Managing Risk of Construction Projects
A case study of Iran

Mana Ghahramanzadeh

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Abstract

The construction industry is one of the most dynamic, risky, and challenging businesses. Due to construction projects' complexity and uniqueness, the number of risks present invariably goes beyond those found in other industries. Therefore, risk management should be applied as an integral part of project management for managing these risks – in particular in developing countries.

Contingency theory was selected as the theoretical framework of this thesis. Since the environment has been considered as one of the important contextual variables being focused on in this theory, the research was situated within a specific environment. Considering the unstable social, economic and political conditions in Iran today in comparison with many other countries, it was found to be a suitable case to be evaluated in this thesis.

A questionnaire was designed and twenty-five risks were identified and categorized in five main categories as follows: Political and Governmental, Managerial and Technical, Economic and Financial, Cultural and Social, and Natural. For each of these risks, relevant mitigation strategies were also proposed. Criticality of risks along with effectiveness of mitigation strategies were evaluated via 100 questionnaires which were distributed to the three key categories of actors associated with construction projects namely clients, contractors, and consultants. Out of 76 valid responses received, interviews were conducted with 24 of the participants in order to extract the knowledge and understand how these groups manage the identified risks.

Findings of the research revealed that Economic and Financial risks have the greatest influence on construction projects in Iran. Moreover, there is a serious lack of risk management knowledge and expertise among all the three key categories of actors. The conclusion drawn from the evaluation of risk management strategies was that due to high volatility of the economic and political situation of the country, reactive risk management is practiced more than proactive risk management. The results of the case study about the risks and their management strategies have also implications for contingency theory;

modifying the theory from a conceptual theory to a more meaningful theory. There is a mixture of proactive and reactive management while utilizing the theory for managing any situation and existence of this mixture needs to be made explicit in the theory. Likewise, utilization of contingency plan needs to be made more explicit in the theory. Moreover, employment of contingency theory for managing situations has been stated to be unique for each particular situation and therefore the situation should be defined in order to refer to a more specific concept. This eventually may lead to a more specific and detailed theory for any situation and hence instead of saying ‘it *all* depends’, it can be stated that ‘it depends on this and that’.

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As any other studies of this nature; all the responsibility for errors and misinterpretation is with the author.

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1 – Introduction

Every human endeavour in life involves risk. Risk by nature may be a cause for concern as it is uncertain and unpredictable, but one needs to step up to the challenge for life to be interesting. There may be success or failure, even though the degree of failure is proportional and cannot be defined as a precise terminology (Dey and Ogunlana, 2004).

As everything in life involves risk, management of projects cannot be an exception. I have been working in a construction company in Iran and considering various aspects of environment, the degree of volatility is fairly high. Therefore, I thought researching in-depth about managing risk of construction projects through using a case study such as Iran is not only useful for my career in the future but also the results may be effective for others who are working in such environments. Thus, I chose the concept of risk and its management for investigation in order to be able to apply the knowledge to both career and life as they are about making decisions.

1.1. Risk and construction risk management

Risk as defined by Oxford English Dictionary (2013) is “a situation involving exposure to danger.”

As presented in this definition and other definitions which are discussed more fully in the Literature Review (Chapter 2), risk is mostly considered as an event involving only negative consequences. The definition of risk used in this thesis is the one proposed by the Project Management Institute (PMI) (2013) as it considers both negative and positive aspects of risk; “an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives such as scope, schedule, cost, and quality”.

In this thesis, the concept of risk is investigated in the context of construction industry which as defined by Mills (2001) is “one of the most dynamic, risky, and challenging business”; and discussion is provided about the reasons why construction industry, having a project-based nature, is subject to more risks compared to other industries. Various classifications of construction related risks proposed by different authors are also considered in order to present the researcher's own classification.

Risk, irrespective of its type, should be managed to achieve a desired outcome. As a result of the common perception about risk - being negative, risk management has also been mostly defined as mitigating and decreasing of negative events. Chapter 2 discusses different definitions of risk management by authors along with the justification for the selected definition for this thesis which is the one proposed by PRINCE2 - (Projects in Controlled Environments 2) (2009) which refers to risk management as "the systematic application of procedures to the tasks of identifying and assessing risks, and then planning and implementing risk responses."

For investigating the process of risk management for the construction projects, a theory was required to be used as the basis of the thesis which is explained below.

1.2. Methodology

For undertaking any research, it is required to define an appropriate methodology according to its objectives so that researcher follows the research processes towards the realization of the objectives. The discussion on the details of the undertaken methodology is provided in chapter 3 (Methodology) and only a summary is explained here.

1.2.1. Theoretical framework

There are a number of competing complementary theories that can be drawn upon in developing risk management strategies and these are discussed more fully in Chapter 2. Among all these theories related to management and risk management, 'contingency theory' was found to be the most appropriate theory for the concept of this thesis as it brings into focus the concept of 'risk' which is deeply associated with construction projects (Noor and Tichacek, 2009).

The theory and this thesis both reject the idea that there is one best way to manage because each management situation is different. When managing projects it should be emphasized that each project is also unique and has got its own specifications which therefore requires suitable management practices according to its situation and specifications.

Contingency theory does not ignore the existence of universal principles for management, but highlights the uniqueness of each management situation. Therefore, the theory uses these universal principles together with unique specifications of the current situation and proposes the most appropriate way for managing that situation. Utilizing contingency theory is mostly done through organizational learning in order to use the past experiences and apply them to current situations where possible. The focus of this theory is on the relationship between contextual variables and the organization; stating that these variables influence the organization and therefore the projects they are implementing. As a result, to manage any project the specific variables associated with it should be considered and evaluated (Gong and Tse, 2009).

As the external environment has an important influence on how any project is managed, this research is situated geographically and temporally within a specific environment. Considering the unstable social, economic and political conditions in Iran today in comparison with many other countries, it was found to be a suitable case to be evaluated in this thesis for analysing the influences of environment on construction project risk management in-depth. A comprehensive discussion (social, economic, and political aspects) is provided in Chapter 3 (Methodology) about the solid, distinct difficulties and risks related to Iran and reasons why it is selected as the case study of this thesis. In this chapter, only a brief introduction about Iran in addition to few recent economic issues are explained.

1.2.2. Research approach

The selected research designs for this thesis are cross-sectional and case study and as mentioned above Iran has been chosen as the case study of this thesis. Secondary data and contextual data are used for this thesis and are discussed comprehensively in Chapter 2 (Literature Review) and 3 (Methodology). The research strategy is a mixture of qualitative and quantitative strategies leading to selection of suitable methods for collecting the primary data. Questionnaire and interview have been chosen as data collection methods and the participants are three categories of actors in construction projects: client, consultant, and contractor.

1.3. Iran

Iran (Persia) is located in southwest of Asia, Middle East and is bordered by ten different countries, gulfs and sea on four sides. Iran can be considered as a country which has oil-based economy and the oil sector provides around 85% of the government revenue. Another important economic sector is the construction industry (especially since Iran is a developing country), and has been facing difficulties in recent years. The economy of Iran can be considered to be single-source and based on oil (Library of Congress, 2008). Therefore, any changes in price of oil can have direct and intense influence on economy of the country and consequently on construction projects and their associated financial aspects (costs). Iran's dependence on oil export revenues has been targeted by United Nations (UN) and United States (US) sanctions; they have obstructed development of oil and gas sector of Iran in order to restrict its resources for uranium enrichment and also suspected terrorist financing (Ilias, 2008). These international sanctions have adversely affected the economy of Iran and resulted in sharp increase of subsequent instabilities in recent years; this is illustrated below regarding inflation and currency exchange which directly cause high fluctuations in price of materials.

According to Central Intelligence Agency (2011), the inflation rate has been reported as 12.4% in 2010 and 22.5% in 2011. As the numbers indicate the official inflation rate of Iran has been almost doubled due to various factors such as international sanctions and weak currency.

Figure 1.1illustrates the inflation rate's changes between January 2011 and January 2012. Since the dates in many of the diagrams extracted from the official websites of Iran are in Persian, which has got a different calendar, correspondence of Iranian and Gregorian calendar has been added to Appendix H. Moreover, every time Iranian dates are shown in diagrams, equivalent dates in Gregorian calendar are mentioned in the diagram's explanation.

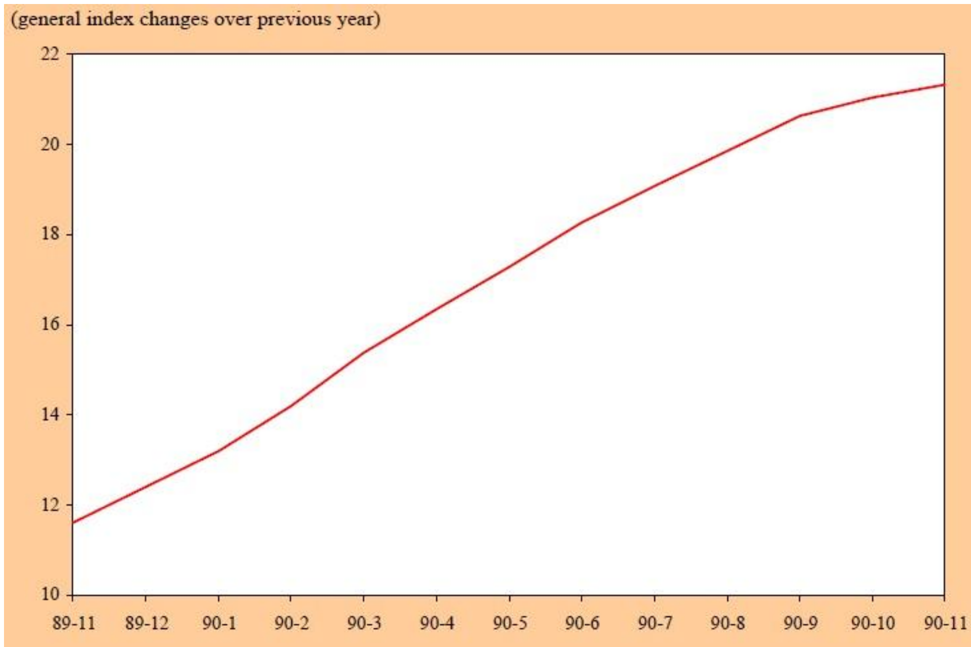


Figure 1.1 Inflation rate of Iran (Central Bank of Iran, 2012)

As reported by Central Intelligence Agency (2012), the exchange rate since 2007 is as follows:

Iranian Rials (IRR) per US Dollar:

- 9,407.5 (2007)
- 9,142.8 (2008)
- 9,864.3 (2009)
- 10,254.18 (2010)
- 10,616.3 (2011)

"The currency has reportedly lost 80% of its value since the end of 2011. Iran's currency dropped to as much as 35,000 to the Dollar, according to agencies citing currency exchange sites in the country." (BBC, 2012)

Figure 1.2 shows the selling rate of Dollar in Tehran, from 11 October 2011 to 11 October 2012 with each of the vertical segments in the diagram being representative of one month. Figure 1.3 displays the selling rate of Dollar in Tehran in one month from10 September 2012 to 10 October 2012, focusing on the last month of figure 1.2 presenting a sharp rise in prices. Each of the four segments (vertical) in the diagram is representative of one week and as it is shown the Iranian Rial has fallen by 25% in one week (Eranico, 2012).

Figure 1.2 Selling rate of Dollar in Tehran – Annual (Eranico, 2012)

Figure 1.3 Selling rate of Dollar in Tehran – Monthly (Eranico, 2012)

Importance of construction projects in Iran together with existence of distinct problems and risks associated with them, i.e. examples of the recent intense volatility in economy of the country provided above, makes Iran different from many other countries in terms of the environment and situation. Therefore, Iran has been chosen as the case study of this thesis as it can be quite interesting and unique to find out the specific risks of the country, the interaction between them and how these risks can be managed depending on the situation.

1.4. Aim and objectives

Aim

The aim of this research is to investigate the risk management process in construction projects with a focus on influences of the environment: a case study of Iran

Objectives

- To investigate the risks influencing construction projects and their management strategies
- To identify the criticality of risks in Iranian construction projects
- To recognize the interaction between various risks influencing the projects
- To examine the current knowledge base regarding the concept of risk and practice of risk management in Iran
- To assess the role of environment in execution and management of construction projects

1.5. Research questions

The overall aim and objectives mentioned above were developed into specific research questions for this thesis through reviewing the relevant literature on risk and risk management and hence related discussion is provided in the next chapter (Chapter 2); and the research questions are provided in the next page.

Using a case study of Iran:

1. **What are the processes of risk identification for construction projects?**
    - ❖ *Identification and evaluation of internal and external risks*
    - ❖ *The nature and strength of interaction between various risks*
2. **How is the knowledge about construction risks utilized in managing risks in line with contingency theory?**

These research questions are investigated in relation to the possible differing perspectives of the three main categories of actors in construction projects: client, consultant, and the contractor.

1.6. Contribution to knowledge

The environment (an external source of risk) affects the outcome of any single project immensely, but there are also the influences created through the interactivities of the risks that can dictate the inner dynamics of each project. This thesis looks at risks influencing construction projects in Iran, and how influences of environment and interactivities of risks on each project are accommodated using contingency theory for risk management.

Using the concept of contingency theory, the decision-making process is studied. This concept recognizes that according to the logic of their situation, managers pursue certain aims and they do this by assessing which is the most appropriate way of achieving these goals within the given situation (focusing on the specific risks which may influence Iran more than other countries).

Therefore, this thesis contributes to knowledge by providing a deeper understanding of how contingency theory works in practice and modifying the theory from a conceptual theory to a more tangible and meaningful theory. Moreover, proposed guidelines for managing risk of construction projects may help managers in Iran and also countries with similar difficult conditions, to manage the construction projects according to the situation and mitigate the risks as much as possible.

1.7. The overall research structure for the remainder of the Thesis

Chapter two: Literature Review – reviews the literature on project and project management; highlights the construction projects as the designated context of this thesis; clarifies the concept of risk (the focus of this thesis) in general and in the context of construction projects; defines the risk management process and refers to its sub-processes; underlines the factors influencing the risk management process; reviews related studies and papers undertaken by other researchers and discusses their findings; evaluates various theories about management and risk management and argues for justification of choosing contingency theory as the theoretical framework of this thesis; examines the contingency theory in context of construction risk management; and finally presents the research questions which are answered through undertaking this thesis

Chapter three: Methodology – discusses the preferred research methodology undertaken for answering the questions of the thesis; defines the adopted research approach; discusses the rationale for the choice of research designs followed by a critical evaluation of the case study design; describes Iran and the social, economic, and political aspects of its situation and argues the reasons for selecting Iran as the case study of this thesis; distinguishes the research strategies and reviews previous studies, their strategies and data collection methods to justify the chosen data collection methods for this thesis; explains the sample size for the questionnaires and interviews; identifies the data analysis methods used; and finally refers to material facts and ethical considerations of the thesis

Chapter four: Questionnaire Analysis – as the first part of data analysis deals with the quantitative data analysis; illustrates the results of different sections of the questionnaire in tables and diagrams and provides explanations for each; and discusses the specifications of environment and differences of three groups of participants who have completed the questionnaires

Chapter five: Interview Analysis – as the second part of data analysis deals with qualitative data collected through conducting interviews; analyses the content of questions one by one; shows the coding scheme for each question; and presents quotations from participants while discussing their responses

Chapter six: Discussion – reviews the results of two previous chapters and analyses them together in relation to the findings of other authors argued in Literature Review chapter and contextual data about Iran discussed in Methodology chapter; answers the research questions; proposes guidelines which may be useful for other countries with volatile situations similar to Iran; and finally discusses the results in relation to the contingency theory

Chapter seven: Conclusion and Recommendations – summarizes findings of the thesis; discusses the contributions to knowledge; explains the limitations of this research and provides suggestions for further research in this area

2 – Literature Review

2.1. Introduction

In the Introduction chapter, the background to the research, the methodology to be adopted and the chosen theoretical framework were briefly presented. An overview of Iran was provided and the aim and objectives were stated. At the end of the chapter, the overall structure of the thesis was outlined.

This chapter reviews the relevant literature on project management with an emphasis on construction projects as the context of this thesis. The concept of risk in general and in the context of construction is clarified and its management process and sub-processes are discussed. This chapter then underlines the factors influencing the risk management process. Related studies undertaken by other researchers are reviewed and their findings are discussed. Management and risk management theories are then evaluated and the selection of contingency theory as the theoretical framework of this thesis is argued. Finally, contingency theory is examined in the context of construction risk management leading to the presentation of research questions to be addressed by this thesis.

2.2. Project and project management

Project Management Institute (PMI) (2013) has defined a project as "a temporary endeavour undertaken to create a unique product, service, or result." It is temporary because it has a defined start and finish date; it is unique, meaning that it is not a routine operation, and the product/service would be different from other similar products/services. Examples of projects can be considered as developing a new product, designing a new machine, building a new shopping mall. Financial resources, human and materials are organized in a project for delivery of a specific work considering a variety of constraints such as time and cost (Turner, 1992). Therefore, different aspects of the project should be managed properly in order to deliver the objectives of the project on time and within budget, and hence it is important to set clear objectives for the project. Due to the one-off nature of the project, information related to each specific project need to be obtained for its management. Project management as defined by PMI (2013) is “the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements.”

Apart from the time, cost and scope of the project which need to be clearly defined, the quality (specifications) of the various parties’ requirements and risks involved in the project should also be determined distinctly. Each of these criteria should be managed in addition to the communication between them. A project usually exists in an organizational context (comprising other projects); is influenced by this context (environment) and may also influence it in turn.

There are various professional bodies and national associations on the development and spread of project management around the world. International Project Management Association (IPMA) is an international non-profit organization that aims at development of the project management profession and provides standards and guidelines for the work of professionals in project management (IPMA, 2013). Project Management Institute (PMI) is another non-profit organization located in United States for advancing the project management; and the Project Management Body of Knowledge (PMBOK) is its book presenting project management standards and is published internationally (PMI, 2013). Similar to IPMA and PMI, Association of Project Managers (APM) is an UK-based organization which exists with the purpose of promoting the science of project management (APM, 2013). Another methodology for the project management developed by the UK government as the standard used for the public projects is called PRINCE2 (Projects in Controlled Environments, version 2) (PRINCE2, 2009). Other standards developed for improving the project management science have been provided by GAPPS (Global Alliance for Project Performance Standards) which is a unique alliance that presents this information freely to be used by institutions and associations (GAPPS, 2013).

The standards presented for managing the projects covers the principles of project management that are generally accepted for all types of the projects; however, some of the professional bodies deal with specific types of projects such as the Chartered Institute of Building (CIOB) which is focused on construction projects’ management and upholds and develops the science and practice of building and construction management by providing the standards of building (CIOB, 2013).

The Construction Extension to the PMBOK Guide is another document which provides industry-specific (construction industry) application area and was published by PMI in 2003 for supporting the project management practitioners in specific industry areas. This extension describes the generally accepted principles for construction projects that are not common to all project types. The purpose of this document as described in PMBOK Guide (2000) Edition (cited in Construction Extension, 2003) is "application area extensions are necessary when there are generally accepted knowledge and practices for a category of projects in one application area that are not generally accepted across the full range of project types in most application areas." The reason why PMBOK has issued the construction extension is that management and practices of construction projects were one of the foundations of the original document of PMBOK in 1987. The concept was then broaden in order to cover all kinds of the projects, however, since it does not fully cover present-day practices for managing the projects in construction industry; the construction extension was provided by PMI in order to improve the effectiveness of construction projects' management and to include applicable materials specific to construction projects (PMI - Construction Extension, 2003).

All these professional bodies and associations provide their own standards and guidelines for managing projects and presents frameworks related to different aspects of the projects. Risk is one of these aspects which is the focus of this study and specific standards have been provided for it such as the Practice Standards for Project Risk Management presented by PMI in 2009 (PMI, 2013). Risk is also one the seven themes on which the PRINCE2 methodology is based (PRINCE2, 2009). The concept of risk is fully discussed in this chapter.

It should be noted that while the management process of the projects is discussed, the Project Life Cycle should not get confused with the Product Life Cycle. The Project Life Cycle as stated by PMI (2013) is "the series of phases that a project passes through from its initiation to its closure"; however, the Product Life Cycle is the duration (which is divided into stages) from which a product is launched in the market until it leaves the market and comprises four stages: introduction, growth, maturity and decline (Baines *et al*., 2008).

Managing the projects, the project life cycle which defines the beginning and the end of a project, can be divided into different phases to provide better management control. There is no single ideal structure that can be applied to all projects and depending on the type of the project, division of these phases might differ but usually comprise conceptual/feasibility, planning, designing, executing and finishing phases (Chapman and Ward, 1997). At the conceptual phase, information is at a preliminary level because the information availability increases as a project progresses. Therefore, in the first phase the objective would be to have strategic planning which in then replaced by more precise plans as the amount of available information grows in subsequent phases. However, because change is an inevitable characteristic of any project, the plans should be checked regularly in order to take account of any changes (Mills, 2001).

There are various types of projects and according to the characteristics of each type, it may be managed differently. One of these types is 'construction' project which is explained next.

2.3. Construction project

Construction project is a type of project dealing with the process of creating physical infrastructure such as residential building, industrial and commercial buildings, highways, and utilities. Phases (stages) in construction project are more or less like all the other types of projects and different authors/institutes have suggested their own division of phases leading to the similar project life cycles. Zou *et al*. (2006) have divided the phases of a construction project into feasibility, design, construction, and operation, whereas Liu and Zhu (2007)'s division of construction phases are as follows: conceptual, design, tender, preconstruction, and build. Phases of the construction project as defined by PMI (Construction Extension) (2003) are Concept, Planning (& Development), Detailed Design, Construction, and Start-up and Turnover.

As is illustrated in different divisions presented above, they broadly stay the same and it is sometimes synonymous words that are substituted for each other in naming the same phases. The number of phases may also increase depending on the managers' viewpoint as they may subdivide one phases in order to focus on the details of each phase separately and more carefully.

Generally, every construction project starts with the feasibility phase in order to check whether it is possible to operate this project or not and result in a go/no-go decision at the end of the phase. However, this phase can be iterative if a project requires modification before a 'go' decision can be made. In case of possibility of the project, there will be a planning phase followed by designing the project according to its specification. And finally, the will be the actual construction phase and building of the project. Other phases such as tendering, preconstruction, and handover may also be added to these phases but the concept stays the same.

There are various parties involved in any construction project; usually the main parties are client (employer), contractor and consultant. However, each of these main categories may consist of different specialist such as superintendent, project manager, subcontractor, quantity surveyor, and technical manager. Any of these parties may get involved in the construction project (in different phases of the project) depending on the type of the project, type of the procurement system, and type of the contract chosen for the project.

Every client at the beginning of any project aims at developing a procurement system which is appropriate for the project considering all the objectives of the project and also specifications of different procurement systems which affect the time, cost and quality of any project. A procurement system (delivery system) as defined by Love *et al.* (1998) is "an organizational system that assigns specific responsibilities and authorities to people and organizations, and defines the various elements in the construction of a project."

Ashworth and Hogg (2007) have defined construction procurement system as the management of the entire procedure which is associated with delivery of a construction project. The difference between the various procurement systems is in the allocation of responsibilities, the sequence of activities, adopted organizational approach, and the processes utilized in project delivery.

Hence, procurement systems vary from project to project and clients may choose different systems in order to divide their multiple responsibilities between individuals for the appropriate delivery of the project. Morledge and Smith (2013) believe that the construction procurement system is mainly about the human aspects of the people who interact with each other and with their environment and as a result their approach is influenced by their human aspect in addition to the social, cultural and ethical aspects.

