods to apply them in reality,
- Reasons of delay in constructions project in Yemen and Egypt,
- Effect of inflation and raise in dollar exchange rate on construction project,
- Effect in delay to pay the contractor's payable dues by the owner on the project,
- Effect of subsurface on the project in terms of accomplishment duration and cost,
- Problems resulted from delay of subcontractors to fulfill their obligations towards the main contract,
- Problems confronted by construction contractors during their execution for projects,

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