Therefore, it demonstrates the importance of allocation of responsibilities and risks to parties in different procurement systems and how these parties cooperate with each other. There are four main procurement system classified as:

- Traditional: comprise three separate sequential phases of design, bid, and build. The client initiates the project; consultant is responsible for the design of the project and then contractor bid for the project in order to take the responsibility of the actual construction.
- Design and build: design and construction phases are handled by the same organization which is the contractor.
- Management contracting: the main contractor called the management contractor executes the project under a series of contracts signed by sub-contractors who are selected in competitive bidding.
- Construction management: project planning, design and construction phases are treated as integrated tasks and the client, consultant and contractor are united (Oladinrin *et al*., 2013).

There are also other types of procurement system such as Public-Private Partnership (PPPs) and Private Finance Initiatives (PFI) which focus on the co-operative relationship of government and private sector companies. One of the significant processes in the construction procurement system is selecting the suitable type of the contract based on the type of the project and its objectives. Subsequently, one of the principal reasons in choosing different types of the procurement systems and contracts is allocation of the responsibilities to involved parties and more specifically allocation of the project's risks to parties (Davis *et al*., 2008).

There are different types of contract available for construction projects and selection of any of them depends on the category and size of the project. Some of the contracts are as follows:

- Fixed price/Lump sum price: contractor is responsible for the tasks determined in the contract and is paid a fixed price by the client.
- Reimbursable/Cost plus: client pays the contractor a percentage of the cost of the project as the profit.

- ❖ Billed rates/Unit rates: payment to the contractor is according to the calculation and assessment of the work done based on the unit rates.
- ❖ Turnkey/Design build: contractor is responsible for all the phases of the project from design to completion.
- ❖ Partnership/Joint venture: due to different reasons (such as the project's extent, political issues) project is getting executed by various companies who work together (Avazkhah and Mohebbi, 2010).

Details, involved parties, client's method of payment and responsibilities of parties in each of these contacts differ from the other. Discussion on how the client transfers the project risk to various parties and how the risk is shared between them depending on the chosen procurement system and the contract is provided in section 2.5 - Risk in construction projects, after explaining the concept of risk.

Selecting the appropriate procurement system and contract for any project (by the client) which deals with allocation of responsibilities and risks to various parties has a great significance in appropriate management of the project. Examples are available in reports of the UK's Public Accounts Committee (PAC) and National Audit Office (NAO) where they explain how the projects are managed and what are the various factors influencing the project from its start to completion. The failure of the Metronet – the company associated with London Underground project executed in 2007 through Public-Private Partnership in London – has been stated in the NAO report (2009) as "the main cause of the Metronet's failure was its poor corporate governance and leadership." Frequent changes of executive management resulting in incapability for efficient management and also poor quality of information available to management caused inadequate performance of the project. It can be understood how the selection of the procurement system such as Public-Private Partnership in this project and the way the parties cooperate during the project execution can influence the management of a project. Moreover, political and managerial issues had also resulted in various difficulties for this project such as frequent changes of management and therefore caused inefficient management and communication for the project (NAO, 2009).

Another example can be referred to London 2012 Olympic and Paralympic Games where the budget was increased almost fourfold from 2.4 billion pounds to about 9.3 billion pounds in 2007. As reported by the PAC (2010) “one of the main reasons for the increased budget for the Games announced in March 2007 was the inclusion of a funded contingency, but three years later there is still no such contingency for LOCOG (London Organizing Committee of the Olympic and Paralympic).” It again demonstrates influences of political, governmental and managerial issues which may result in client’s unrealistic planning and cost estimation that may subsequently cause an increase in budget of a project which is not always possible to get added (PAC, 2010).

Examples related to Iran on how the clients manage construction projects and the political, governmental, economical and managerial influences on any project are provided in Chapters 5 and 6 (Interview Analysis and Discussion).

Therefore, each construction project has its own unique characteristics which affect the approach adopted and the way the project is managed. There may be many interdependent activities where each activity has its particular time, cost, quality specifications and risks (Gunhan and Arditi, 2007). Among all the factors associated with the construction projects, the concept of “Risk” has been chosen as the focus of this study and is discussed next.

2.4. Risk

“If you are sure you understand everything that is going on, you are hopelessly confused.”
Walter F. Mondale

The Italian verb “Riscare” that means “to dare” or “to have the cheek to do something” is where the word “risk” is coming from, showing that risk is not fate but a choice (Bernstein, 1996). All choices in life involve risk, and risk stems from uncertainty, which in turn is caused by a lack of information, knowledge or experience (Jannadi and Almishari, 2003). It was during the Renaissance when the study of risk started and since that time people and institutes have proposed various definitions for risk, some of which have been discussed below. However before discussing risk, it is required to define some other terms which may sometimes be used interchangeably: uncertainty, hazard, and vulnerability.

As defined by Flanagan and Norman (1993), uncertainty is “a situation in which there are no historic data or previous history relating to the situation being considered by a decision-maker." Likewise, risk relates to the same underlying concept – unknown future, however the probability of the event occurring can be assessed by decision-maker when the decision is made under risk due to the existence of information and historical data. Therefore, there is always uncertainty and there will be no risk without uncertainty; but the difference is in the ability for estimating the probability of the event (either intuitively or rationally) for the risk and not for the uncertainty.

Another distinction between uncertainty and risk as discussed by Hillson and Murray-Webster (2004) arises from consideration of the consequences; because uncertainty without consequences does not cause risk. Therefore, they believe that risk can only be defined in relation to objectives and the consequences it may have on them as "an uncertainty that could have a positive or negative effect on one or more objectives."

The Health and Safety Commission (1995) defines hazard as "the potential to cause harm." There is a probability for occurrence of this potentially damaging phenomenon and from the exposure of it (hazard), a degree of loss will be resulted which is called vulnerability (Brimicombe, 2003). Therefore, hazard and the degree of loss it may cause (vulnerability) can be considered as components of risk.

Another component of risk can be stated to be the Uncertainty Avoidance which is one of the four dimensions of culture presented by Hofstede *et al*. (2010). Culture as defined by them is "the collective programming of the mind which distinguishes the members of one group or category of people from another" and the most significant differences among cultures is to discover to what extent members of these cultures who can be the people living in different countries differ with regard to four dimensions of the culture: power distance, collectivism vs. individualism, femininity vs. masculinity, and uncertainty avoidance. Uncertainty avoidance as defined by Hofstede *et al*. (2010) is "the extent to which the members of a culture feel threatened by uncertain or unknown situations and try to avoid such situations." This dimension of the cultures is measured from weak to strong where high uncertainty avoidance societies use formality in interaction with others, show strong resistance to change, take moderate risks, and rely on rules whereas low uncertainty avoidance societies use informality in interactions with others, show less resistance to change, take risks easier, and rely on informal norms. Looking at the Hofstede's website, it is shown how different nationalities deal with uncertainty avoidance as a major component of risk. As it is demonstrated in the left section of figure 2.1, the Uncertainty Avoidance Index (UAI) of Iran has been scored as 59 which shows a high preference of people in this country for avoiding uncertainty. Countries with high uncertainty avoidance maintain rigid codes of belief, they may have the need for rules, and innovation may be resisted since this index exhibits the way a society deals with the fact that the future is unknown, the extent to which they feel threatened and therefore create beliefs in order to try to avoid it (The Hofstede Centre, 2013).

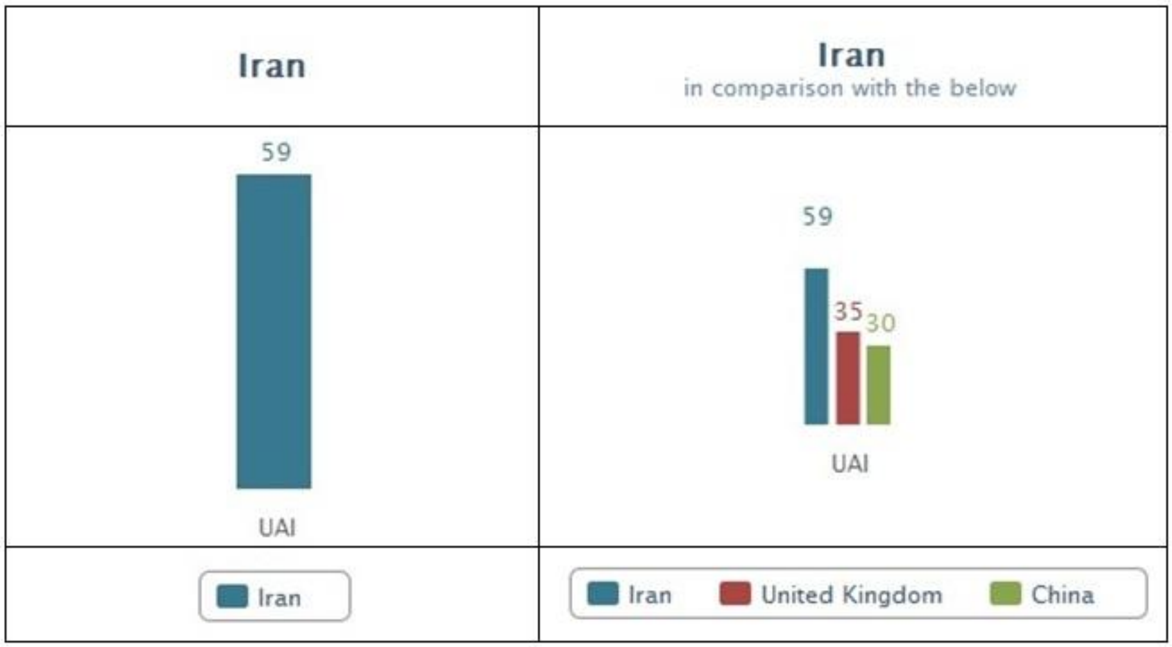


Figure 2.1 UAI of Iran and in comparison with UK and China (Based on The Hofstede Centre, 2013)

Right section of figure 2.1 compares Iran with UK and China. Looking at the indices for UK (35) and China (30), it is demonstrated that these countries have low scores on uncertainty avoidance. Therefore, adherence to rules may be more flexible in order to suit the situation and the people are more comfortable with ambiguity and not knowing what the day brings in comparison with countries with high uncertainty avoidance such as Iran (The Hofstede Centre, 2013).

As it is seen from the differences between cultures and how people rely on rules for lessening the unpredictability of future events; it can be understood why behaviour of people is different in taking risks and why risk management strategies used in one country cannot necessarily have similar results in another country.

However, it should be recalled that the above terms, uncertainty, hazard, vulnerability, and uncertainty avoidance are all considered as components of the risk and should not be confused with 'risk' which is the concept being studied in this thesis.

Willet (1951) has described risk as "a phenomenon objectively correlated with subjective uncertainty of an undesirable event occurring." Loosemore *et al*. (2006) have further improved the definition of risk as "A potential future event which is uncertain in likelihood and consequence and if it occurs, could affect a company's ability to achieve its project objectives."As it is illustrated in these definitions, Willet refers to risk as an undesirable event and likewise Loosemore *et al*. have stated that risk affects the ability of the company to achieve the project objectives. Commonly, people perceive risk as just "negative" consequences of an event, whereas it includes "positive" consequences as well. Project Management Institute (PMI)'s definition of risk considers existence of both positive and negative consequences of risk as "an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives such as scope, schedule, cost, and quality" (PMI, 2013). These potential effects (negative/positive) of the possible and uncertain event would be named as "threat" in case of negative effects and "opportunity" in case of positive effects (Figueiredo and Kitson, 2009). Definition of risk presented by PMI is what the researcher means by risk in this thesis.

As discussed above, all choices in life involve risk and executing projects can also be considered as choices. Chapman and Ward (1997) believe that all projects are associated with risk and it does not worth pursuing a zero-risk project. Definition of project risk presented by them is "the implications of the existence of significant uncertainty about the level of performance achievable." Construction project is not an exception and involves risks. Therefore, the concept of risk in construction projects is further discussed below.

2.5. Risk in construction projects

Akintoye and Macleod (1997) have defined risk in relation to construction as "a variable in the process of a construction project whose variation results in uncertainty as to the final cost, duration and quality of the project."

Construction is one of the most dynamic, risky, and challenging industries which has both a project-based and multi-organizational nature (Mills, 2001). Due to construction projects' complexity and uniqueness, not only does the number of risks present invariably go beyond those found in other industries but the risks also change from one construction project to the next (Panthi *et al*., 2009).

Risk is an inevitable phenomenon in an industry as dynamic as construction, irrespective of the size of the project. It is subject to more risks because of distinctive characteristics of construction such as financial intensity, complex procedures, lengthy duration, offensive environment and dynamic arrangements of organizations. Many other factors affect the level of risk including situation of market, level of competition, size of the project, political and economic variations, expertise of parties (Flanagan and Norman, 1993; Akintoye and MacLeod, 1997; Smith, 2003) (PMI, 2004; Smith *et al*., 2006)

These risks are distributed through the entire project life cycle and some of the risks may happen at more than one phase. There are arguments regarding the degree of risk in different phases of a construction project. Hayes *et al*. (1986) and Godfrey (1996) believe that the greatest degree of risk exist in the earliest phase of the project when available information about the project is the least. This is in agreement with other people such as Chapman and Ward (1997) and Hassanein and Afify (2007) who have stated that risk is at its peak in the conceptual phase. However, it is in contrast with Zou *et al*. (2006) who consider the construction phase to be more risky phase than the feasibility (conceptual) phase. In addition to these, there are other theorists believing that risks of construction projects increase as the project progresses and this illustrates that each phase of the construction project includes more risks than the previous one (Wang *et al*, 2004).

However, the researcher considers that this greatly depends on the type of the project, type of the contract and even type of the risks (the risks which are getting compared)that determine which phase may include more risks (especially since some risks may occur in more than one stage). Otherwise, this is not something precise and absolute to be measured, ranked and then allocated to different phases of the construction project for comparison.

Various institutes and authors have classified construction risks into different types and hierarchies. A broad classification has been proposed by Flanagan and Norman (1993) as Pure/static risks which are relating only to potential losses with no potential gain and dynamic/speculative risks with possibility of potential gains as well as losses. Dissimilar to consideration of losses and gains associated with the risk for its classification, Smith and Bohn (1999) have considered internality and externality of the risk to the project. They have classified risk into two types of internal and external; internal risks are the ones generating inside the project and more probable to be controlled whereas external risks are originated outside of the project and therefore mostly not controllable. Looking at another classification suggested by Smallman (1999), it can be seen that sometimes commonalities can be realized in classifications which have different names. His classification comprises two broad categories of direct risks including human, organization and technological (HOT) and indirect risks including regulatory, infrastructural and political (RIP). Comparing two recent classifications, it can be assumed that direct and indirect categories have similarities with internal and external categories, both present the extent to which the risks are specific to the project.

Risk has also been broadly categorized as either subjective or objective. Subjective risks are the ones which are analysed based on the experience and knowledge of the analyst (qualitative), whereas objective risks are analysed by calculation of their impact and likelihood (quantitative). Adams (2008) believes that most of the construction project's risks are subjective because there are not sufficient historical data for their quantitative analysis and should be analysed according to analyst's judgment. Risks can be further sub-categorized into smaller groups according to their type and impact. Examples are risk classifications of Wiguna and Scott (2006) into four categories: economic and financial risks, external and site condition risks, technical and contractual risks, and managerial risks; and the PMI (2004)'s one into another four categories: Technical risks, organizational risks, project risks and external risks (TOPE risks). As discussed earlier, similarities can be recognized in different classifications such as technical risks or external risks being presented in both of the recent examples. The researcher also proposes a different classification for the construction risks in the Methodology chapter (Chapter 3).

Risks, irrespective of their type, should be managed in order to decrease or remove the negative outcomes and discover the opportunities at the earliest chance for maximizing the benefits realized from them. At the outset of a project, all risks lie with the client but depending on the selection of the procurement system and the contract for any construction project, the risks may be transferred to other parties than just the client during the project.

Different construction procurement systems and contracts were explained in section 2.3 - Construction projects and how the risks are shared between the parties in any of these are discussed here.

In traditional procurement system as the parties share the responsibilities for various phases of a project, the intention is having a balance of risk between parties whereas in design and build because the contractor accepts the responsibility for both design and construction, majority of the risks are placed on the contractor. In management contracting and construction management procurement systems, the client accepts a considerable amount of risk since the contractor is mostly providing only the management expertise (Oladinrin *et al*., 2013; Davis *et al*., 2008). However, the type of the contract chosen for the project under any of the selected procurement systems would also determine the ratio of risk transferred to the involved parties. In fixed price contract since the contractor is responsible for majority of the tasks, the risks are mostly transferred to contractor than the client whereas in the reimbursable contract because the contractor is paid a percentage of the cost of the project, it is possible that contractor tries to maximize the cost of the project in order to earn more profit and therefore the client is dealing with majority of the risks (specially financial risks) in this contract. In billed rates and also turnkey contracts, since the contractor is responsible for executing the majority of the phases of the project and client is only paying the contractor, responsibility of managing the majority of the risks is also by the contractor. Partnership contracts, however, would have a balance in sharing the risks between the parties based on the details of the contract (Avazkhah and Mohebbi, 2010).

Therefore, it can be seen that the level of risk transferred to the parties varies in different procurement systems and contracts; however no matter which party is responsible for the risks more than others, the risks should be managed systematically. Risk management which is an essential part of the project management is discussed in the next section.

2.6. Risk management

Due to the one-off nature of a project and changes or even problems which are happening during its lifetime, there are inherent uncertainties and risks involved in a project. These risks are difficult to deal with and it makes the existence of risk management as an integral part of project management important (Ward, 1999). Characteristics of construction projects such as dependency on environment, transient nature, and being multi-organizational makes risk management in construction projects difficult but a necessity for achieving the objectives of the project (Zou *et al*., 2007).

Project risk management is all about people making decisions for improving project performance and achieving project objectives (Loosemore *et al*., 2006). The most difficult part in the risk management process is not finding techniques for identifying and managing risks, but accepting that life is uncertain and it cannot be ignored so it is better to grasp it.

Risk can be considered as an element in all decision making processes (Skorupka, 2008). Tools and techniques of risk management are useful in determining a decision, but it is finally the human, whose risk appetite (amount of risk s/he is prepared to tolerate/accept) varies, who makes the decision not the tools. Any decision contains two components: subjective view/interpretation and objective facts about the probability of what is to be lost or gained because of the decision made. Illusion of certainty can be assumed as a significant source of bad decisions and therefore related information should be gathered as much as possible for making any decision (Flanagan and Norman, 1993).

Similar to effective presence of project manager with required qualifications, skills, knowledge and expertise for managing a project; presence of risk manager can be quite valuable for managing risks of a project since s/he has the specific ability and expertise to manage the risks systematically. The bigger and more complicated a project, the more it is essential to divide the responsibilities related to various aspects of a project to people who have the required expertise; risks associated with a project are not exception and require dedicated risk managers to manage them. The specialized word used for this role in project management guides and standards is ‘risk owner’; however, general understanding of people from the word ‘manager’ as an individual responsible for management of different fields has led to the use of ‘risk manager’ title for this role by most of the people who are involved in management area. Risk owner as defined by PRINCE2 (2009) is “a named individual who is responsible for the management, monitoring, and control of all aspects of a particular risk assigned to them, including the implementation of the selected responses to address the threats or to maximize the opportunities.” Therefore, although the correct title for the person responsible for managing the risks is ‘risk owner’, the word ‘risk manager’ has been used in the questionnaires and interviews of this study in order to prevent any confusion for participants.

Uher (2003) has defined risk management as "a systematic way of looking at areas of risk and consciously determining how each should be treated. It is a management tool that aims at identifying sources of risk and uncertainty, determining their impact, and developing appropriate management responses." Due to the nature of the risk management process, contingency plan can be considered as an essential element of this process. Contingency plan as defined by Gray and Larson (2008) is "a plan that covers possible identified project risks that may materialize over the life of the project" and is discussed more fully in relation to risk management in Chapters 5 (Interview Analysis) and 6 (Discussion). Division of risk management process is as follows: risk classification, risk identification, risk analysis and risk response, with further division of risk response into avoidance, reduction, retention, and transfer (Berkeley *et al*., 1991; Flanagan and Norman, 1993). Division of risk management process into further processes and also actions of risk response process may differ from other people's viewpoints which are discussed later.

Risk management should be a part of project life cycle (PLC) and an on-going activity because prerequisites of a project and its environment will vary throughout its duration. Chapman and Ward (1997) believe that risk management should be considered as an 'add-in' process to the project management process as a whole, not an 'add-on'. They argue that the risk management process should be addressed in all phases of the project life cycle and they have considered the planning phase as the initiation point of this process. This is in contrast with what was discussed earlier in this chapter about the risk and phases in the construction project. There is usually a feasibility phase before planning which is considered as one of the risky phases in any construction project. Therefore, Risk Management Process (RMP) must address all phases of a project including the feasibility phase in order to manage the risks associated with a new project which is about to start. Feasibility phase is where a go/no-go decision is taken for starting a new project. Hence, significance of RMP in this phase can never be ignored because it may result in a no-go decision in case of a very risky project that leads to failure.

Hastak *et al*. (1994); Brown and Chong (2000); and Skorupka (2003); have described risk management as a group of techniques and actions for decreasing disturbances which may occur during the project life cycle and ensuring the realization of the project objectives. They have assumed the aim of this process at identifying and analysing risks and then applying proper mitigating actions. Likewise, Flanagan and Norman (1993) have referred to risk management as a discipline for living with the possibility of adverse effects that may get caused by future events.

What was explained in the last two definitions of risk management proposed above, illustrates that authors have only considered the negative effects of the risk (threats). The word “disturbances” points out the existence of only the threats in the project which leads to applying “mitigating” actions. Second definition similarly considers possibility of “adverse” effect by future events. The Project Risk Analysis and Management (PRAM) guide presented by the Association of Project Managers (APM) (2000) addresses how the risk management process is connected between the project level and corporate level and has been defined as “a process designed to remove or reduce the risks which threaten the achievement of project objectives” (APM, 2000). Likewise, this guide has also considered only the negative aspect of the risk and these are not in agreement with the definition of risk presented by PMI, considering both positive and negative aspects of the risk, which is the used definition in this thesis. If the risk may result in either negative or positive outcomes then risk management means managing both kinds of effects and not only the negative ones.

In this thesis, the researcher adopts the definition proposed by PRINCE2 (2009) which refers to risk management as “the systematic application of procedures to the tasks of identifying and assessing risks, and then planning and implementing risk responses.”

Risk management except from assisting to get the project completed on time and within budget, has got more benefits for any project such as:

- ❖ Allowing the decision making process to be less subjective and more systematic.
- ❖ Making the significance of risks apparent, minimizing losses and maximizing opportunities.
- ❖ Improving the project’s understanding by identifying risks and thinking about response actions.
- ❖ Impacting management by imposing an awareness regarding project’s possible outcomes.

- Improving communication.

There are also other risk management guidelines provided by other associations for presenting formalized risk management process (considering both aspects of risk) throughout organizations such as the ISO 31000:2009 published by International Organization for Standardization. As defined in the ISO official website (2013) "ISO 31000:2009, Risk management – Principles and guideline, provides principles, frameworks and a process for managing risk." Other related standards come with this standard and provide more detailed information regarding the risk management process namely: ISO Guide 73:2009 providing definitions related to risk management and also ISO/IEC 31010:2009 focusing on risk assessment techniques. One of the key changes in the ISO 31000 is related to the conceptualization of risk which is defined as "the effect of uncertainty on objectives" and it is no longer defined as chance of *loss* and therefore it demonstrates how this standard refers to both positive and negative possibilities. Subsequently, its risk management framework covers universal principles for identifying, analysing, and evaluating opportunities and threats in order to apply appropriate risk responses. The ISO 31000 has not been developed for any particular industry or group, it rather starts the risk management process for any operation concerned with risk management by establishing the context which comprises the objectives of the organization, its environment and stakeholders which helps identifying the nature of the risks and developing risk management frameworks according to the organization's objectives, strategy, values and risk attitude of the stakeholders (ISO, 2009). This formalized risk management process is broadly adopted by Enterprise Risk Management (ERM) organizations.

ERM as defined by the Committee of Sponsoring Organizations of the Treadway Commission (COSO) (2004) is "a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives." ERM aims at determining how much risk an organization should accept in order to grow the value for its stakeholders, and has various frameworks for describing approaches for managing risks such as Casualty Actuarial Society framework and COSO ERM-Integrated framework. The processes and components involved in each of these frameworks help managing the risks related to an organization's objectives based on the identified risk appetite of the organization and stakeholders. Therefore, parties involved in any construction project would consider the level of risk associated with each project they are about to execute and evaluate whether or not it is acceptable for them to hold its associated risks. For instance, consideration of the risk exposure of a particular project may result in a no-go decision by a contractor in the feasibility phase in case the contractor recognises that the risks associated with the project is not within the acceptable level of risks for the organization to manage, taking into account achievement of the objectives.

Therefore, risk management process should be a part of any construction project. This process cannot remove all (negative) risks from the project; but it is helping the business to take the right risks and ensuring that risks are managed in an appropriate manner. It aims at creating an organized framework to aid decision makers to manage risks competently. This point should be reiterated that risk management is not a one-off activity and there should be continuous management of risks throughout the life of the project (Mills, 2001). Division of risk management process into further processes and details of each process are argued in the following section.

2.6.1. Risk management sub-processes

Risk management process has been divided into various sub-processes by different authors and institutes, some of which have been explained below.

Berkeley *et al.* (1991); Flanagan and Norman (1993) have categorized risk management process to risk identification, risk classification, risk analysis and risk response. Chapman and Ward (1997) have gone further and have divided the process into more detailed processes. Their stage structure of risk management process consists of: define, focus, identify, structure, ownership, estimate, evaluate, plan and manage. However, others' divisions after Chapman and Ward comprise fewer sub-processes. The risk management framework has been divided into five stages by PMI (2004) and it contains risk planning, risk identification, risk analysis, risk response, and risk monitoring and control. Adams (2008) has further integrated some of these sub-processes and has divided the risk management process into three sub-processes as: risk identification, risk analysis and evaluation, and risk response and management.

It can be considered that the generality is the same in the risk management process and its sub-processes and it is identifying risks, analysing them and then managing them. The categorization which is going to be used in this thesis is the one proposed by PMI. Other classifications are not discussed further because the researcher believes that they have not included two important processes called: risk planning and risk monitoring and control. Absence of risk planning in the list of sub-processes shows the lack of scheduling and strategy designing for other processes and how these processes are going to be implemented. The risk planning process should be included in the risk management framework and before all the other process in order to define what is going to happen later. Another process which is not considered in the classifications mentioned above is risk monitoring and control. After planning, risks will be identified and analysed in order to find an appropriate risk response for them, but this cycle needs to be monitored regularly. As discussed earlier the prerequisites of a project and its environment vary throughout its duration and therefore it should be expected that the new risks appear in the project or the responses selected for identified risks are not suitable anymore. Hence, there should be another process, risk monitoring and control, in order to check the regularity of other processes. Omission of this process in the classifications proposed above is not accepted from researcher’s viewpoint as it leads to failure of risk management process.

The five interdependent sub-processes are explained in more details below:

2.6.1.1. Risk planning

Plans are nothing, planning is everything. Napoleon Bonaparte

The planning process defines how to implement and practice the risk management framework’s sub-processes. Without planning managers do not know exactly what to do, when and how. This process prepares the organization for risk management such as developing policies, determining the steps which need to be taken and their order, any resources which may be required, how long it may take, who is responsible for specific processes and may even include trainings and seminars for improving the risk management expertise of personnel (PMI, 2004).

2.6.1.2. Risk identification

The initiation point for this process is a clear definition of the project objectives. The process continues with identifying, categorizing and a primary assessment of the risks associated with the project. There are some tools and techniques which may be used in identification process such as checklists, brainstorming sessions, stakeholder discussions, review of historical records related to other similar projects, cold eyes reviews, collecting historical information available, strengths, weaknesses, opportunities, and threats (SWOT) analysis. Risk register, containing the risk ID, risk description, estimated impacts, risk probability, and risk score is the output of the risk identification process (Adams, 2008).

2.6.1.3. Risk analysis / assessment

Once the risk has been identified, there should be an assessment of its level and prioritization. This process also analyses the qualitative and quantitative information of the risk description, probabilities and impacts. Risk analysis aims at identifying and assessing the probability of the risks and their impact on project outcomes. The starting point for this process can be considered as the quantitative and qualitative evaluation of expert/analyst judgment about probability and impact of the risks based on their experience (Ranasinghe, 1994).

There are tools and techniques which are used in risk analysis process for assessing the probability and impacts of the identified risks more precisely. These techniques may be quantitative such as probability analysis, sensitivity analysis, scenario analysis, simulation analysis, and correlation analysis or may be qualitative like direct judgment, ranking options, comparing options and descriptive analysis (Minassian and Jergeas, 2009).

2.6.1.4. Risk response

This process evaluates the potential impacts of the risks and aims at removing as much as possible the negative impacts and maximizing the positive ones.

Division of risk responses is similar to division of risk management processes; different authors and institutes have divided risk responses into various numbers of responses. They have mostly focused only on negative impacts of risk and have not suggested any response for the positive impacts at all. Berkeley *et al*. (1991), Flanagan and Norman (1993) have divided the risk responses to avoidance, reduction, retention and transfer. Figueiredo and Kitson (2009) has further divided the responses into risk avoidance, mitigation, acceptance, research, transfer and monitoring. Likewise, APM's PRAM guide (2000) has also focused on negative impacts of risk and has divided risk responses to remove, reduce, avoid, transfer, and acceptance.

However, an inadvisable aversion to risk may result in overlooking opportunities for profits, as risk may be associated with benefit. Therefore, like all the other definitions and divisions regarding risk used in this thesis, the focus is on both positive and negative effects of the risks and therefore responses for both kinds should be proposed. PRINCE2 (2009) has categorized risk responses to ten categories relating to both threats and opportunities. Responses followed by a short description of each are presented below.

Responses for threats are:

- ❖ Avoid: changing some aspect of the project so that the threat either cannot have an impact anymore or can no longer happen.
- ❖ Reduce: a proactive action taken to either reduce the probability of the event occurring or to reduce the impact of it.
- ❖ Fallback: a reactive form of the 'reduce' response for reducing the impact of the threat with no influence on the probability.
- ❖ Transfer: this is another form of 'reduce' response for reducing the impact only, and it is mostly only the financial impacts (a third party takes this responsibility).
- ❖ Accept: a conscious decision taken for retaining the threat.
- ❖ Share: parties sharing the pain (within pre-agreed limits), normally when the cost plan is exceeded.

And responses for opportunities are:

- ❖ Exploit: grasping an opportunity to make sure it will happen and its impact will be realized.

- ❖ Enhance: a proactive action taken to enhance the probability of the event occurring or to enhance the impact of it.
- ❖ Reject: a deliberate decision taken for not exploiting or enhancing the opportunity.
- ❖ Share: parties sharing the gain (within pre-agreed limits), normally when the cost is less than the cost plan.

2.6.1.5. Risk monitoring and control

The purpose of this process is to certify that the risk identification, analysis and response processes are on-going. Some of the requirements for this process are: checking the status of the identified risks in the risk registers periodically; evaluating the efficiency of the risk responses used; identifying new risks, assessing them and developing risk responses for them.

The task of identifying new risks in this sub-process is not only because of changes in the project and its environment which cause new risks to come up but also due to appearance of secondary risks. Secondary risk can be considered as a new risk that may arise after implementation of a risk response (Cruz *et al.*, 2006).

2.7. Factors influencing the risk management process

As discussed above, risk management is all about humans making decisions according to the project specifications and its environment and hence information is required to make an appropriate decision. At the early phase of a project, large quantities of data may exist from similar previous projects. Past experience and historical records as well as intuitive judgment are necessary for making decisions on an unknown future. In case of insufficient historical data or unavailability of information, experts' subjective judgment should be used for identifying risks of a project and proposing responses for them (Minassian and Jergeas, 2009). Experience, functioning as a database, can be considered to be the strongest source available to the decision maker. People infer from the past into the present and then into the future (Flanagan and Norman, 1993).

Therefore, people and experts in a project should adopt a continuous learning approach and gain experience from past events and past projects which are real-life scenarios. Knowledge and experiences achieved from the past might put them in a good position where they can identify the probable risks that might be faced in a new project early and take appropriate management strategies. However, Hayes *et al*. (1986) and Godfrey (1996) believe that no two construction projects are the same, and this of course makes it significant to identify risks for every single project. It cannot be expected that the decisions made solely on the past (where information exist) forecast an uncertain future. Therefore, collected data relative to previous similar projects to the one being undertaken should be used, but for a new project, the actual risk identification and management would be based on specific information of the new project.

Project risk management relies heavily on expert judgment and knowledge. However, due to the nature of the construction risks, it is unlikely that one individual can have adequate experience of all the risks, allowing her/him to propose a proper risk identification and management. Moreover, the judgment of individuals with the similar information and experience may differ due to their personality, values, perception and preferences. Therefore, for the risk management process to be appropriate; there should be a procedure for extraction and aggregation of the opinions from multiple experts. This procedure will be helpful in decreasing the influences of individual perceptions and biases on the identification and estimation of risks and improves the efficiency of risk management process (Adams, 2008).

Risk management is making decision about an unknown future and anything regarding the future involves forecasting. Except from influences of the individual biases on risk management effectiveness, there are some other considerations which may affect this forecasting process such as availability of data, consistency and quality of data, cost of producing the forecast, time horizon of the forecast.

Flanagan and Norman (1996) have developed a model for a forecasting process as presented in figure 2.2. It shows that there are some requirements and considerations related to human in addition to available techniques as well as competence in employing the forecasting methodology (which uses specific information of the new project) that results in the qualitative and quantitative forecasts about future.

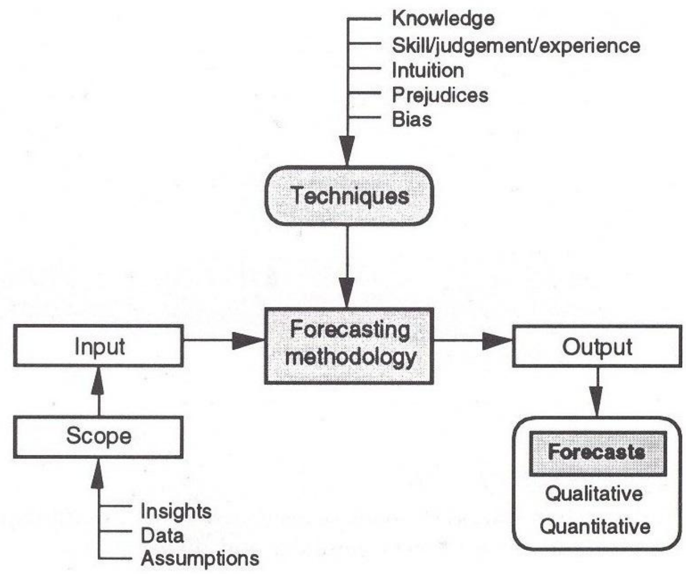


Figure 2.2 The forecasting process (Flanagan and Norman, 1993, p. 37)

For enabling people to learn from the past and make best use of their experience, ‘organizational learning’ is suggested in organizations that are managing projects. Liu and Low (2009) have defined organizational learning as “an integrative process during which an organization can meet existing and emerging needs to identify and exploit existing and acquired knowledge assets, increase decision-making potential and develop new opportunities.” It is imperative to avoid previous mistakes when making decisions, therefore it can be considered beneficial to document the lessons from the risk management process for the purpose of organizational learning (OL). Organizational learning is difficult to occur in construction industry as it is largely project-based. Generative learning should be adopted in organizations as part of their culture and even their reward system in order to result in translation of mistakes into valuable learning experiences (McGill *et al*., 1992).

In spite of all the techniques available, managers’ experience and knowledge, organizational learning and other methods, there is still no one best way for responding to the risks. Depending on the nature and type of the risks and also project characteristics, various risk handling strategies should be adopted for managing the risks.

The risk identification process can be considered as one of the difficult processes in the risk management process because what is considered as ‘risk’ is greatly affected by people’s perceptions which are highly dynamic in nature. After the risks have been identified and analysed, appropriate risk responses should be employed. Apart from the nature of the risks, their probability and consequences, there are some other factors which influence the type of response adopted for the risks such as risk attitude of an individual or a group. Although risk attitude is influential on making a decision, it should not be confused with risk appetite which is a *tendency* because the risk attitude is a *chosen response* to a situation (Hillson and Murray-Webster, 2011). As mentioned earlier, risk management is undertaken by people with various risk attitudes and this attitude can exist at individual or group levels. Risk attitude as defined by Hillson and Murray-Webster (2004) is “chosen state of mind with regard to those uncertainties that could have a positive or negative effect on objectives.”

Flanagan and Norman (1996) have divided the risk attitude of people and organizations into three types of risk loving, risk neutral and risk averse whereas Hillson and Murray-Webster (2004) believe that risk attitudes exist on a spectrum and would be different for individuals or groups based on how they perceive the risk. Figure 2.3 illustrates the risk attitude spectrum presented by them.

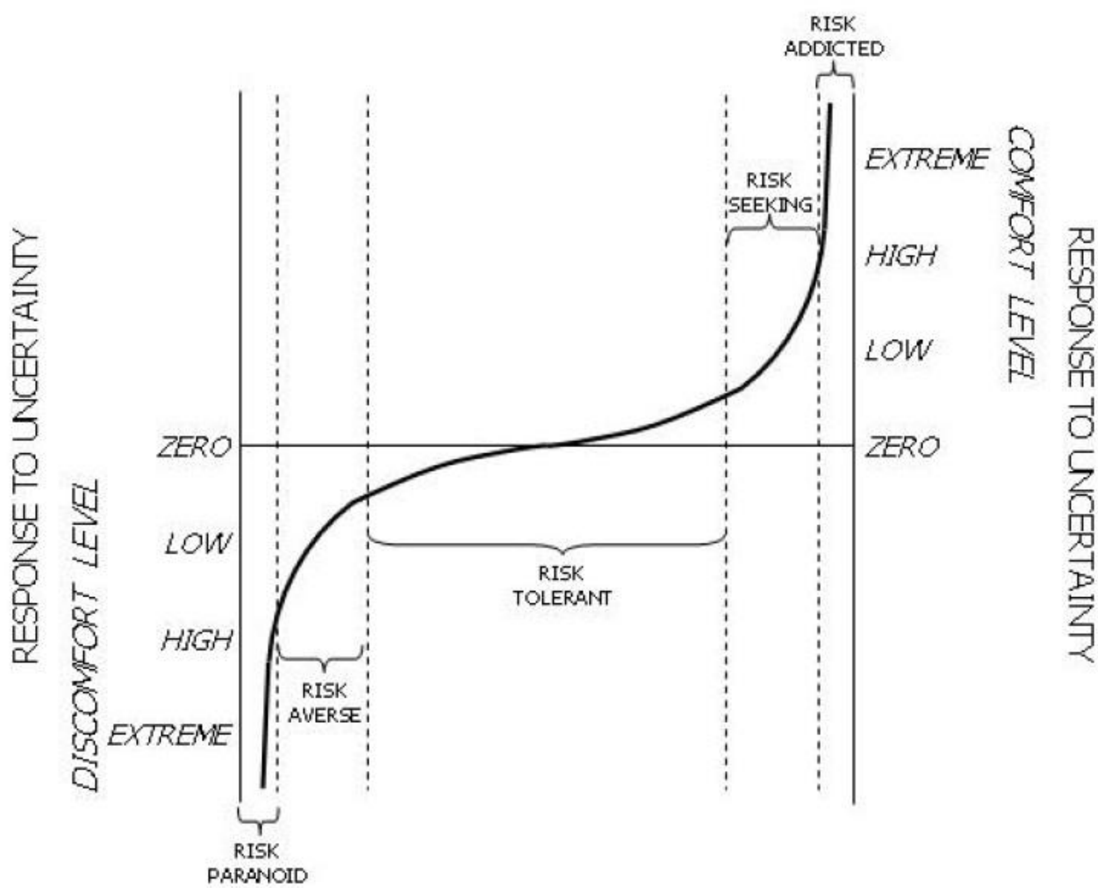


Figure 2.3 Risk attitude spectrum (Hillson and Murray-Webster, 2004, p.5)

A more structured approach for determining risk attitude of the decision maker uses utility theory because the theory captures the trade-offs (preferences) of individuals and organizations while making decision under risk. Using utility theory, all the possible outcomes that a decision maker can choose from should be assigned a utility value and the relationship between this choice and the expected return would be stated by the utility function. Therefore, the theory assesses the utility function for the decision maker and chooses the strategy which maximizes the expected utility. Hence, utility theory can be used for measuring risk attitudes of decision makers while managing risks (Flanagan and Norman, 1993; Norstad, 2011).

Significance of risk attitude on risk management process has been emphasised by authors and organizations. Flanagan and Norman (1996) have developed a risk management framework shown in figure 2.4 in which risk attitude has been shown as a pre-requisite to be considered for the risk responses process; they believe that different types of risk attitude influence the type of risk response people or the organization may adopt for the project's risks.

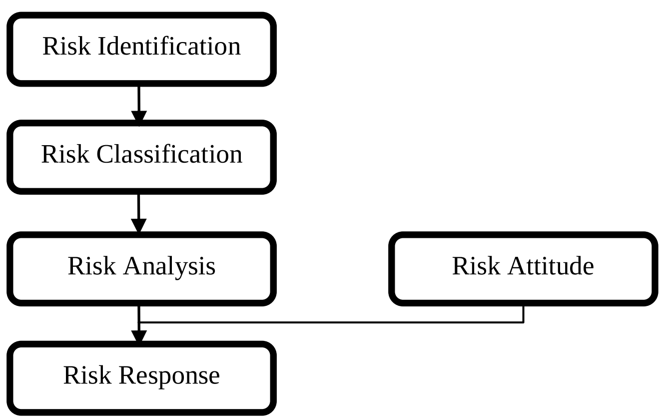


Figure 2.4 Risk management framework (Based on Flanagan and Norman, 1993, p. 46)

Likewise, the risk management process proposed by the ISO 31000 (2009) which has been illustrated in figure 2.5 discusses the same underlying concept as Flanagan and Norman. While the risk evaluation phase is being discussed in this guide, it is explained that the decision made in this phase which leads to the chosen responses in the risk treatment phase is largely influenced by risk attitude of individuals and organization (ISO, 2009).

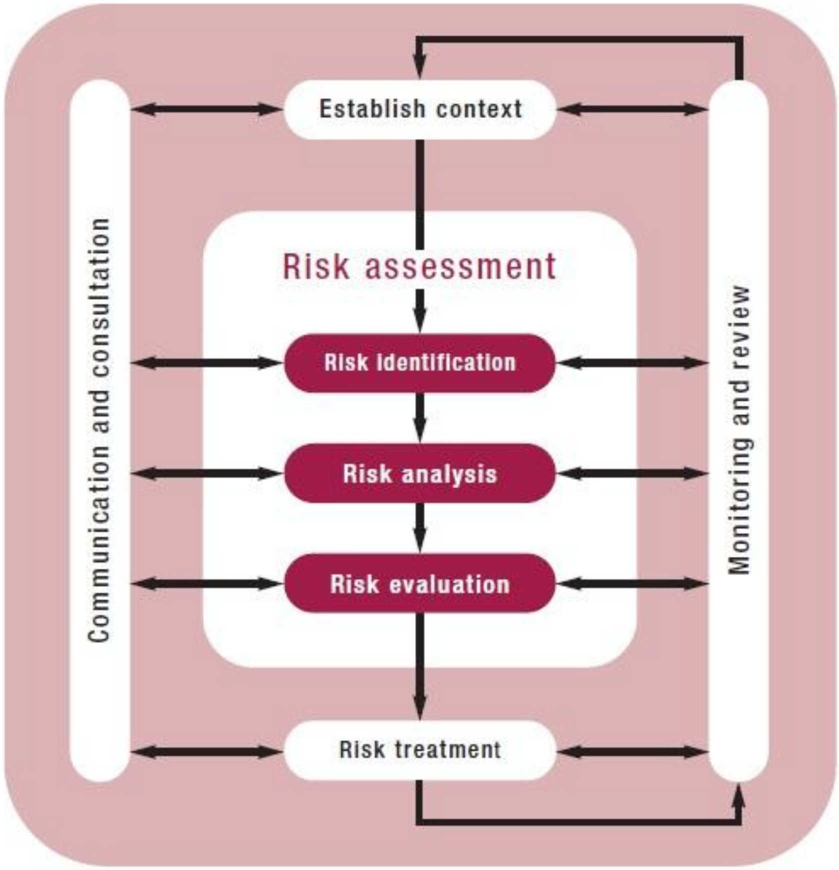


Figure 2.5 Risk management process (Based on ISO, 2009, p.14)

Various Attitudes (A) result in various Behaviours (B) which subsequently lead to Consequences (C) and this is called the ABC of risk psychology and has been presented by Hillson and Murray (2004). The individuals' risk attitudes and their subsequent behaviour may be influenced by factors such as capability and experience, work environment, task perception, mistakes, motivation, actions of other participants, social interaction with other people and organizations which finally leads to their risk management decisions (Ritchie and Marshall, 1993). How and why an organization behaves in a given situation (Organizational Behaviour - OB) may also be affected by individuals, structure, culture and strategy (Miles and Snow, 1978). Smallman (1999) has also referred to the size of a firm as another factor influencing organizational attitude towards risk. Influences of all these factors on individuals or organizations greatly affect their overall approach for managing the risks.

Different papers considering construction projects, their associated risks and the implementation of the risk management process have been studied for this thesis. The papers are reviewed and a summary of their findings are argued below.

2.8. Construction projects' risk and risk management in various countries

Among all the papers being studied for this thesis, only findings of those in which a specific country had been chosen as the case study of the research are reviewed here. Research conducted by Mills (2001) in Sydney, Adams (2008) in United Kingdom, Dey (2009) in India, Grace (2010) in United States, and Ghoddousi and Hosseini (2012) in Iran are mostly focusing on the categorization of risk. Therefore, for the purposes of this literature the pertinent research in which important risks and also risk management strategies have been proposed are provided below.

Cruz *et al.* (2006) have conducted a research in Spain about downside risks in construction projects. The findings demonstrate lack of project management and project risk management maturity in Spain, and political issues have been marked as the main obstacles preventing a higher maturity level.

In a paper by Tang *et al*. (2007), they have compared criticality of the risks and have evaluated the methods and risk responses used by project parties in Chinese construction industry. They ranked the five most important risks as 'poor quality of work', 'premature failure of the facility', 'safety', 'inadequate or incorrect design', and 'financial risk'. They believe that the existing risk management systems are not sufficient for managing risks and the key barrier to proper risk management is lack of joint management mechanism. Their research suggested a need to introduce an information management scheme and the partnering principles to risk management process, encouraging the open communication among participants in order to manage the project risks jointly and collaboratively.

In a research carried out by Hassanein and Afify (2007), they aimed at investigating contractors' perceptions of construction risks and their attitude toward risk identification and management based on a case study of power station projects in Egypt. The results show a lack of consistency in contractors' risk identification behaviour and also point out previous experience with the same owner as a factor having significant effect on the contractor’s risk identification effort.

Liu *et al*. (2007) have studied key issues and challenges of risk management and insurance in Chinese construction industry. According to the results of their research, managers’ knowledge and understanding about risk management is very little in Chinese construction projects. Great percentage of the respondents who had participated in this research believe that risk management skills are essential for project management activities but have not developed in China as much as project management. Unsupportive culture was identified as the biggest barrier in development of risk management in China’s construction industry, followed by other factors such as attitude and perception of the contractors.

Perera *et al*. (2009)’s research on construction projects in Sri Lanka has ranked scope change and tentative drawings as the two most influential risks in construction projects. Authors have concluded that one best way for responding to risk does not exist and various risk handling strategies should be employed for dealing with the risks.

Zou *et al*. (2006) in their paper have identified and analysed the risks associated with the development of construction projects from the perspectives of stakeholders and project life cycle in Australia. The results indicate that many risks occur at more than one phase and it was also concluded that construction phase is the most risky phase, followed by the feasibility phase.

Pourrostam and Ismail (2011) have conducted a research focusing on identification of the main causes and consequences of delay in construction projects of Iran. The result of research identified 10 predominant causes of delay as poor site management and supervision, delay in progress payment by clients, change orders by client during construction, ineffective planning and scheduling of project by contractor, financial difficulties by contractor, slowness in decision making process by client, delays in producing design documents, delay in reviewing and approving design documents by clients, poor contract management by consultant and problems with subcontractors. The research also found 6 negative effects of delay as time and cost overrun, disputes, arbitration, total abandonment and litigation.

Table 2.1 Top risks of construction projects in various countries

Author (year)	**Country**	**Risks**
Cruz *et al.* (2006)	Spain	Political issues / inadequate prequalification system
Zou *et al.* (2006)	Australia	Tight project schedule / design variation
Tang *et al.* (2007)	China	Poor quality of work / premature failure of the facility
Dey, P.K. (2009)	India	Environmental risks / technological risks
Perera *et al.* (2009)	Sri Lanka	Scope changes / tentative drawings

Table 2.1 illustrates top risks of construction projects in some of the above countries. Looking at the findings of these papers and referring to the evidences provided in Introduction chapter about the situation of Iran – the chosen case study for this thesis; it was expected that major differences emerge from the findings being revealed by this thesis. Moreover, this thesis has implications for a risk management theory and hence this theoretical position can be considered as its distinctiveness and the knowledge gap it is planning to fill. Further comparison between the above research's findings and results of this thesis in addition to an in-depth discussion on the theory are provided in Chapter 6 (Discussion). However, before continuing to collect the data specifically for this thesis; it was required to investigate different theories related to project management and risk management in order to choose an appropriate theory for this thesis. Below there is an argument regarding theories and the choice of contingency theory as the theoretical framework of this thesis.

2.9. Theories: evaluation of management theories for selecting a theoretical framework

As Stoner *et al*. (1995, pp. 31-2) have stated "theories are perspectives with which people make sense of their world experiences." Theory as defined by Olum (2004) can be assumed as interdependent concepts and principles to be systematically grouped for giving a framework to a significant area of knowledge. Acharyya (2007) defines the theoretical framework of the study as "a structure that can hold or support a theory of the research work. It presents the theory which explains why the problem under study exists and serves as a basis for conducting research."

As each study requires a theoretical framework to be built upon, various theories were evaluated for this thesis in order to choose an appropriate theory constructing the concept of this thesis which is risk and its management.

Management theories tend to interpret the rapidly changing nature of today's organizational environments. Scientific management school which is the first management theory (referred to Frederick Taylor's Scientific Management) replaced the management by 'rule of thumb' with 'the one best' practice. Taylor also proposed four main principles of management as developing a science of work, scientifically selecting the workers, bringing these two together and finally dividing the responsibility equally between management and workers (Taylor, 1911). Suggestion of 'the one best' practice for management in this theory is not possible for managing risk as an unpredictable event that needs to be treated differently depending on its type and the environment.

A sub-category of classical organizational theory is Henri Fayol's administrative theory focusing on personal duties of management. Five principle roles have been suggested by him for management as follows: to plan, to organize, to command, to co-ordinate, and to control (Pugh, 1971). Even though these roles are still actively practiced today for management in general; each aspect of the project still needs to be managed more specifically and risk can be considered as one of those aspects requiring its own detailed management.

Behavioural theory presented by Elton Mayo concentrates on human relations movement and introduced new concepts of teamwork, group dynamics and social systems (Mayo, 1960). Although the concept of teamwork is quite important for organizations managing the risks of any project, it is still not covering the main concept of this thesis.

Systems theory defines system as a collection of parts being united for achieving an overall goal and can have inputs, processes, outputs and outcomes. The influences of this theory on management results in a broader look at the organization by the managers and also helps them to recognize the parts of the organization and the interrelations of them (Klir, 1971). This theory sounds good to be considered in construction projects due to their complexity and existence of interrelations between different parts and aspects of the projects. Moreover, it can help managers to interpret patterns and the interaction between risks in any project. However, more theories are reviewed in order to choose the most appropriate theory for the main concept of this thesis and its dynamic nature.

Theory X and theory Y proposed by Douglas McGregor state that the way an organization runs depends on the beliefs of its managers. Theory X considers the negative aspects of human behaviour, assuming most people are immature and need direction and control. Whereas theory Y is the opposite and argues that people seek to fulfil themselves through self-development and self-respect at work. The behaviour of people in organizations, how they actually relate to managers and peers, and also factors motivating them should all be evaluated in any organization performing projects in order to increase the productivity of the workers and employees and subsequently the productivity of the project (McGregor, 1985). While considering risks in any project, existence of external risks and the ones which are not related to the people in the organization cannot be ignored and therefore this theory is still not fulfilling the objectives of this thesis.

Agency theory defines the relationship of individuals hiring agents (others) for delegating responsibilities to them. This theory analyses the separation of managerial motivation and ownership. Managerial attitudes toward risk taking and hedging are influenced by agency issues in risk management field. The problem arises when the interests of management and agents differs which may result in taking too much risk or not even engaging in projects with positive net value (Smith and Stulz, 1985). Therefore, there should be a logic helping management to keep the balance for taking risk in projects.

Situational or contingency theory is the fit between contextual variables and organizations. Contextual variables can be considered as culture, environment, size, strategy, technology; and for any organization the best organizational structure is the one that constitutes the best fit with these variables at a specific period. The theory asserts that when managers make a decision, all aspects of the current situation should be taken into account and they have to act on those aspects which are key to that situation (Burns and Stalker, 1961). Main concept of this theory is “it depends” and therefore quite suitable for the concept of risk in projects as it all depends on the type of the project and its environment at a particular period of time.

Various theoretical frameworks evaluated for this thesis cover different aspects of management as discussed above. Each of these aspects has got its own importance for management of organizations and projects but among all, contingency theory was found to be the most appropriate theory constructing the concept of this thesis as it brings into focus the concept of 'risk' which is deeply associated with construction projects (Noor and Tichacek, 2009).

Moreover, while reviewing other research about construction projects' risk management for this thesis, 'contingency theory' was the predominant theory being used as the theoretical framework of most of these research which therefore shows its appropriateness to the concept. Discussion on the details of contingency theory and also the theory in context of construction risk management is provided below.

2.10. Contingency theory

As discussed earlier in this chapter on page 18, each project is unique and therefore should be managed according to its specific characteristics and environment in the particular period of time. The focus of this thesis is managing risk of construction projects and asserting that due to one-off nature of the projects there is no one best way to manage them. Therefore, choosing contingency theory can be considered as an appropriate theoretical framework for this thesis because the main concept of this theory is in common with the focus of this thesis; the theory rejects the idea that there is one best way for managing.

The fact that management situations are not similar clarifies the reason why specific management practices work in some cases but not in others. Much in management and organizational life is situational and these realities of organizational life are what contingency theory has been grown from (Longenecker and Pringle, 1978). Discussing contingency theory within the context of organizational studies, Kast and Rosenzweig (1973) have pointed out that the theory represents a middle ground between:

1) Existence of universal principles for management and organizations
2) Uniqueness of each organization and therefore analyzing each situation separately

This suits the objective of this research where the theory recognizes the complexity involved in managing risk of construction projects but uses patterns of relationship of risks in order to facilitate risk management.

Although the contingency approach refuses the existence of ‘one best way’ for managing risk, it proposes that there is ‘one most appropriate’ approach for each specific situation (Contingencies). The word ‘contingency’ indicates how the environment (external source of risk) relates with the system, and determines the activities and construction of an organizational system (Longenecker and Pringle, 1978). Therefore, ‘one best way’ to manage all the construction projects cannot be defined and for this thesis, the most appropriate way in risk management depends on the nature of the environment (Iran) in which the projects are taking place.

Improvement in organizational effectiveness is what contingency theory aims at in order to respond to uncertainty in performance. Contingency is mainly generated for removing or decreasing the negative outcomes of unforeseen events. The novelty of contingency theory, as recognized by Steiner (1979), is adaption of a new way to be identified for specific structures and activities which are the most appropriate for the current requirement of the organization. This illustrates that it is no longer suitable to utilize all-purpose theories or one-size-fit-all integrative frameworks in management and studies. So, contingency theory is used in this thesis in order to describe an approach in managing risk of construction projects that best suits the Iran’s current situation.

The aim of the contingency theory has been identified as two-fold by Ritchie and Marshall (1993):

a) Determining the probability of existence of relationships between specific elements in the environment of organizations
b) Identification of various organizations’ responses to these elements in order to provide guidelines for other organizations with similar environmental influences (these influences should not be necessarily identical)

This thesis would extract and focus on the *interaction between various risks influencing the project*; that along with the specific influences of environment on risks and general responses to them; forms the foundation of the risk management process.

Contingency theory has been criticized by authors like Galbraith (1973) and Schoonhoven (1981) on the ground that it has problems such as lack of clarity in its theoretical statement. As a consequence of this problem, theoretical statements also fail to provide any clues about the specific form of the interaction intended. These criticisms are argued in Discussion chapter more fully when the theory is getting evaluated - including the researcher's considered view of the criticisms that other authors have made about the contingency theory. Although some objections may have been pointed out about contingency theory, it was found to be the most appropriate theory for this study as it is risk-based (the focus of the thesis), which gives it the power to take into account the environmental circumstances that can be considered as a significant source of risk for construction projects (Noor and Tichacek, 2009).

2.11. Contingency theory in context of construction risk management

As mentioned above, contingency theory recognizes that there are a range of contextual variables (risks), each influencing the project that the theory is going to be applied to. Examples of these variables are external environment, technology, organizational structure and size, cost, culture, people involved, supply chain, strategy. Different categorizations for these variables have been stated earlier in this chapter and the researcher's classification is provided in Methodology chapter. This thesis investigates the influences of these risks and the interaction between them on construction projects. Any of these risks may have an influence on a project and hence contingency theory can be suitable to be used for covering these influences depending on the situation of Iran.

Adaptation in contingency theory mostly happens through organizational learning which can be defined as any modification of an organization's knowledge occurring as a result of its prior experience (successful or unsuccessful). Madsen and Desai (2010) believe that "organizational knowledge is not static; it is created, refined, altered, and discarded as organization members experience reality and attempt to update their individual and shared understandings of it to reflect the lessons they draw from their experience". This thesis also makes use of past experience of people involved in construction projects as a key tool for managing the risks.

Panthi *et al*. (2009) have pointed out that construction projects are complex and unique, and because it is difficult to evaluate the level of risks in construction projects, it is therefore also hard to apply risk management activities appropriately. One of the unavoidable outcomes of a construction project is variation that may lead to adverse impacts on time, cost and quality. Hence, utilizing contingency theory in projects is useful for mitigating these variations that arise later, through organizational learning which uses past experiences and applies them to current situations where possible. These guidelines can be communicated vertically within an organization and horizontally between organizations.

As discussed above, contingency theory is predominantly created for elimination / mitigation of adverse impacts of unforeseen events and therefore contingency cost can be considered as a significant element of contingency theory for confronting these events. Therefore in this thesis, different categories of risk are evaluated with a particular attention on cost and contingency cost. Cost is very influential in construction projects because except from the factors which may impact the cost of any project in its lifetime; the construction projects mostly have a bidding phase dealing with competitive estimation of an appropriate cost for implementing the project and this is what contingency theory is capable of, as it is risk-based and flexible.

Liu and Low (2009) have considered flexibility as a key solution for the modern businesses and their associated disorders (risks) and therefore have emphasized on the ability of contingency theory for presenting an explanation depending on the conditions and facts of each specific case. As Figueiredo and Kitson (2009) have presented "contingency is a cost element of an estimate to cover the probability of unforeseeable events to occur and that if they occur, they will likely result in additional costs within the defined project scope." Some costs in the projects cannot be readily determined or they are significant in the aggregate but too small to be estimated individually; so in order to account for these costs it is useful to include contingency in any cost estimate such as cost estimation for construction projects (Humphreys and Wellman, 1996). It should be noted that contingency is different from allowances in the projects. The events which are expected to occur and are within the scope of the project drive the allowances and as a result the allowances are not risk-based or dependent (Noor and Tichacek, 2009).

Contingency, as an estimated value of the risks which are not covered by contract terms or insurance but may be encountered during the project's implementation, can be determined through various approaches. A fixed value of 5-10% of total costs has been suggested by many text books to be added to project cost as the contingency cost. Smith and Bohn

(1999) have also reported the same fixed percentage (5-10%) of the contract value for the contingency cost. This is also in agreement with assertion of many other authors about accuracy level of the contingency estimation for the construction projects being remained at around 10% level for the past four decades (McCaffer, 1976; Flanagan and Norman, 1983; Morrison, 1984; Gunner and Skitmore, 1999; Ling and Boo, 2001). Likewise, Blok (1982) and Yeo (1990) have considered this fixed percentage of the estimated budget as contingency to be 10-15%.

However, given the complicated nature of construction projects; the common traditional practice of allocation of a fixed percentage (ranging from 5% to 15%) of the estimated budget or the contract value as the contingency may not be appropriate. From the researcher's professional experience, complexity of the projects and inherent uncertainty in the project execution and involved parties' performance make it very difficult to forecast the exact budget of the construction projects precisely. As a result of this, it is required to include contingency as a funding source in projects' budget in order to provide the flexibility for the managers to address these deviations. So, how is it ever possible to estimate a fixed percentage of the project budget as the contingency when the budget itself is not precisely estimated?

Moreover, there are other factors that contingency allocation is dependent on such as the attitude of involved people towards risk (risk averse, risk neutral, risk taking), the expected return, how well the scope of the project is defined at the time of cost estimation, the level of risks on a project, organization's state in relation to available work, the type of contract chosen for the project, the economic situation of the country in which the project is taking place (Ranasinghe, 1994).

Therefore, contingency estimation should be considered as one part of the risk management process (Figueiredo and Kitson, 2009) and the contingency cost should be large enough to cover the impacts of risks but not to exceed the needs of the project. Allocating contingency is largely based on the estimator's perception of the project risks and therefore a matter of judgment. Contingency may be derived through statistical analysis of past projects, by applying experience or through a projection based on assessed probability of what may occur. Risk assessment can provide the data which can be used for determining the degree of contingency to be assigned to each risk associated with a new project but because it is hard to estimate the monetary impact of these risks in a deterministic manner, a range is given to them (Minassian and Jergeas, 2009). This is the reason why the same fixed range (5-15%) cannot be allocated to all construction projects as the range for each project is dependent on various factors specific to that project as mentioned above. Even though each of these techniques may be used for any type of contingency prediction and estimation; the most common approach is still using previous experience that is the main characteristic of contingency theory through organizational learning (Gunhan and Arditi, 2007).

Since the contingency theory is risk-based, it can be sufficient to manage the realization of risks and as a result has been chosen as the theoretical framework of this thesis which is focusing on the risks associated with construction projects. As discussed above, the theory is the fit between organizations and contextual variables with the environment being considered as one of the important variables for any organization and subsequently the project which the organization is implementing. Therefore, Iran – as an environment with clear distinct difficulties and risks – has been selected as the case study for this thesis and the discussion about its situation is provided in details in Chapter 3 (Methodology).

Due to the nature and specifications of contingency theory, the research questions of this thesis (investigation of risk management in construction projects) are best answered in relation to this theory and through a case study that offers certain advantages for the concept of thesis – Iran. However as mentioned earlier, Discussion chapter includes deeper arguments about contingency theory, its relation to risk management, and also criticisms about this theory. Therefore, these thoughts are looked at through the case study and the findings are provided in the Discussion chapter. Setting the context of this thesis, the research questions are recalled here. Using a case study of Iran:

- ❖ **What are the processes of risk identification for construction projects?**
- *Identification and evaluation of internal and external risks*
- *The nature and strength of interaction between various risks*
- ❖ **How is the knowledge about construction risks utilized in managing risks in line with contingency theory?**

These research questions are investigated in relation to the possible differing perspectives of the three main categories of actors in construction projects: client, consultant, and the contractor.

2.12. Conclusion

This chapter has reviewed the literature on project, project management, construction projects, risk, risk management process and its sub-processes. It also reviewed related studies and their findings, continued with evaluations of different theories and justification for selection of contingency theory as the theoretical framework of the thesis and finished by presenting the research questions.

Next chapter, Methodology, explains the undertaken methodology of the thesis including clarifications on research approach, research design and case study design. An in-depth discussion about Iran as the chosen case study of the research is provided comprising social, economic and political aspects. And, research strategy, data collection methods and data analysis methods are explained.

3 – Methodology

3.1. Introduction

In Chapter 2, Literature Review, the concepts of risk and risk management in construction projects were covered. It continued with analysing the findings of other related studies and finally different theories were evaluated and contingency theory was discussed as the theoretical framework for the thesis followed by the research questions.

In this chapter, the preferred research methodology undertaken for answering the questions of the thesis is justified. It firstly outlines the approach adopted for the thesis, followed by a discussion on the rationale for the choice of research design and evaluation of case study design. The next section is an argument about the reasons for selecting Iran as the case study of this thesis which considers social, economic and political aspects of the environment. The chapter continues with explanations about research strategies, data collection methods including a discussion on the sample size, and then evaluates data analysis methods. And finally, explains the material facts which may influence the results and describes ethical considerations.

3.2. Research methodology

The terms ‘methodology’ and ‘method’ are sometimes used interchangeably. Hussey and Hussey (1997) refer to the methodology as overall approach taken, along with the researcher’s theoretical basis, whereas method is various means for collecting data and analysing them. In agreement with these writers, in this thesis ‘methodology’ refers to the overall approach undertaken comprising all aspects of the research process. Thus, the research approach, design, strategy, data collection methods and the means of analysis are all part of the methodology of this thesis.

Every research is conducted to answer one or more research questions and the research methodology structures the path for doing so. Meanwhile, the research philosophy is pivotal in portraying the researcher’s standpoint against the research problem. Saunders *et* *al*. (2003) portrays in form of an onion, an illustration of the relationship of research philosophies, strategies, approaches, and methods that could be undertaken by researchers based on the nature of their investigation (Figure 3.1). Besides, this logically sets out various stages of a research project in form of an onion where layers indicate inward levels of progression.

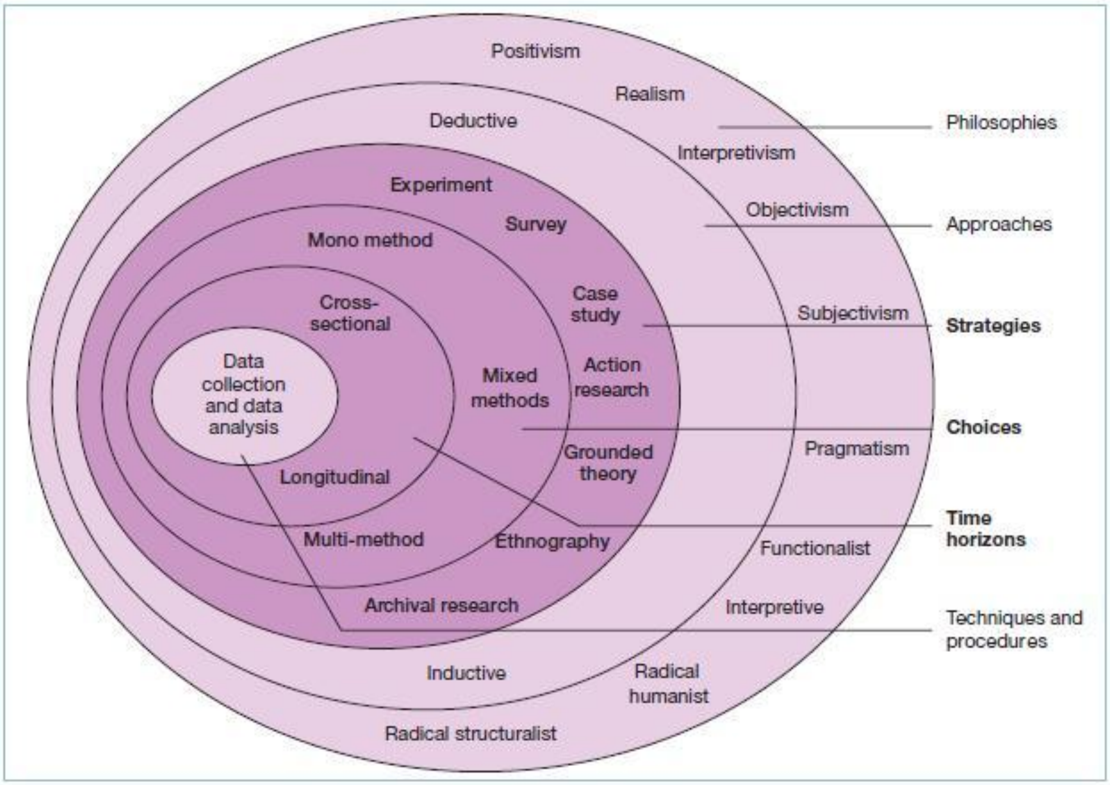


Figure 3.1 Research process onion (Saunders *et al.*, 2003, p. 83)

Reviewing various philosophical standpoints, Marsh and Furlong (2010) refers to epistemology as the study of knowledge and justified belief. Epistemology can be outlined as exploring the possibility, limits, origin, structure, methods and truthfulness of knowledge along with methods that knowledge can be acquired, validated and applied (Delanty and Strydom, 2003). In epistemological term, researcher is a scientist who employs surveys, questionnaires, random sampling and other similar data collection methods for testing a theory utilizing a deductive approach. Ontology, as stated by Smith (2003), is providing a definitive and exhaustive classification of entities in all spheres of being. Definitively, ontology outlines the essentiality of classes of entities to give an account of what makes true all truths while exhaustively, it underlines the inclusivity of all types of entities along with the types of relations by which entities are tied together in this classification. In other words, ontology is an inductive theorizing method constructed upon investigation and exploration. As regards, the researcher in an ontological viewpoint is a detective who extensively employs ethnographic study, in-depth interviews and other analytical approaches.

Burns and Stalker (1961) highlighted the understanding of interrelations between contextual variables namely culture, environment, size and strategy and their best fit in management of organizations. This research utilizes contingency theory but applies it to a totally different context of Iranian construction industry and conclusively draws a brief comparison with the international experiences. In this context, the epistemological assumption of this research focuses on the concept of risk and its association with construction projects through application of contingency theory. The ontological perspective of this thesis, however, observes a set of different contextual variables/risks within the Iranian construction industry for developing patterns and/or classifying entities which could be testified against the contingency theory.

Drawing upon the review of the research literature on projects, construction projects and management of associated risks involved in Chapter 2, the following section constructs the methodological principals (layer by layer analogous of figure 3.1) on which the research is based.

3.2.1. Research approach

Two broad approaches of reasoning can be named as ‘Deductive’ and ‘Inductive’. Deductive approach (top-down approach) as a logical process of reasoning usually begins with a general theory (what is known about in a particular domain) and moves toward inferring a more specific hypothesis which is subjected to empirical scrutiny against observations. Inductive approach (bottom-up approach) moves the other way round from specific observations towards detecting patterns and formulating some hypotheses to be explored, ending up in broader generalizations and theories (Trochim and Donnelly, 2008). Figures 3.2 and 3.3 shown below illustrate an overall view of each of these approaches.

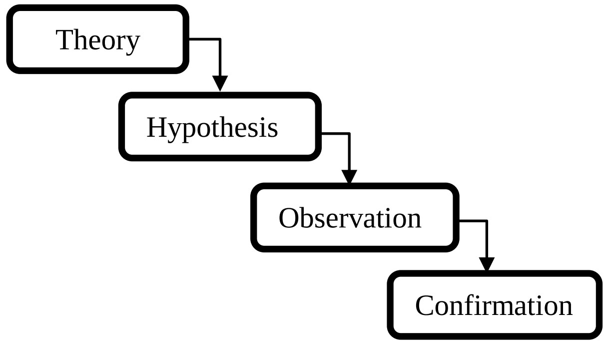


Figure 3.2 A schematic representation of deductive reasoning (Based on Trochim and Donnelly, 2008)

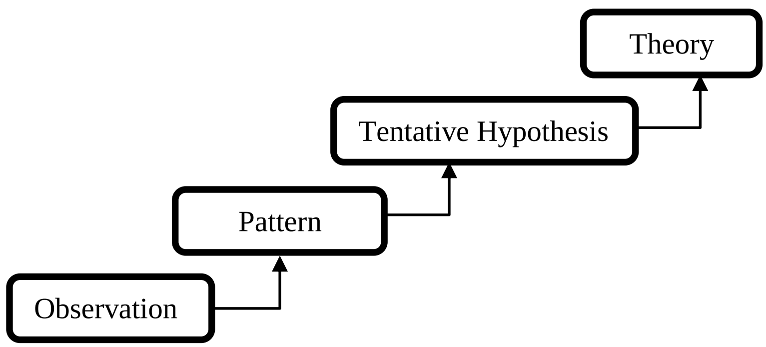


Figure 3.3 A schematic representation of inductive reasoning (Based on Trochim and Donnelly, 2008)

This study is largely based on a deductive approach signifying the relationship between the theory and the research. Contingency theory is studied as the theoretical framework of this thesis, and its relationship with construction risk and risk management is investigated. It will be then tested to figure out whether or not it has got influences on the process of risk management in Iran. Moreover, risks involved in construction projects will be evaluated in order to investigate the relationship between these risks and implementation of contingency theory for risk management of construction projects in Iran. The risk management process will be observed to find out more about how risks involved in construction projects are managed in Iran. In doing so, the observations may lead to new patterns and resulting in more details being added to the existing theory. Therefore, this thesis is based on a mixed-style method of reasoning, involving both inductive and deductive at some time in the project. It can be considered to continually cycle from theories down to observations and move up again to theories.

3.2.2. Research design

According to Ghauri and Gronhaug (2005), selection of research design can be considered as the ‘bridge’ between processes associated with the conceptual and empirical levels. Authors have proposed various types for the design of the research. The research design (which can be considered as the structure of the research) is to ensure that the acquired evidences will lead the researcher to achievement of clear answers for the questions of the research. Trochim and Donnelly (2008) have classified research designs into three main types of randomized (true experiment), quasi-experiment and non-experiment. Other design types proposed by authors are case study, causal, observational, philosophical, descriptive, cross-sectional, action research, exploratory, historical, sequential, and longitudinal. Among all these different types, Bryman (2004) has classified research design to five groups as follows: Experimental, cross-sectional, longitudinal, case study and comparative. Selecting which type of design is appropriate for a research depends on factors such as nature of the research problem (question), the personal experiences of the researcher or sometimes even type of the audience the researcher is writing the research for.

The thesis identifies the risks associated with construction projects in Iran, the risk management process and influences of contingency theory on this process. Considering the design types proposed by Bryman (2004), this thesis does not undertake experimental design because it is not going to evaluate the effects of any variation or intervention on other objects under any experiment. The thesis is not using longitudinal design either because of the matter of time. The risks and risk management process are being considered at this point of time in Iran and the researcher does not have the plan to observe these risks and processes over long period of time. And finally, it is not even comparative design as there is only one case in the thesis which is not going to be compared with any other specific contrasting case.

Research designs adopted for this research are cross-sectional and case study designs. As defined by Bryman (2004) “a cross-sectional design entails the collection of data on more than one case and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables which are then examined to detect pattern of association."

Therefore, the design of the thesis is cross-sectional because at this point of time, people from top levels (of three categories of client, contractor and consultant) are selected and their knowledge and experience are evaluated. Data are collected about construction risks in environment of Iran and risk management process; moreover, their interaction with the contingency theory is examined.

The thesis is also employing case study design and 'Iran' has been chosen as its case study. As it has been defined by Robson (2002, cited in Saunders *et al*., 2003, p. 145), case study is "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence." For this thesis, the specific phenomenon being risks related to construction projects in environment of Iran are investigated using available data and people.

The case study design, like any other design type has got strengths and weaknesses and may be selected as a research design type depending on the nature of the research questions. Below there is a discussion on the rationale for the choice of case study design followed by the reasons for selecting Iran.

3.2.2.1. Case study design

Authors have written much about case study, its pros and cons as a research design, the research strategies which can be used with case study, and there are even misconceptions existing related to case study. As the knowledge about case study has been improved and more authors have researched about it, it is shown that some of these misconceptions are not true anymore which are discussed below.

There are different opinions about research strategies which can be used in case study; some authors such as Ragin (1989), Creswell (1994) and Stake (1995) are assuming it should just include qualitative methods whereas others like Lee (1999) and Yin (2003) are supposing quantitative methods usage. Case study strategy mainly gives emphasis to qualitative methods as it is a thorough study about one or small number of cases, but it can also cover quantitative data. Therefore, empirical data which is focus of case study can be quantitative (objective), qualitative (subjective) or combination of both.

Biased view of the case study has been criticized, but as recent research shows; researcher's prejudice and bias may influence some of other research designs or even data collection methods and not only case study. Rosenthal (1966) believes in presence of bias in experiment, and also Sudman and Bradburn (1982) consider bias to be influential in questionnaires for surveys.

Some of the authors consider lack of reliability as one of case study's disadvantages saying it is poorly documented. When the researcher wants to replicate the research or when other investigators want to study more about the same phenomenon, they should all reach to the same findings. However, as Yin (2003) recommends, developing a database for the case study during the data collection phase can be beneficial to overcome this misconception.

Therefore, as the results of recent research show and in protection of case study as a strong research design in reality, it should be emphasized that bias is not just associated with this research strategy. The criticism of reliability and validity of the results from case study design is based on misconception of bias, so it totally depends on analysis skills of researcher to maintain the objectivity (Smith, 1990; Brown, 1998).

As the construction risks and the risk management process were about to be investigated in a country with specific environment, there was a need for a case study design in order to select a case and implement the research on. Iran has a particular situation; it provides the environment in terms of politics, economy, social and cultural settings and it is the nature of that setting in relation to the external world and current issues such as UN sanctions which are producing this situation. All sectors of economy are affected by this situation including the construction sector and this specific situation of the country makes it a good case study particularly when it comes to the concept of risk management. Hence, Iran is the case study and the focus is on a specific sector of economy which is construction and more specifically the public projects. The client, contractor and consultant are three key categories of actors in this sector and thus are only a part of it and their thinking and the way they interact around risk management and contingency are also studied. Therefore, the unit of analysis - the main entity being analyzed in the study – would be the public sector construction projects and the study focuses on finding out the risks associated with these projects and how they are managed. Below there is an explanation about the characteristics of the country and the construction projects there, covering the reasons for choosing Iran as an appropriate case for this thesis.

3.2.2.2. Iran: chosen case study

Figure 3.4 Map of Iran (United Nations, 2004)

Iran (Persia) is located in southwest of Asia, Middle East. It is bordered on the west by Turkey and Iraq and on the east by Afghanistan and Pakistan. It borders the Persian Gulf and Gulf of Oman in the south and Turkmenistan, Caspian Sea, Azerbaijan and Armenia in the north. The total area of Iran is nearly 1.65 million square kilometres and the population is around 70 million. Iran can be considered as a country which has oil-based economy and is ranked among the world's top three holders of natural gas reserves and oil reserves. Oil sector is providing around 85% of the government revenue and other economic sectors can be named as natural gas, agriculture, construction, petrochemical, automobile, and manufacturing (Library of Congress, 2008).

Construction industry can be considered as one of the important sectors of economy; has a great contribution to development and can also be considered as an engine of economic growth through forward and backward linkages in the economy. According to the annual report published by Central Bank of Iran (2009), during 1971-2000 (30 years) 33% of the total investment was in construction and housing. As stated by Lopez (1998), the investment in construction sector is a major driver of the economic growth since it increases the demand for other industries such as steel, cement, electronics, and machinery. Moreover, the construction's wider significance to the economy can be referred to its products and services which generate substantial economic benefits and also building of workplaces in which other businesses operate (UK Construction, 2013). Statistics published by Global Market Information Databases (GMID) (2011) demonstrate that over the period of 1995-2009, the construction sector of Iran has contributed about 17% of country's Gross Domestic Product (GDP).

There are construction projects of various types all over the country, although the numbers and types may be more specific in particular cities. Tehran, as the capital of the country, has a great number of projects being executed. A great portion of projects are then distributed over the capitals of provinces and other large cities; however, the ratio and type of project may be different in some cities due to the specific situation there such as great number of projects being executed in Asaluyeh due to its massive oil and gas resources, Kish as a tourist attraction, and Chabahar due to its significance in international trade (Avazkhah and Mohebbi, 2010).

The construction industry of Iran has faced difficulties especially in recent years. Social, economic and political aspects of the country are considered in more detail to justify the selection of Iran as a suitable case study for this thesis.

❖ *Social*

Iran is the researcher's home country which can be considered as a great opportunity for collecting the required data about the environment. It was much easier for the researcher to stay in the country for a longer time comparing to any other country in terms of accommodation, duration of residency and cost.

Another factor increasing the possibility of conducting the research in Iran was familiarity with the country's condition, society and people. Knowing the culture and language made communication with people and reviewing available documents much easier and more reliable. Moreover, working in a construction company which is the family business of the researcher, gave her the authority to find comprehensive data. Having worked there, access to different categories of people (Client, Contractor, and Consultant) involved in construction projects was more convenient. And, there are more chances of using the research and applying the results in the projects later on because the environment in which the study was done will be the place where the researcher is about to work in future.

❖ *Economy*

Economy of Iran can be considered to be sole-source and based on oil. Therefore, any changes in price of oil can have direct and intense influences on economy of the country. Iran has been long subject to different US economic sanctions since the crisis of US embassy hostage in Tehran in 1979. Except from recent unilateral sanctions of the US which applies pressure on other countries and companies to limit business with Iran, other sanctions introduced by UN and more recently by European Union have adversely affected the economy of Iran. Concerns about Iran's nuclear program and support for terrorist organizations have caused these sanctions which have subsequently resulted in sharp decreases in purchases of Iranian oil and Iran's isolation from international relations. As reported by Congressional Research Service (2013) "Iran's oil exports have declined to about 1.1 million barrels – less than half of the 2.5 million barrels per day Iran exported during 2011." Therefore, due to Iran's dependence on oil export revenues, the economy of the country is suffering from high level of instabilities because of the recent sanctions (Ilias, 2008).

Unstable economy has resulted in fairly high inflation and price fluctuations. Apart from dependency on the oil revenues, principal factors for high inflation can be considered as liquidity growth and also dependency of central bank of Iran on government. One other significant factor resulting in inflation in Iran is inappropriate management of oil revenues by which expansionary monetary policy is practiced causing the liquidity growth and dependency of central bank (Dehnavi and Taherian, 2010).

The diagram below demonstrates the inflation rate of Iran from 1959 to 2009 (50 years):

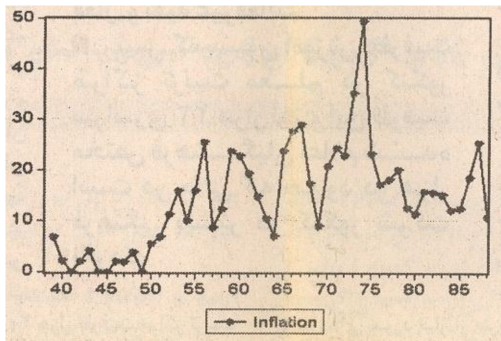


Figure 3.5 Inflation rate (Dehnavi and Taherian, 2010, p. 10)

According to the official rates provided by Central Bank of Iran, the country experienced the double-digit inflation in 1973 for the first time. As it is shown double-digit inflation rate exists in Iran for nearly four decades and except the years 1978, 1985, and 1990 high rate of inflation (more than 10%) was always present in the economy. It should be added that the duration between years 1993 to 1995 was the most unstable period of Iran's economy; and the highest rate of inflation in history of Iran was 49% in 1995 which reportedly was due to expansionary monetary policies and value reduction of the country's national currency.

As stated in the Introduction chapter, the inflation rate in 2011 has been almost doubled compared to 2010. Although the inflation rate has been announced by Central Bank of Iran to be 22.4% in July 2012; Statistical Centre of Iran announced this rate as 25.9% (*Khorasan*, 2012). Many of the Iranians believe that the real inflation is much higher than the official rate, and as discussed above many of the official organizations provide different statistics and therefore some lawmakers have accused the government for providing incorrect figures. . As reported by Congressional Research Service (2013), "The loss of revenues from oil, coupled with the cut-off of Iran from the international banking system, has caused a sharp drop in the value of Iran's currency, the Rial; and raised inflation to over 50%."

Another reason for the intense rise of inflation in recent years can be considered as the decision of government in December 2010 for phasing out subsidies on food and fuel with the intention of cutting state spending and reducing wasteful consumption. However, this is not the only reason and as reported by Al Arabiya (2012) "Prices have also been hit, indirectly, by a tightening of international sanctions over Iran's disputed nuclear program."

Existence of double-digit inflation in Iran since long time ago and the subsequent price fluctuations have definitely influenced the price of construction materials. It has led to fairly high fluctuations in material prices and even in particular periods some of the specific materials were so rare. Reviewing available documents releasing the adjustment indices of recent years, it can be realized that due to instability of economy there were strong price fluctuations within very short periods. The table below shows one row from the table of the indices for Bill of Materials (Building type) on a quarterly basis (every three months of the year) in 2008. This illustrates an example of the intense fluctuation in the price of 'Steel works (Bar)' with increase of 44% in the first 6 months followed by 43% decrease in the second 6 months of the year.

Table 3.1 Indices of Bill of Materials (Based on Iran. President Deputy Strategic Planning and Control, 2008)

Description	Fourth quarter of 2007	Quarters of 2008			
		1	2	3	4
Steel works (bar)	250.3	313.7	359.6	252.2	204.0

It can be understood how difficult it would be to manage the projects with contracts such as Fixed Price or Billed Rates - that are according to these Bill of Materials - due to intense price fluctuations which are not predictable.

Another important reason for these price fluctuations can arise from fluctuations of currency rate which as illustrated in the Introduction chapter has seen extreme changes over the last year. Fluctuations of foreign currency rate obviously have negative impacts on the materials utilized in construction industry. For example, the market indicates an 80% increase in the iron price within the last ten months because the ingot imports to Iran is drastically influenced by the foreign currency rate which therefore can disturb its supply and sale. Consequently, it can impact the market security so that the salespersons avoid supplying their goods which is considered as one of the influential factors to increase the prices. Moreover, it can be seen that prices of some of the materials such as utility systems, pumps, electronic equipment have also been doubled (>100%) (Payam-e-Abadgaran, Construction Companies Association, 2012).

As Iran is in the category of developing countries and due to the population growth, construction and housing is a need (a basic factor for development) and huge amount of income from oil is spent on construction projects. Construction industry in one of the main sectors in economy of all the countries and plays a much more important role in developing countries (Altaf, 1979). The demand exists in various sectors of construction industry in Iran, i.e. there is a need for 800,000 additional housing units every year (Iran. Ministry of Housing and Urban Development, 2009). The ratio and also absolute amount of construction projects are quite high in Iran; these factors not only make construction projects important but also present a large sample to research on.

A considerable portion of the country's annual budget is allocated to construction and housing sector and due to recent financial policies introduced by the government it has been increased from 17.5% in 2003 to more than 24% in 2006 and 28.8% in 2008 (Ghoddousi and Hosseini, 2010). Any variation and deviation in economy of the country (budget shortage) leads to a major change (in fact, decrease) in construction sector budget. Consequently, overall plans and budget allocations of construction projects will be influenced.

Considering the estimates released by Research Centre of the Iranian Parliament, during the years 1997 to 2010 on average only 74% of the planned construction budget has been allocated to the projects showing an average of 26% unallocated part (Tehrani, 2012).

According to the report released by a member of the Majlis Economic Committee; construction budget has been decreased from 44 billion Dollars (planned budget) to 32 billion Dollars (allocated budget) in 2011. Iranian targeted subsidy plan (also known as the subsidy reform plan) has been accused as one of the main reasons of decrease in construction budget allowances of recent years because the government takes the subsidies of people from the construction budget. As reported by one of the members of the Majlis Plan and Budget Committee (2012), 500 million Dollars of the money being paid to people as the cash subsidies have been taken from construction budget each month. As discussed earlier, sometimes the official rates are announced differently by various organizations and disagreements between these organizations is also an issue when talking about the economy of the country and how the budget has been used for different expenditures of the country. While some of the committees accusing the subsidies payment for shortage of construction budget; it has been denied by the chief executive officer of Iranian targeted subsidy organization and he has stated that government has not taken even 1 Dollar from the construction project's budget for the subsidies. Due to all these problems with the construction budget in the country and lack of planning, many of the scheduled projects each year remain incomplete. According to the report released by Research Centre of the Iranian Parliament in 2011, more than 19 billion Dollars incomplete construction projects exist in the country and physical improvement of more than 39% of these projects are less than 40% (Tehrani, 2012).

Because of the strong instabilities resulting in high inflation rate and intense price fluctuations over the last year and due to recent tightening of international sanctions over Iran's disputed nuclear program, it has been reported by one of the members of the Iranian's Parliament that only 25% of allocated construction budget would be realized this year (Momtaz News, 2012).

Unbalanced economy, high inflation, intense price fluctuations and budget shortages are all factors which make construction industry to be confronted with a high level of risk. These cost-related (financial) issues used to be covered more or less with various adjustment tariffs and regulations. But recently government has changed many of these rules and only a minor part of financial losses arising from economic issues are covered by the new tariffs.

- *Political*

Political instability and relatively non-democratic government in Iran has led to international sanctions to target Iran having consequences on various aspects of a country - mostly influential on economy - which was discussed in previous section. Another significant issue related to the political instabilities of the country is lack of reliable published information about the country especially regarding its economic situation. There are different reasons causing this; on the one hand there is an intensive lack of private institutions for statistics and on the other hand the principal centres for publishing this information are governmental establishments such as Statistical Centre of Iran and Central Bank of Iran which are dependent on the government. Therefore, statistics may get altered by these organizations in order to support the policies and strategies of the government and the government has been frequently accused for providing incorrect statistics and figures. This lack of reliable published information makes management of any sort of project difficult in Iran as managers do not have the required (reliable) information for making decisions. The type of Iranian government has resulted in practicing regulations less and applying individual’s opinions instead. These factors along with existing connections in society cause the lack of professional management. Moreover, in many positions managers do not have adequate authority and responsibility. Qualified managers either leave the country or work in private sectors as they are not selected for governmental positions. Presence of inexpert persons in addition to application of individuals’ opinions may result in unpredictable and personal decisions and also major changes in regulations such as cancellation of adjustment tariff for many types of projects. Existence of incompetence management for majority of construction projects can be considered as one of the principal factors for increasing the risk in construction projects in Iran. Although this sort of information rarely gets published in Iran, these can be considered as the common knowledge of residents of this country.

Having reviewed the information above, it can be concluded that significance of construction industry in economy of Iran in addition to presence of inexperienced and unqualified managers, instable political and economic condition of the country, great number of construction projects being executed and existence of high level of risk in these projects make Iran a suitable case study for this research. Finding out various risks and their interaction along with evaluation of how the projects are executed considering the country’s condition, led to some guidelines which can be used for construction projects in Iran and similar countries in future.

3.2.3. Research strategy

Research strategies can be divided into qualitative and quantitative. Qualitative strategy deals with non-numerical data which are in various forms such as words, texts, sound bites, and pictures, whereas quantitative strategy is all about numbers and numerical data, statistics and graphs. The chosen research strategy can be any of these strategies depending on the type of research questions and what is required for answering them (Saunders *et al.*, 2003).

This thesis employs mixture of both qualitative and quantitative strategies because all risks are not numerically quantifiable and moreover, this process involves people and organizations, where the intangible issues such as mentality of the people or culture of the organization play a dominant role. Therefore, combination of both strategies is used here to cover statistics (quantifiable data) and people' knowledge and past experiences (abstract data).

3.2.4. Data collection methods

This thesis, as in many research topics, uses both primary and secondary sources of data. Secondary data are data that have been collected by others previously and may provide larger and higher-quality databases which might not be possible for an individual researcher to collect on her own. Utilization of secondary data saves time and money, and can be beneficial because part of the background needed for the research has been already surveyed with a pre-established degree of validity and reliability. The researcher can re-use them without the need for re-examining them. However, using the secondary data may not be quite adequate for the research questions because they have been collected for other studies with diverse objectives (Craig and Douglas, 2000) but it can provide a baseline for a research which is about to start and be useful in designing the appropriate methodology by identifying key issues and data collection methods. Hart (2001) advocates more reasons for using secondary data namely identification of relevant work already done or in progress which accordingly prevent duplication of previous work done; avoidance of the errors related to previous research; and assistance in finding the gap in existing research which can be led to a unique topic.

A review of available literature can be considered as one of the sources for collecting the secondary data. In this thesis it included books, journal articles, online data sources and documents, and catalogues about construction projects, project management, risks associated with construction projects and risk management process.

The selected case study for this thesis is Iran and therefore more information about the country, economy and construction projects there had to be achieved. Sources used were as follows: reports such as annual economic reviews of Iran, construction and housing economic reports, economic trends reports, reports published by Central Bank of Iran about inflation rate and foreign exchange, and also documents like General Conditions of the Contract and Bill of Quantities for consecutive years. Reviewing and analysing these data was used to contextualize the case study and strengthen the arguments in research by providing both quantitative and qualitative evidence. It also helped the researcher to analyse the collected data from primary sources about this particular environment more robust and in-depth. After collecting the secondary data, previous studies were reviewed in order to select the appropriate methods for collecting the primary data.

3.2.4.1. Previous studies and their data collection methods

Having reviewed other authors' previous studies, a summary has been given below, explaining the objectives of each research in addition to the data collection methods employed for them.

Smith and Bohn (1999) have evaluated small to medium contractor contingency and assumption of risk. The objective was an Investigation into the use of contingency in construction firms. They conducted interview with 12 contractors in order to collect their required information. (Qualitative)

Nasir *et al*. (2003) have evaluated risk in construction-schedule model and developed a method to assist in the determination of the lower & upper activity values for schedule risk analysis. The study undertook usage of questionnaires and also case studies. (Qualitative – Quantitative)

Wang and Chou (2003) have examined risk allocation and risk handling of highway projects in Taiwan. They recognized risk allocation by contract clauses and analysed its influences on the contractor's risk handling strategies. Data were collected from different sources including case studies, documents, interviews and observations. (Qualitative)

Wang *et al*. (2004) have developed a risk management framework for construction projects in developing countries. Collecting data was done via posting 400 hardcopy questionnaires to selected companies, with only 31 valid replied being received. (Quantitative)

Arditi and Chotibhongs (2005) have evaluated the issues in subcontracting practices and investigated the working relationship between subcontractors and general contractors from the point of view of subcontractors, general contractors and owners. The method used was questionnaire comprising three different types of questionnaires to be filled by three different categories of participants. (Quantitative)

Cruz *et al*. (2006) have considered downside risks in construction projects developed by the civil service in Spain. They aimed at improving the efficiency of the construction project management processes. Data collection methods were distribution of 280 questionnaires where 56 valid responses were received and also conduction of interviews. (Qualitative – Quantitative)

Zou *et al*. (2006) have identified key risks in construction projects, considering life cycle and stakeholder perspectives in Australia. Required data were collected using questionnaires, being distributed to 60 construction practitioners in Australia and receiving 22 valid responses. (Quantitative)

Tang *et al*. (2007) have studied risk management process in the Chinese construction industry to investigate this process from the perspective of project participants. They distributed 115 questionnaires to different groups of people in different cities in China. After completing the questionnaires they conducted interviews with participants. Case study was also used as another method for considering the risk management practices in Three Gorges Project which is one of the largest projects being undertaken in China. Moreover, they made use of direct observation and evaluation of published project documents. (Qualitative – Quantitative)

Sonmez *et al*. (2007) have done a study on determination of cost contingency in international projects and focused more on determining the financial impacts of risks during the bidding phase. They used questionnaire as a mean of collecting data and sent 48 questionnaires to international Turkish contractors. (Quantitative)

Gunhan and Arditi (2007) have studied budgeting owner's construction contingency and have proposed a methodology for budgeting contingency funds. A case study was conducted in nine parking lot projects for analysing the contingencies budgeted. (Qualitative)

Liu *et al*. (2007) have studied key issues and challenges of risk management and insurance in China's construction industry. For collecting the data, 150 questionnaires were sent to different groups of people via e-mail, mail and fax and 37 were selected out of the 41 responses being received. (Quantitative)

Hassanein and Afify (2007) have investigated contractors' perceptions of construction risks and their attitudes towards risk identification and management. The data were collected from distributing questionnaires and also various types of documents such as bid evaluation report, tender documents. (Qualitative – Quantitative)

Adams (2008) has researched on construction contract risk management and practices in the United Kingdom. He assessed usage of available techniques for identifying and analysing risk and their appropriateness. He used questionnaires, distributed 160 copies and received back 29 responses. (Quantitative)

Perera *et al*. (2009) have done a research about risk management in road construction in Sri Lanka. The aim was to find out more about risk responsibilities of contractual parties and improving risk handling strategies. They adopted multiple case studies approach for validating the result through replication and therefore focused on two road projects. They also used multiple sources of evidence including semi-structured interviews, documents such as various reports, bill of quantities and archival records. (Qualitative)

Panthi *et al*. (2009) have undertaken a research on contingency estimation for construction projects through risk analysis. They developed a methodology for contingency estimation that incorporates risk assessments. Distributing questionnaires, conducting interviews and acquiring cost estimates or bill of quantities of the projects were methods of collecting data. (Qualitative – Quantitative)

Figueiredo and Kitson (2009) have done an investigation on defining risk and contingency for pipeline projects and have used questionnaires for data collection. (Quantitative)

Liu and Low (2009) have undertaken their research on developing an organizational learning-based model for risk management in Chinese construction firms and established a conceptual framework linking organizational learning with risk management. They distributed 38 questionnaires to Mainland China and Singapore. They also conducted case studies and 15 semi-structured interviews. (Qualitative – Quantitative)

Hallowell and Gambatese (2009) have done a research on construction safety risk mitigation and determined the relative effectiveness of safety program elements by quantifying individual's ability to mitigate construction safety and health risk. They have done so through collecting the data via distributing questionnaires. (Quantitative)

Studies reviewed above were all researching about construction risk in different countries, from various parties' perspectives and also the risk management processes applied for managing those risks. For finding out more details about the projects and the country (environment) in which they were taking place, various data collection methods were used. Predominant methods employed were questionnaire and interview which sound quite appropriate for investigating knowledge, experience and opinion of people involved in construction projects. Having reviewed these studies and their data collection methods, the selected methods for this thesis are explained below.

3.2.4.2. Chosen data collection methods: Questionnaire and Interview

The primary data were collected directly from the involved people in construction projects in Iran via distributing questionnaires and conducting semi-structured interviews. With self-completion questionnaires, respondents can conveniently answer the questions by completing the questionnaires themselves, with absence of researcher's influences. In semi-structured interviews, interviewer has got the opportunity to ask follow-up questions (depending on what interviewee might say) and has some instructions which are not seen by the interviewee. Moreover, interviewer can record any observation about the process of the interview and attitudes of interviewee (Trochim and Donnelly, 2008).

The questionnaire was designed based on the knowledge obtained from reviewing the literature, available samples and according to the research questions and required data for answering them. Additionally, emails were sent to the authors of the papers in which questionnaire was used as a method for collecting data and samples were asked from them. Not all the authors replied but few samples were received and among all, two were found to be quite useful for designing the questionnaire for this thesis since the rest were focused on specific parties or project types. For instance, the questionnaire sent by Arditi and Chotibhongs (2005) focuses on issues in subcontracting practice and is therefore dealing with differences between contractors and subcontractors and the issues they may have in a construction project. Another example can be referred to the questionnaire which was received from Panthi (2009) related to the paper he has written with his colleagues on contingency estimation for construction projects through risk analysis which focuses on power projects and the questions are related to risks associated with this type of construction project. Other samples were similar and mostly focused only on risks related to construction project but had no information about risk management strategies. However, the questionnaire received from Wang used in the paper written by himself and his colleagues about risk management framework for construction projects in developing countries (2004) was found to be the most comprehensive one compared to others. It focuses on the identification and evaluation of risks associated with construction projects and their mitigation strategies which is quite similar to the objectives of this thesis. Moreover, the questionnaire was used in developing countries in Asia and therefore more similarities can be found between the countries which were aimed at in Wang *et al*.'s study and this study which is about Iran. Therefore, the overall structure of the first two sections of questionnaire for this study followed the structure of this sample including the terms used as evaluation measures such as 'criticality' for risks and 'effectiveness' for mitigation strategies. Although these terms are predominantly used in the literature on risk and its management, the rational to use them in this study's questionnaire was to follow the structure of a questionnaire which had been distributed in other countries before and had resulted in a clear understanding for participants regarding what the researcher means by these terms in relation to risk and its management strategies. However, some amendments were made in the questionnaire in order to make it stronger, i.e. combining two risks together under one broader heading where both were pointing at very similar risks and there was a probability of confusion for the participants; adding more mitigation strategies for specific risks.

There was also another section “agreement with the proposed statements” which was added to the questionnaire based on the sample received from Sonmez (2007) used in the paper about determination of contingency for international construction projects during bidding phases. This questionnaire was also found to be very widespread, covering various aspects of construction projects in its statements and was not focusing on any specific country or type of project. Similar to the previous sample used, amendments were made on these statements, i.e. deleting the repetitive statements, grouping together the statements related to similar concept.

As discussed earlier, research is going to be done in Iran. Culture plays a dominant role in any environment in which the research is about to be done. In Iranian culture, talking about risk is talking about something dangerous which should be prevented. According to Avazkhah and Mohebbi (2010), project risk is an unpredictable event should it occur will have negative influences on the project objectives; causing delay, suspension or failure of the project.

Due to the existing culture in Iran and also what is defined in majority of the books and articles about risk in Iran, perception of risk in people’s minds are more or less similar and in agreement with the definition presented above. They mostly believe that risk is a negative and bad event that may either happen or not (there is no chance of something positive to happen when talking about risk). Therefore, because of the predominant perception about risk in Iran, questionnaire is designed based on only the negative consequences of risk (a copy of the questionnaire is available in Appendix D). Considering both positive and negative consequences of risk in the questionnaire and interview would be problematic for this case study since the researcher might have to suggest the answers to participants while explaining positive consequences of risk to them. Hence, although the literature in previous chapter covered both positive and negative consequences of risk, it is important to clarify that the word ‘risk’ in this thesis from now on is referred to the negative consequences of the unforeseen event which is usually called threat.

The questionnaire was divided into 5 main sections as follows:

1. *Construction risk:* 25 risks were listed in a table with a short description and a 1-5 scale (Low to High) for each showing their criticality which respondents had to rank and choose a number for them depending on their opinion and experience. A preliminary categorization for the risks was proposed by the researcher and the risks were allocated to these categories in order to be able to analyse the risks and their interactions after data collection. The five main categories were as follows: Political and Governmental, Cultural and Social, Economic and Financial, Managerial and Technical, and Natural. And, the 25 risks were: approval and permit, change in law, justice enforcement, government influence on disputes, corruption, expropriation, political instability, cultural differences, human resource, cash flow, foreign exchange and convertibility, inflation and interest rate, cost overrun, inadequate design, low construction productivity, site safety, late payment, inadequate quality control, inadequate project management, environmental protection, public image, intellectual property protection, force majeure, market demand, and competition. In order to offer respondents a time to think independent before reading the provided list of risks, an empty table was given in the first page of the questionnaire asking them to write the important construction risks and rank them according to their experience. And after that they were guided to the next page which was the list of risks explained above.

2. *Effectiveness of risk mitigation measures:* as it was only the negative risks listed in the questionnaire, the strategies provided for managing them were only mitigation measures. Different measures provided more or less covered the existing categories of responses for the negative risks discussed in previous chapter. One or more measures were suggested for each of the 25 risks and again with a 1-5 scale (not effective at all to very effective) for each measure so the respondents can rank the effectiveness of each according to the environment of Iran.

3. *Agreement with the proposed statements:* in the third section a table was given including statements about construction risk and risk management with a scale of 1-6 (1-5 from strongly disagree to strongly agree and 6 for the option of do not know).

Every few statements were grouped together comprising following topics: risk management, insurance, finance, politics and government, experience / communication between parties, market / material / human resource, construction site, contract, project bidding, and time.

4. *Personal information:* in order to compare and contrast different respondents, their opinions and answers after completing the questionnaires; their personal information were asked. This section started with an ID allocated to each respondent in order to pursue their files later on. The rest contained information about respondents' name, company, address, telephone number, fax, email, job title, gender, approximate years of experience, average number of company employees, average annual turnover, and finally whether they had worked in other countries or not. The job title was divided into three main categories of client, contractor and consultant with each category being sub-divided into more detailed professions.

5. *Company information:* last section dealt with practicing risk in the company, number of risk managers, the communication between those and other employees and the overall risk management strategy of the company.

A general question was proposed after all these sections asking the respondents to rank the suggested risk groups from 1 to 8 (least severe to most severe) according to their experience. And finally, the questionnaire ended with asking the respondents whether or not they are willing to participate in the interviews.

Pilot testing was applied to check whether or not the content of questionnaires is clear and then these were distributed among managers of three categories of actors in construction projects (client, contractor, and consultant). These were completed to find out more about criticality of risks in construction projects, effectiveness of mitigation measures and respondents' experience, opinions and details.

Semi-structured interviews as the other method for collecting the required data were conducted only with those respondents who had mentioned their interest and availability for the interview while completing the questionnaire. The interviews consisted of 10 questions asking the participants more about the types of projects, construction risks, their risk management strategies, implementation of contingency plans, learning process, relationship with other involved parties in any construction project, and their suggesting mitigation strategies for the risks which they believed were more critical. (Interview questions are available in Appendix G)

3.2.4.3. Sample size

The decision about the sample size depends on a number of considerations and there is no one definitive answer, and is mostly affected by considerations of time, cost and the problem of non-response. The number of the samples in this thesis was one hundred to be completed by three main categories of people involved in construction projects as follows: client (employer), contractor, and consultant. Definition of each of these groups as provided in the General Conditions of the Contract (2010) in Iran is as follows:

Client: is a legal person who signs the construction contract and assigns the contract activities to contractors based on the contract's documents. Legal representatives and substitutes of client are tantamount to client.

Contractor: is a legal or real person who is the other side signing the construction contract and has accepted the responsibility for execution of contract activities based on the contact's documents. Legal representatives and substitutes of contractor are tantamount to contractor.

Consultant: is a legal or real person who is introduced to contractor from client's side for supervising the execution of the work within the authorities appointed to them in the contract's documents.

It was decided to distribute the questionnaires to these three groups in order to gain an insight into different perspectives and perception of risks and types of risk they are affected by depending on their tasks and responsibilities in a construction project. The number of questionnaires to be completed by these three categories was decided to be 100, and with the estimation of the response rate to be more than 70%, it was considered to be adequate to represent the opinions and experiences of involved parties in construction projects in Iran.

According to the existing regulations in Iran, clients do not have any limitations in number of construction projects being executed by them at one single point of time, whereas consultants can have maximum of 6 projects in any specific type concurrently (50 types are available), and this number is decreased to maximum of 3 projects for the contractors in any type (10 types are available) (Iran. President Deputy Strategic Planning and Control, 2011). It can be concluded that the number of contractors who are executing the construction projects at any single point of time is more than consultants, and consultants more than clients accordingly. Therefore, the number of questionnaires distributed between these three groups had the same ratio and were completed more by contractors followed by consultants and then clients (number of questionnaires distributed to participants were 50 to contractors, 30 to consultants, and 20 to clients). The exact number of each of these categories (population) is not easily accessible especially since the number of governmental organizations and also division of projects into various types change frequently. A brief explanation has been provided below for each of the categories regarding their approximate population.

Client: Iran has 18 ministries, each having central organizations in 31 provinces of Iran, and more regional organizations in the cities. Additionally, there are municipal organizations and utility companies all over the country and any of these organizations and companies can own and execute a public construction project.

Before explaining the population for two other categories, existing regulations regarding their variety should be clarified. Contractors and consultants can obtain distinct grades - ranging from 1(the best) to 5 – for different types of projects which their company can execute. Although the process is quite complicated; the grades are given to them by the President Deputy Strategic Planning and Control based on three main factors: 1) financial viability of the company 2) certificates and qualifications of stakeholders, managers, and staff 3) resume of the company i.e. number of projects they have executed and monetary value of the projects.

Contractor: there are 10 types of projects available for them which any contractor can get a grade (1 to 5) in any of the types they have the qualifications for. Therefore, there may be one contractor who has different grades in different project types and this is the reason why the exact number of contractors cannot be determined since there may be common contractors under the list of different types and it is not easy to exclude the common ones while checking the number of them in any specific type. Only the contractors with the grades of 1 to 3 (qualified for different project types) were selected for this study and the approximate number of them can be defined here by examples: number of contractors with grades of 1 to 3 in Power projects is: 93, Water projects: 273, Mining and Industrial project: 57. It is recalled that there can be common contractors existing in these numbers.

Consultant: there are 50 types of projects available for this category and the explanation is same as contractors for determination of their exact number. Examples for the approximate number of consultants with grade of 1 to 3 in different types can be referred to Road projects: 91, Water and Sewerage projects: 108, Oil and Gas projects: 27 (Iran. President Deputy Strategic Planning and Control, 2011).

Apart from selecting the participant from these three groups, some other points were considered about the projects they had done or were executing at that moment:

- ❖ Parties who were involved only in governmental projects (Public sector): Private sector was excluded in this thesis because of following reasons:
    - Proportion of private projects compared to governmental projects and also their sizes are small, private sector in Iran has not grown as much as public sector and huge capital sums are rarely invested in private sector. Majority of the building sector and construction projects are inclusive to government
    - Specifying the boundary for particular private projects is not easily feasible due to their nature. In Iran, there are ministries, central and regional organizations, municipal organizations and utility companies where each can run different types of public sector construction projects (as clients); and contractors/consultants with different grades cooperate with these governmental organizations. Therefore, although project sizes differ, there are selection criteria for choosing public projects for a study i.e. defined project types, registered grades of contractors and consultants, categorized types of client's organization. However, these specifications cannot be defined for the private projects; considering a small house being built by an individual and a massive shopping mall being built by a big company with non-governmental financial budget, both go under the private sector construction projects' category. Hence, defining the selection criteria for private projects would be very difficult compared to public projects

- Many of the risks which are very important in public projects and influence them significantly; influence private project much less. Example can be referred to financial resources of a project where can be provided much easier for a private project since the resources belong to individuals and private companies whereas it may be provided with delay for public projects or sometimes not even provided in case the budget of the country faces issues

❖ Parties involved in various types of project in public sector such as building, dam, highway and road, industrial, oil and gas, power, utility, water and sewerage, installation

❖ Parties involved in construction projects of different cities in Iran in order to cover various regions as much as possible and evaluate the specific risks which may be more influential in the projects according to the specifications of their location. Cities were Tehran (capital), Mashhad, Tabriz, Esfahan, Asaluyeh, Kish, Chabahar, Birjand, Shiraz, Kerman, Torbat, and Sabzevar

3.2.4.4. Data collection process

After completing the design of questionnaire and interview questions, they were translated to Persian (Farsi). Although majority of the managers and engineers involved in construction projects know English, it was decided to translate them to Persian (as they contain some specific words) in order to ensure everyone understands the content completely and any mistranslation by participants is prevented. The documents were revised after translation in accordance with the formal documents which are normally used in construction sector (using common jargons) in order to provide familiar literature for the participants.

Other documents accompanying questionnaires in time of handing over to participants were as follows:

Invitation to participant letter: It is a letter for inviting to participate in a research project; potential participants are informed that once they agree to participate, they remain free to withdraw at any time without any disadvantage to themselves and without any obligation to give a reason. When they decide to participate, they have to complete and return the enclosed consent form and the questionnaire provided. They are also provided with researcher's contact details so they can ask any questions or discuss the information provided before agreeing to take part in the research (a copy of it is available in Appendix A).

Participant information sheet: in this letter potential participants were provided with the information that they need to consider in deciding whether or not they want to participate in the research. It includes project title, project description, a short explanation about the interviews which may be conducted including location, duration and a sample of interview questions. Moreover, it explains how the confidentiality is preserved and the participants' data are protected (a copy of it is available in Appendix B).

Consent form: in this letter participants consent to what has been provided in other letters for them comprising confidentiality of their data and being free to withdraw at any time. They need to print their name in the form, sign it and return it back to researcher together with the completed questionnaire (a copy of it is available in Appendix C).

The approach for distributing the questionnaires was initially purposive among the people the researcher knew or had worked with them before (preliminary list); it then used snowball sampling since some of the questionnaires were distributed via the participants in the preliminary list to others, explaining them the selection criteria used for the participants of this study. After collecting questionnaires, 76 valid responses were attained with 28 of participants being interested in attending an interview and after all 24 interviews were conducted.

Questionnaires together with consent forms were archived in the researcher's office. The content of questionnaires was entered into Microsoft Office Excel file according to the code book prepared for analysing them. For interviews, it was decided to record the answers in addition to making notes. As Bryman (2004) has also stated, recording of answers keeps errors related to the interviewer to a minimum. When asking questions in semi-structured interviews, the interviewer should listen to what the interviewee is saying and maybe asking more questions depending on what they answer. Moreover, interviewer should make sure that the appropriate answer for each question has been provided by the interviewee and cannot be busy only writing without the focus on the communication. Therefore while conducting interviews, each interviewee's voice was recorded in a separate file via voice recorder and important parts were written down while s/he was talking. These files were useful in the time of analysing the data as the researcher could look for similarities and differences between different files.

3.2.5. Data analysis methods

Once the data were collected, they had to be analysed and preferably illustrated in diagrams, charts and tables.

After collecting the questionnaires from participants, a code book was prepared comprising distinctive codes for different sections of it. Data written and marked in each questionnaire was entered into Microsoft Office Excel according to the code book and using the unique ID which was provided for them before distributing to respondents. The code book contains a code for each section which was then sub-coded for the parts included in that section, and details of each section were shown in a separate sheet in the Excel file. Therefore, quantitative data were analysed using Microsoft Office Excel and SPSS (Statistical Package for Social Science). The level of criticality of the risks in construction projects, the level of effectiveness of proposed mitigation strategies and opinion of participants about various aspects of construction projects were evaluated. The results from the questionnaires demonstrated how different categories of people perceive risk while managing projects, and to what extent influences of risk are different for the three groups involved in construction projects. Results are illustrated and discussed completely in Chapters 4 and 5 (Questionnaire / Interview Analysis).

As mentioned earlier, interviews were conducted with people in Iran. Hence, the questions had to be translated into Persian language and subsequently answers and discussions were in Persian as well. For prevention of any unintentional alterations in answers of the interview questions while translating them back to English, first the interviews were analysed in Persian and then the results were shown and argued in English.

Content analysis is the method used in this thesis for analysing the content of interviews. Content analysis is a research method appropriate for analysing the documents; it uses a set of procedures to make valid inferences from text and quantify content in terms of predetermined categories (Weber, 1990). Content analysis as defined by Krippendorff

(2004) is “a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use.” However, it is not restricted to written material and may also include other materials such as images, sounds, and symbols. Content analysis is a scientific tool which involves specialized procedures; while analysing the data, this method can be used in comprehensive manners and go into further details. Therefore, it may identify body language and facial gestures in communications for extra investigations on people’s state of mind and evaluate them from psychological aspects. However, content analysis did not go into this level of detail for this study since it was rather more significant to look for specific codes being mentioned by participants and also the strategies they may undertake for managing risks than investigation on their attitude and style of speaking. Although the psychological aspect of participants’ personality and mentality is influential in their answers, the focus of these interviews was more on the expression of the codes and sub-codes.

The coding schemes created for the interviews in order to facilitate the interpretation of answers are discussed in more detail in the Interview Analysis chapter (Chapter 5).

3.2.6. Material facts

While analysing the collected data; there were some material facts which would be needful to be explained.

❖ *Questionnaire*

- Completing the questionnaires, there were some statements about different aspects of construction projects which respondents had to say their agreements with them. Statements related to “politics and government” were marked as “neutral” or “do not know” more than statements related to other topics (There were 6 options suggested for each statement which respondents could choose including: strongly disagree, disagree, neutral, agree, strongly agree, and do not know). Confidentiality of the data collected from respondents was explained for them in the participant information sheet as follows:

"The information obtained as part of this project will be treated in confidence and will not be made available to anyone else. The interviews will be recorded and stored in a voice recorder, the recordings and any notes or transcripts that you provide will be coded to safeguard your anonymity. Questionnaire results and analysis of interviews will be written up in research thesis and journal papers but they will be anonymised so that individual participants cannot be identified. All data will be stored securely and accessed solely by the researcher. The interviews will be coded with a number instead of a name."

Although they had read this information, it was assumed that they were concerned about stating their opinions frankly about political issues existing in the country.

- There was a question at the end of questionnaire as follows:

From your experience or perspective, how would you rate the Risk Groups (A to H) with respect to severity? (Least Severe = 1 and Most Severe = 8)

A. Political/Government Level Risks [ ]

B. Risks associated with rules and contract [ ]

C. Project Finance and Cash Flow Risks [ ]

D. Construction and Design Risks [ ]

E. Sociological and Environmental Risk [ ]

F. Managerial Risks [ ]

G. Force Majeure [ ]

H. Macro/Market Level Risks [ ]

Majority of the respondents had rated these sentences with repeated numbers, rating couple of sentences with the same number. For example there were answers like this:

A. [7] - B. [7] - C. [8] - D. [4] - E. [1] - F. [8] - G. [1] - H. [8]

This was not what the researcher was expecting from this question, each number has to be allocated to one sentence only. Although the questionnaire was tested before distributing to all the respondents and everyone had answered this question correctly; it seems that the question was not clear for others. Maybe this ambiguity could be solved by adding this explanation at the end of the question: Use each number only once

Because the number of responses which were not valid for this question was quite high, this questions was completely removed in analysis.

❖ *Interview*

- Although the structure of the interview questions was evaluated, there was a question which was still a bit ambiguous for the participants while conducting the interviews.
  Question 3: Regardless of type of the project, what are your broad organizational processes and policy documents which may create risk?
  The participants were confused on what exactly the researcher is looking for by asking this question, and because of giving hints to them, the answers for this question should be treated carefully while analyzing.

3.2.7. Reliability and validity

This section is dealing with consistency of the results over time and determining if what was planned to be measured by the research has been truly measured. Applying triangulation method in this thesis has been employed for increasing the reliability and validity of the results and greater confidence in findings. Triangulation, originally conceptualized by Webb *et al*. (1966), involves employing more than one method or source of data while studying social phenomena. Using two different methods, questionnaires and interviews, in addition to analysing secondary data strengthen the research findings.

3.2.8. Ethical considerations

In the context of research, ethics refers to the suitability of the behaviour of the researcher in relation to the rights of those who become the subject of the work or are influenced by it. Cooper and Schindler (2008) define ethics as the "norms or standards of behaviour that guide moral choices about researcher's behaviour and relationships with others."

Ethical principles were applied in this thesis in order to prevent ethical issues, because people were involved in questionnaires and interviews and the researcher's behaviour with them was important. Participants were assured that their information is kept confidential, they have the right to withdraw at any time and everything is with their consent, there is no deception and they were informed about every single step. Ethics application was approved by Quality Assurance before the actual data collection starts.

3.3. Conclusion

In this chapter, the research methodology undertaken for answering the questions of the thesis was discussed comprising the rationale for the research approach adopted, chosen research designs followed by the reasons for selecting Iran as the case study, and chosen research strategies. It was then continued with discussion on data collection methods and data analysis methods; and finished with providing explanation about material facts and ethical considerations.

The next Chapter, Data Analysis, discusses the quantitative (questionnaire) analysis of the collected data in-depth using the secondary contextual data. The tables and diagrams illustrating the results of data analysis are also shown in next Chapter.

4 – Data Analysis: Questionnaire

4.1. Introduction

Previous Chapter, Methodology, discussed the research methodology undertaken for this research including research approach, research design, Iran as the chosen case, research strategies, data collection methods and data analysis methods.

This Chapter, Questionnaire Analysis, is the first part of the data analysis which deals with the quantitative data. Results of different sections of the questionnaire are shown in tables and diagrams and explanations are given for each. Moreover, discussions are provided concerning the specifications of the environment and differences in the three groups of participants completing the questionnaire. It should be remembered that analysing the data from questionnaires is quantitative and analysing the interviews is qualitative which is given in the next Chapter, Interview Analysis.

4.2. The structure of the questionnaire

As discussed in the Methodology chapter, the questionnaire has been divided into five main sections:

1- Evaluation of the criticality of 25 risks
2- Evaluation of the effectiveness of the mitigation strategies suggested for these 25 risks
3- Evaluation of the level of agreement with construction project related statements
4- Personal information
5- Company information

A copy of the questionnaire has been provided in the Appendix D, and if necessary some sections of it are shown in the chapter to avoid any ambiguities while discussing the details. The results extracted from each of these sections listed above are explained below together with their related diagrams and tables to illustrate the results clearly. Apart from the environment (Iran) and its specifications (discussed in the Methodology chapter) which influence the results; the questionnaires have been completed by three different groups involved in construction projects that may have different opinions depending on their perspectives and responsibilities. Therefore, although the definitions of these groups have been provided in the Methodology chapter, they are repeated below once again to distinguish their differences.

As defined in the General Conditions of the Contract (2010) in Iran:

Client: is a legal person who signs the construction contract and assigns the contract activities to contractors based on the contract's documents. Legal representatives and substitutes of client are tantamount to client.

Contractor: is a legal or real person who is the other side signing the construction contract and has accepted the responsibility for execution of contract activities based on the contact's documents. Legal representatives and substitutes of contractor are tantamount to contractor.

Consultant: is a legal or real person who is introduced to the contractor from client's side for supervising the execution of the work within the authorities appointed to them in the contract's documents.

More explanations are provided for each of these groups regarding their responsibilities while discussing the results. While there are different numbers of people in each group, the overall number of participants returning valid questionnaires is 76.

4.2.1. Personal information

Although this section is the fourth section in the questionnaire, it is analysed first to clarify what types of participants have completed the questionnaires.

A unique ID was written by the researcher on each questionnaire (before distributing) for keeping a record of the names of participants and also making the analysis more structured. Data written in sections of name, company, address, telephone number, fax and email are kept confidential and were only for the researcher's use for contacting the participants if necessary. Job title was divided into three categories of Client (Employer), Contractor, and

Consultant with further sub-categories for each. Due to the diversity of sub-categories, only the frequency of three main categories was considered. As it is shown in figure 4.1, there are 41 contractors, 24 consultants and 11 clients who have completed the questionnaires.

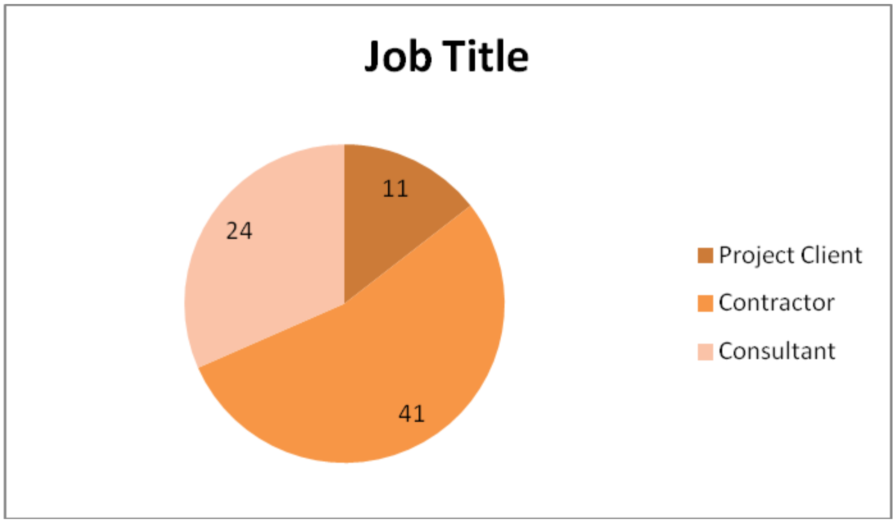


Figure 4.1 Number of participants in each group

The proportion of these groups (more contractors followed by consultants and then clients) was planned on purpose due to the existing regulations in Iran that determine the limitations of these groups for executing construction projects at any single point of time - the discussion was provided in the sample size section of Methodology chapter.

Division of gender for these 76 participants is:

Table 4.1 Division of gender

Female	11
Male	65
Total	76

The approximate years of experience is illustrated in figure 4.2. As it is seen, more than 50% of the participants have at least 10 years of experience working in construction industry.

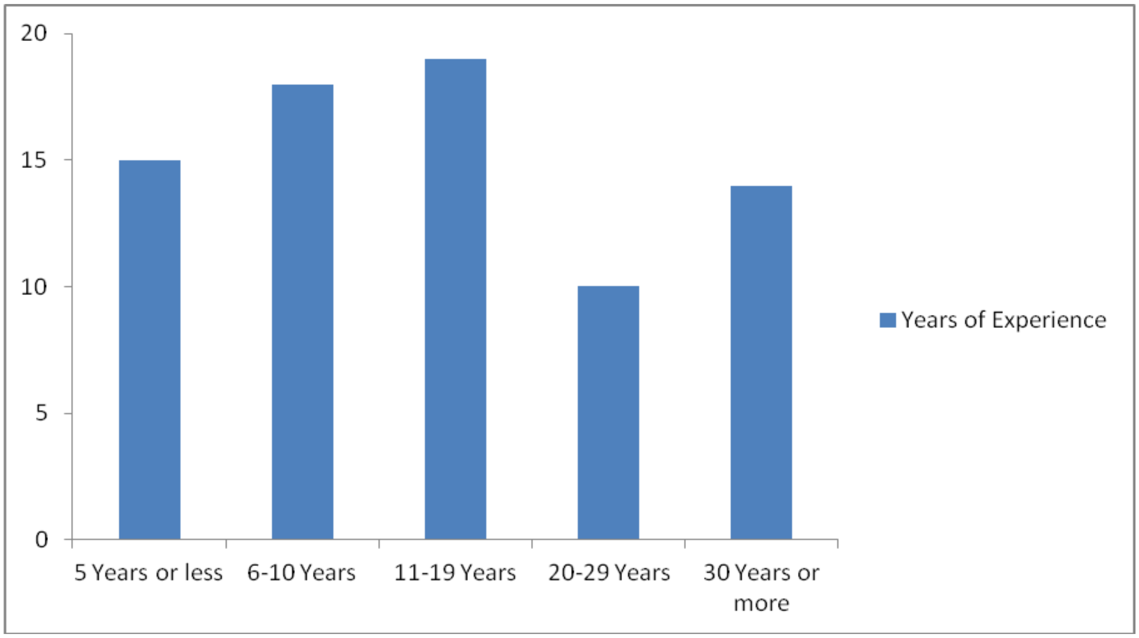


Figure 4.2 Years of experience

Having a great number of participants with more years of experience can be considered as a good point for analysing a concept such as risk. This concept as an intangible and subjective concept cannot always be numerically quantified and therefore knowledge and experience of people managing it are so valuable to be evaluated.

The average number of employees and also the annual turnover, shown in figures 4.3 and 4.4, demonstrate the size of the companies and consequently the size of the projects these companies are executing which require all these employees. Since the management process is being investigated in this thesis, the larger the number of employees to be managed by participants and also the greater number of projects being executed by them resulting in larger annual turnover determine the higher level of their management capabilities.

And, the last question in this section has been answered as 'No' by all the participants; none of the 76 respondents have the experience of working on construction projects in other countries except Iran.

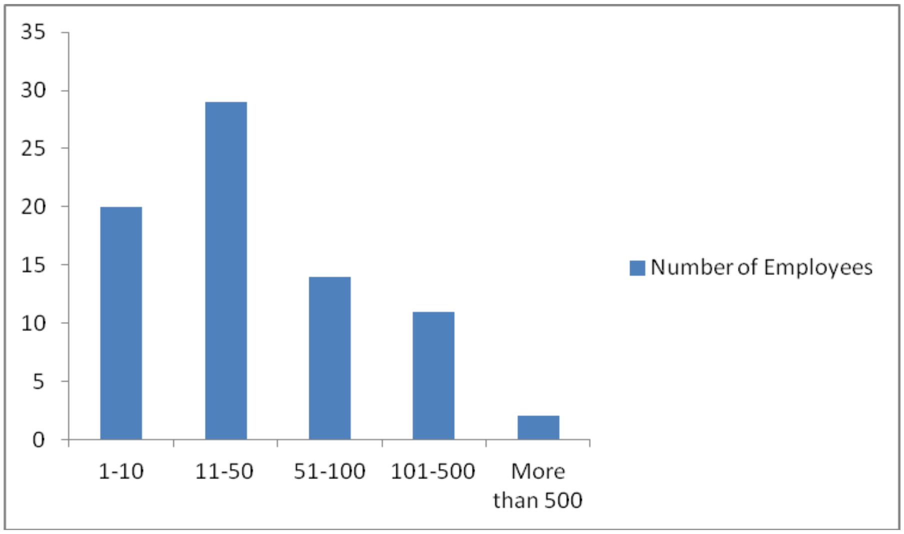


Figure 4.3 Number of Employees

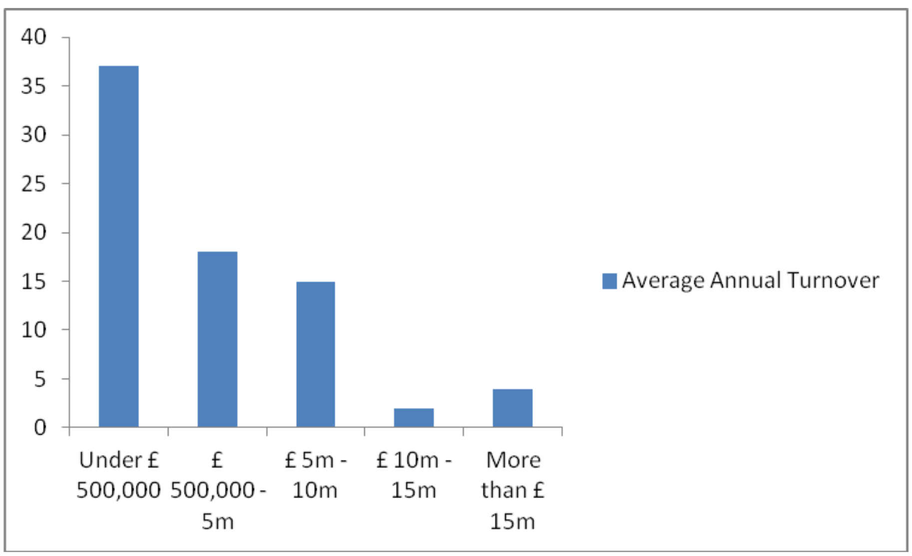


Figure 4.4 Average annual turnover

4.2.2. Company information

The information about the company is the last section in questionnaire but is analysed before the first three sections in order to determine the specifications of the participants' companies.

The number of expert risk managers in the participants' companies has been demonstrated in figure 4.5, showing that nearly 58% of the companies have no risk manager at all.

Although these are mostly top grade companies executing major government projects, they do not have expert risk managers for their projects. This represents the existing culture in Iran about the concept of risk in projects and lack of knowledge about the formal risk management process.

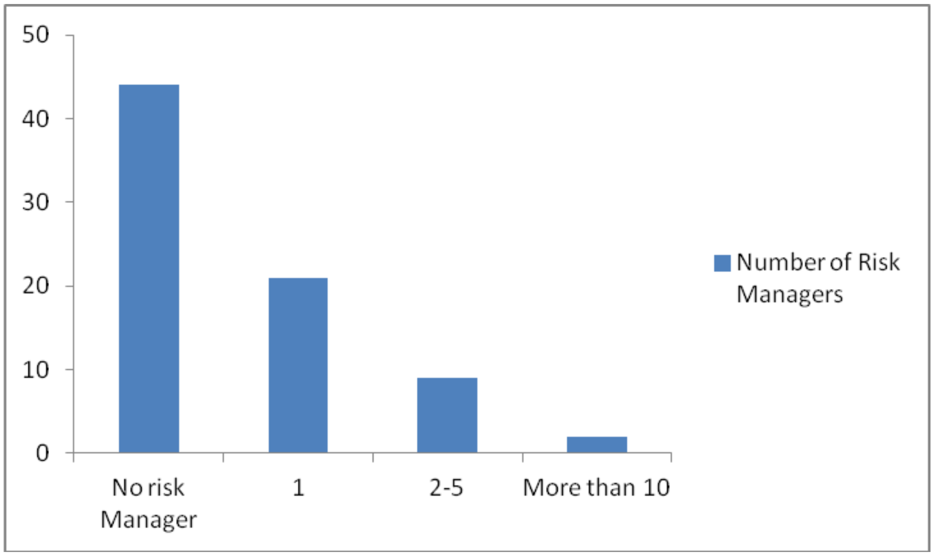
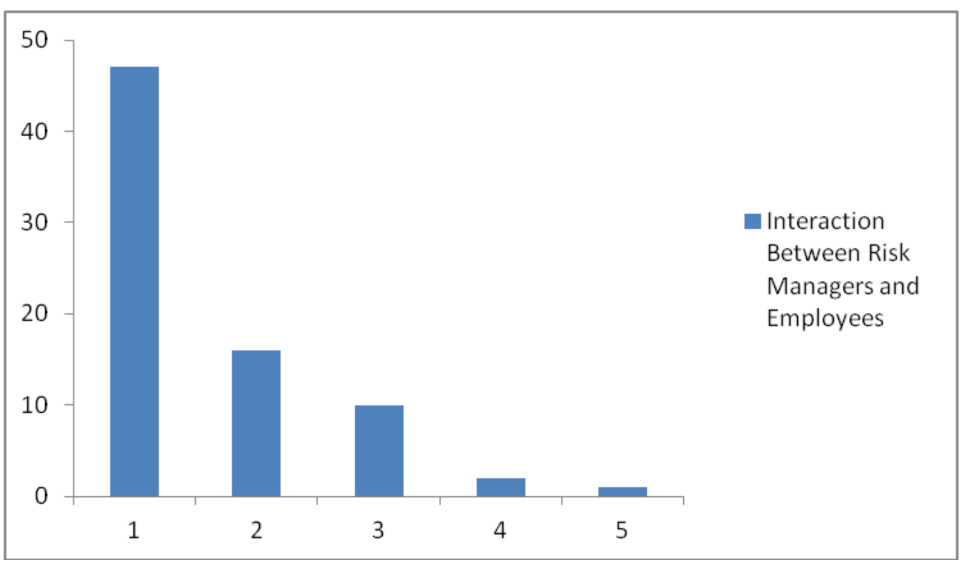


Figure 4.5 Number of Risk managers

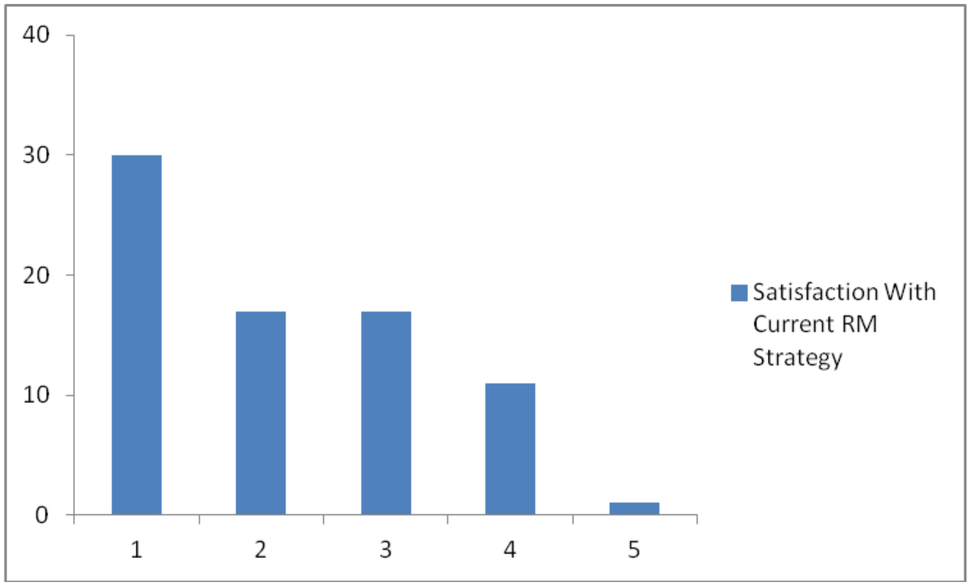
Figure 4.6 illustrates the interaction between the risk managers and other employees in the company. As it is seen, almost 62% of the companies which have risk managers asserting that there is no interaction between the risk manager and other employees.



1 = No Interaction at All 5 = Very Strong Interaction

Figure 4.6 Interaction between risk managers and employees

Considering the last question in this section, figure 4.7 demonstrates a great percentage of participants' dissatisfaction with the prevailing risk management strategy of their company:



1 = Not Satisfied at All 5 = Very Satisfied

Figure 4.7 Satisfaction with current risk management strategy

Looking at the last three diagrams, it can be concluded that not all the companies of the participants have risk managers, and even the ones having them do not consider a strong interaction between them and other employees. Moreover, the overall risk management strategy existing in the companies is not very satisfactory. All these factors establish the extent to which the risk management knowledge is known and implemented in Iran and show how the risks in the projects these companies are executing are rarely managed by risk management experts.

4.2.3. Evaluation of the criticality of 25 'Risks'

This section of the questionnaire includes 25 risks listed for the participants, asking them to rank their criticality from low to high (1-5). Before this section, an empty table was provided in the first page of the questionnaire seeking participants' opinion about the construction risks before they get involved with the provided list of risks. The reason behind this was giving the participants time to think independently (before reading the provided list because it would influence their opinion) and write whatever they consider as risk and then rank them according to their experience. Therefore, before analysing the list comprising 25 risks, the contents of the table in the first page are analysed below.

Not all the 76 participants had added risks in this table and the ones who had done so, had written and explained the risks in various statements and formats (sometimes referring to the same risk but in different wording). Hence, the content of this table had to be coded, and related risks were grouped under some general codes.

Coding for this table and also the next table including 25 risks was according to the preliminary categorization of risks provided by the researcher in the Methodology chapter.

This categorization was the result of reviewing the literature and comparing other people's categorizations added to the knowledge and experience of the researcher. Five main categories are as follows:

1- Political and Governmental (P&G)
2- Managerial and Technical (M&T)
3- Economic and Financial (E&F)
4- Cultural and Social (C&S)
5- Natural (N)

It is required to emphasize that these categories are not absolutely distinct from each other; they are interrelated and may function interdependently. Therefore, some of the sub-categories may have the potential to be fitted in two of these categories and only because a sub-category has been allocated to one of these main categories it does not mean that it is independent of other categories. Moreover, interrelation of these categories makes it occasionally difficult to allocate a sub-category to only one category especially since these concepts cannot be detached easily in philosophical contexts.

All the risks participants had added to the first table were allocated to 11 categories – these 11 categories are themselves the sub-categories of 5 main categories discussed above. Appendix E displays a table showing all these categories and their sub-categories - representative of the risks written by participants.

The frequencies for these 11 categories have been measured in order to find out the importance of the risks. All the participants who had added risks in this table had mentioned a minimum of three risks and therefore the first three most important risks are given in table 4.2:

Table 4.2 Three most important risks of the first table of the questionnaire

Risks	Rank 1		Rank 2		Rank 3	
	Count	%	Count	%	Count	%
Project Finance and Cash Flow	30	39.5				
Price Fluctuation			18	23.7		
Managerial					18	23.7

As it is seen from the table above, the categories of risk ranked as first and second by participants refer to the Economic and Financial risks, followed by the Managerial and Technical risks for the third rank. According to the discussion provided in the Methodology chapter about the economic situation of Iran and its instability, it was expected to see that influences of Economic and Financial risks are considered to have high importance in participants' opinions. The importance of managerial issues as the third risk can also be referred back to the discussion about the political situation of Iran in Methodology chapter and how it affects the management.

The investigation is now continued with the analysis of the table of 25 risks and whether there are similarities between its results and what was shown above regarding the results of the first table. These 25 risks are listed below and a short definition for each of them has been provided:

1. **Approval and Permit:** Delay or refusal of project approval and permit by government
2. **Change in Law**: Government's inconsistent application of new regulations and laws
3. **Justice Enforcement**: Lack of enforcement of legal judgment

4. **Government Influence on Disputes**: Unnecessary and unjust influence by government on court proceedings regarding project disputes
5. **Corruption**: Corrupt government officials demand bribes or unjust rewards
6. **Expropriation**: Due to political, social or economic pressures, government takes over the facility run by the firm without giving reasonable compensation
7. **Political Instability**: Frequent changes in government; agitation for change of government or disputes between political parties or different organs of the state
8. **Cultural Differences**: Differences in work culture, education, and values between project partners
9. **Human Resource**: Facing difficulties in hiring and keeping suitable and valuable employees
10. **Cash Flow**: lack of information about partners' creditworthiness, client's inconsistency for payment
11. **Foreign Exchange and Convertibility**: Fluctuation in currency exchange rate and/or difficulty of converting currencies
12. **Inflation and Interest Rate**: Unanticipated inflation and interest rate
13. **Cost Overrun**: Unavailability of sufficient cash flow, inadequate measurement and pricing of Bill of Quantities, ill planned schedule
14. **Inadequate Design**: Unanticipated design changes and errors in design/drawings
15. **Low Construction Productivity**: Obsolete technology and practices by partners; or low labor productivity of workforce
16. **Safety**: High rate of accidents during construction or operation phases
17. **Late Payment**: Client pay the contractors much later than is specified in the contract
18. **Inadequate Quality Control**: Partner tolerance of defects and inferior quality
19. **Inadequate Project Management**: Inadequate project planning, budgeting; inadequate project organization structure; or incompetence of project team
20. **Environmental Protection**: Stringent regulation which will have an impact on construction firms' poor attention to environmental issues
21. **Public Image**: Victim of prejudice from public due to different living standards, values, culture, and social system.
22. **Intellectual Property Protection**: Former employees, partners and/or third parties steal company's intellectual property, commercial secrets or patent details

23. **Force Majeure**: The circumstances that are out of the control of partners, such as flood, fires, storms, epidemic diseases, war, and hostilities.
24. **Market Demand**: Inadequate forecast about market demand
25. **Competition**: Competition from other investors/developers/contractors

Each of these 25 risks is allocated to one of the 5 main categories of risk presented by the researcher in this thesis. The 5 categories themselves are assigned to be either Internal or External. Even though setting the boundary between internal and external is quite difficult due to the complexity of the subject; the ‘project’ was considered as the concept which determines internality and externality for these categories. Categorizing risk to Internal and External has been also suggested by Smith and Bohn (1999) as discussed in Literature Review chapter. They have referred to internal risks as the ones generating inside the project and more probable to be controlled whereas external risks are originated outside of the project and therefore mostly not controllable. So, the parties involved have higher level of ability to manage the internal risks compared to external ones which are imposed to the project.

Allocation of 25 risks to 5 main categories is given below:

Political and Governmental (P&G) - External

- Approval and permit
- Change in law
- Justice enforcement
- Government influence on disputes
- Corruption
- Expropriation
- Political instability
- Intellectual property protection
- Competition

Managerial and Technical (M&T) - Internal

- Inadequate design
- Cost overrun

- Low construction productivity
- Site safety
- Inadequate quality control
- Inadequate project management

Economic and Financial (E&F) - External

- Cash flow
- Foreign exchange and convertibility
- Inflation and interest rate
- Late payment
- Market demand

Cultural and Social (C&S) - Internal

- Culture differences
- Human resource
- Public image

Natural (N) - External

- Environmental protection
- Force majeure

It needs to be added that some of these risks are just on the border and can be considered both internal and external to the project especially since the client is the government for the projects being studied in this thesis. Therefore, any risk related to the client can be considered as internal to the project (as an involved party) and also as external since it is the government.

The criticality of these 25 risks are analysed firstly from the viewpoint of all the 76 participants and then each group is evaluated separately to find out the similarities and the differences.

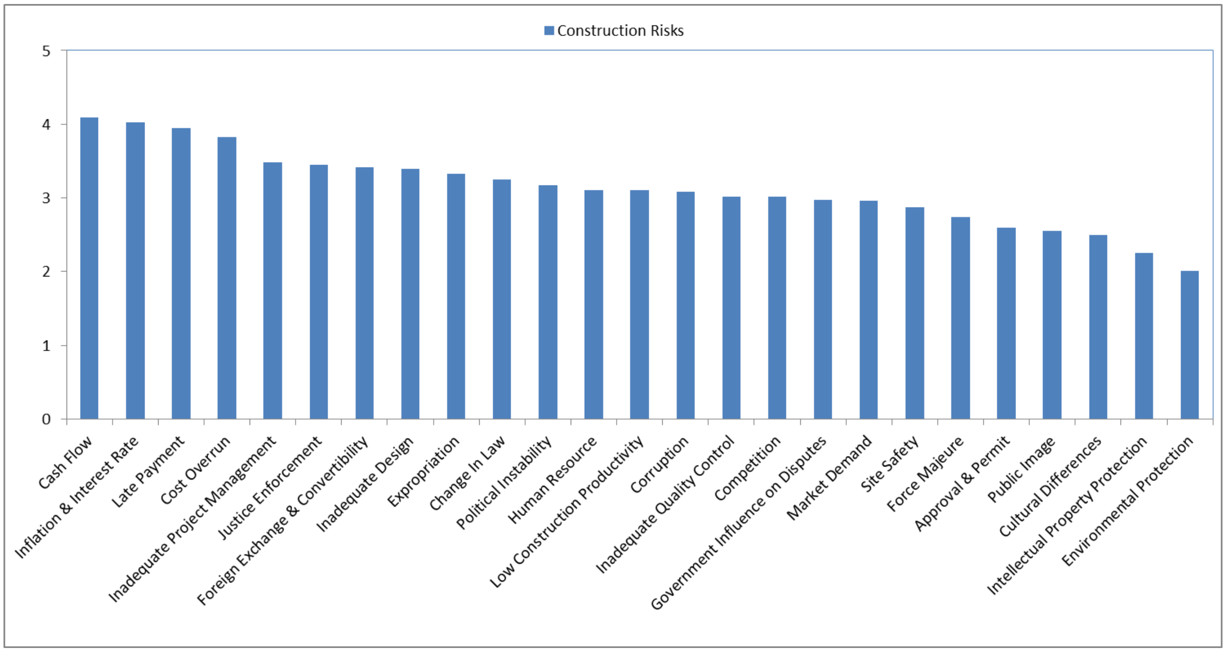


Figure 4.8 Criticality of 25 risks from the viewpoint of all the participants

Figure 4.8 illustrates the level of criticality for the construction risks in Iran. As it is seen, the first three risks in terms of criticality are cash flow, inflation and interest rate, and late payment. Referring to the risk categorization presented earlier, it can be determined that all these three risks are sub-categories of Economic and Financial category. This indicates the great significance of influences of economic and financial risks on the construction projects in Iran.

Each risk in the questionnaire had a scale of 1 to 5 for its criticality. While analysing, numbers in this scale have been grouped together in order to make the understanding of the results easier:

1: Not critical at all
2: Slightly critical → Not Critical

3: Somewhat critical → Intermediate

4: Critical
5: Very critical → Critical

Table 4.3 illustrates the mean of responses for the 25 risks and also their *p*-value after testing the responses (Test Value = 3).

Table 4.3 Mean and *p*-value of responses for 25 risks

	Descriptive				Test Value = 3		
	N	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Approval & Permit	76	2.59	1.061	.122	-3.353	75	.001
Change In Law	76	3.25	1.097	.126	1.987	75	.051
Justice Enforcement	76	3.45	1.193	.137	3.268	75	.002
Government Influence on Disputes	76	2.97	.993	.114	-.231	75	.818
Corruption	76	3.08	1.252	.144	.550	75	.584
Expropriation	76	3.33	1.159	.133	2.474	75	.016
Political Instability	76	3.17	1.258	.144	1.185	75	.240
Cultural Differences	76	2.50	1.089	.125	-4.001	75	.000
Human Resource	76	3.11	1.040	.119	.882	75	.381
Cash Flow	76	4.09	1.085	.125	8.772	75	.000
Foreign Exchange & Convertibility	76	3.42	1.158	.133	3.171	75	.002
Inflation & Interest Rate	76	4.03	.909	.104	9.845	75	.000
Cost Overrun	76	3.83	1.088	.125	6.642	75	.000
Inadequate Design	76	3.39	1.144	.131	3.008	75	.004
Low Construction Productivity	76	3.11	1.078	.124	.851	75	.397
Site Safety	76	2.87	1.124	.129	-1.021	75	.311
Late Payment	76	3.95	1.130	.130	7.308	75	.000
Inadequate Quality Control	76	3.01	1.172	.134	.098	75	.922
Inadequate Project Management	76	3.49	1.039	.119	4.084	75	.000
Environmental Protection	76	2.01	.959	.110	-8.970	75	.000
Public Image	76	2.55	1.112	.128	-3.506	75	.001
Intellectual Property Protection	76	2.25	.995	.114	-6.571	75	.000
Force Majeure	76	2.74	1.320	.151	-1.738	75	.086
Market Demand	76	2.96	1.113	.128	-.309	75	.758
Competition	76	3.01	1.026	.118	.112	75	.911

Looking at the table 4.3 above and considering the grouping of the scales; each of the 25 risks can be allocated to one of the three groups of not critical, intermediate, and critical according to their *p*-value presented in table 4.3. This grouping has been illustrated in table 4.4:

Table 4.4 Allocation of 25 risks to three groups of critical, intermediate, and not critical

Critical	**Intermediate**	**Not Critical**
Cash Flow	Change in Law	Approval and Permit
Inflation and Interest Rate	Political Instability	Public Image
Late Payment	Human Resource	Cultural Differences
Cost Overrun	Low Construction Productivity	Intellectual Property Protection
Inadequate Project Management	Corruption	Environmental Protection
Justice Enforcement	Competition	
Foreign Exchange & Convertibility	Government Influence on Disputes	
Expropriation	Inadequate Quality Control	
Inadequate Design	Market Demand	
	Site Safety	
	Force Majeure	

Conforming table 4.4 with figure 4.8,it can be realized that the first 9 risks in figure 4.8 has been fallen in the 'Critical' group, followed by the next 11 risks in the 'Intermediate' group, and the last 5 risks in the 'Not Critical' group.

Risks in the first group - Critical - are discussed further in order to discover the aspects which are influencing the construction projects more significantly. Referring back to the 5 main categories of risk, these 9 critical risks are allocated to these categories as follows:

Table 4.5 Allocation of 9 critical risks to 5 categories of risk

P & G (E)	M & T (I)	E & F (E)	C & S (I)	N (E)
2	3	4	0	0

It can be ascertained that among the 9 critical risks, Economic and Financial risks have the highest frequency, followed by Managerial and Technical risks, and then Political and Governmental risks. Moreover, none of the sub-categories of Cultural and Social, and Natural categories can be observed in the critical group of risks. The table also determines that external risks are influencing the construction projects more than internal ones with the proportion of 6 and 3 among the 9 risks ranked as critical by the participants. These results are in agreement with the results of the first section of the questionnaire shown in table 4.2. It confirms that the priority of the risks both in the list added by the participipnats and the list of 25 ones evaluated by them goes to the Economic and Financial risks followed by the Managerial and Technical risks.

Figure 4.8shown above displayed the level of criticality of the 25 risks from the viewpoint of all the participants. Three other diagrams are presented below demonstrating the level of criticality separately for each group: Client, Contractor, and Consultant:

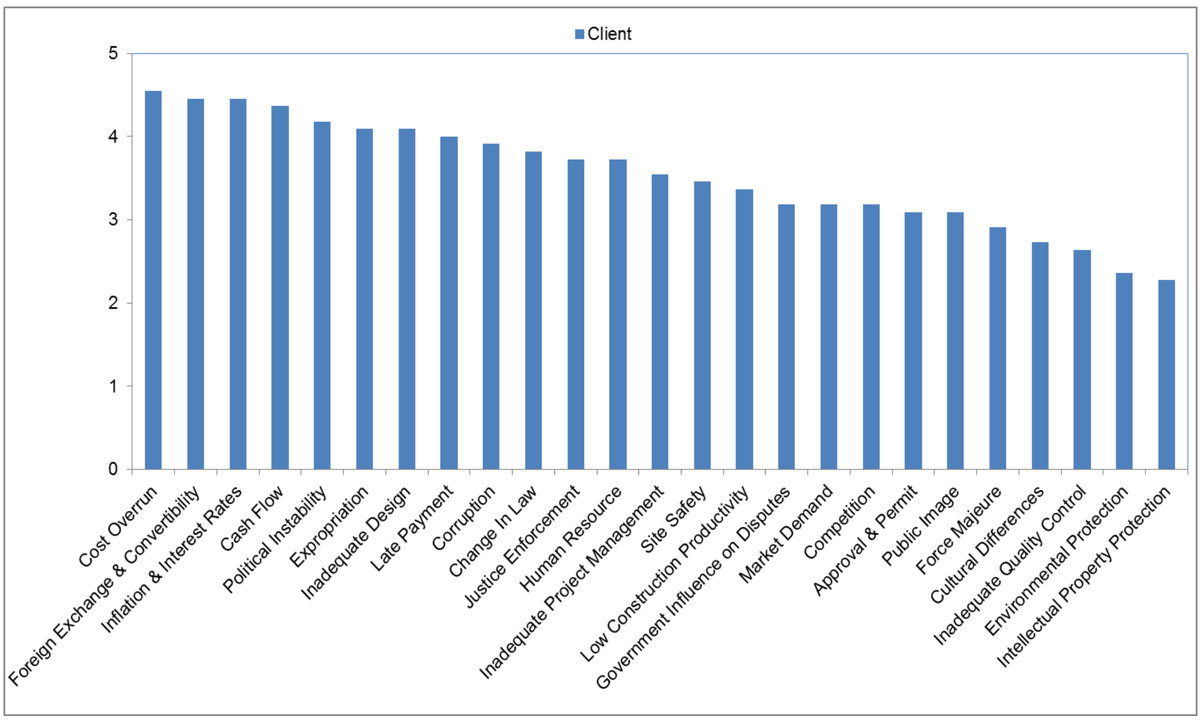


Figure 4.9 Criticality of 25 risks from clients' viewpoint

From clients' viewpoint (figure 4.9), the first three risks in terms of criticality are cost overrun, foreign exchange and convertibility, and inflation and interest rate. These risks in turn represent a Managerial and Technical risk followed by Economic and Financial risks for the last two. Since the first 9 risks were evaluated in figure 4.8 and then they were allocated to the 5 main categories, same was done for other diagrams. The table for the first 9 risks from Clients' responses is as follows:

Table 4.6 Allocation of 9 critical risks (from Clients' viewpoint) to 5 categories of risk

P & G (E)	M & T (I)	E & F (E)	C & S (I)	N (E)
3	2	4	0	0

It is seen that although the risk ranked as having the highest criticality is the cost overrun which falls in the Managerial and Technical category, the frequency of Economic and Financial risks is still higher than other categories. It is then followed by Political and Governmental risks and then Managerial and Technical ones with no risk mentioned under the categories of Cultural and Social risks and natural risks.

Figure 4.10 shows the level of criticality of the 25 risks from contractors' viewpoint which is continued with a table analysing the first 9 risks. Looking at the diagram, the first three risks are late payment, inflation and interest rate, and cash flow which are all sub-categories of Economic and Financial risks, certifying the significance of economic risks' influences on the construction projects.

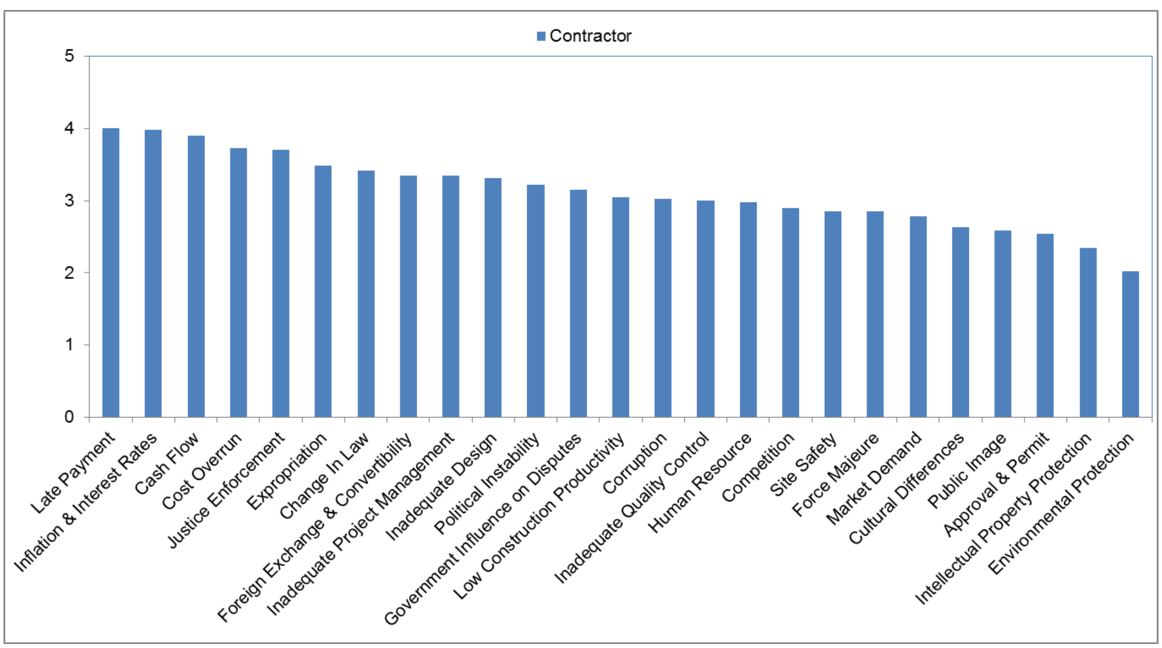


Figure 4.10 Criticality of 25 risks from contractors' viewpoint

Table 4.7 Allocation of 9 critical risks (from Contractors' viewpoint) to 5 categories of risk

P & G (E)	M & T (I)	E & F (E)	C & S (I)	N (E)
3	2	4	0	0

Comparing table 4.7 with table 4.6, it can be understood that the frequency of the risks under the main categories is the same for the client and the contractor. Although they have different responsibilities and viewpoints, Economic and Financial risks' influences have been considered to be more than other categories. This demonstrates the influences of external risks to be more than internal ones for both clients and contractors (7 external risks/ 2 internal risks).

Finally, the last group to look at is the consultants (figure 4.11) pointing at cash flow, inflation and interest rate, and late payment as the first three risks, all falling in the Economic and Financial risks category.

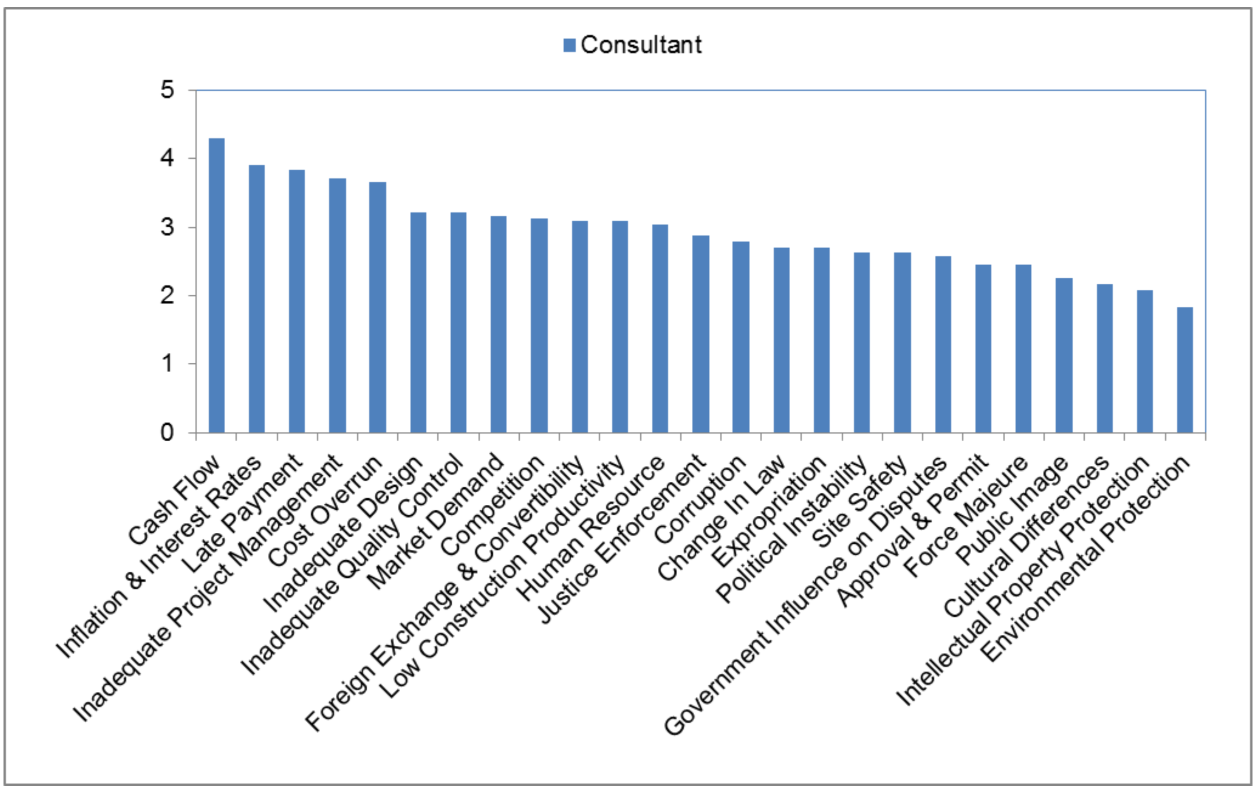


Figure 4.11 Criticality of 25 risks from Consultants' viewpoint

From evaluating the first 9 risks ranked by the consultants, table 4.8 can be drawn:

Table 4.8 Allocation of 9 critical risks (from Consultants' viewpoint) to 5 categories of risk

P & G (E)	M & T (I)	E & F (E)	C & S (I)	N (E)
1	4	4	0	0

It can be deduced that the frequency of Economic and Financial risks is still the same for the consultants comparing to the clients and contractors but Political and Governmental risks have got lower criticality for them. Even though Managerial and Technical risks have been ranked as more influential than Political and Governmental risks for consultants, the overall frequencies certifies that similar to the two other groups still external risks have more influences than internal ones (5 external risks/ 4 internal risks).

From what was illustrated in the last four diagrams, table 4.9 can be drawn for further discussion showing only the first three critical risks from the viewpoints of all the participants, clients, contractors and consultants:

Table 4.9 first three critical risks from viewpoint of all the participants and each group individually

	Risk 1	Risk 2	Risk 3
Overall (76)	Cash Flow (E&F) - E	Inflation & Interest Rate (E&F) - E	Late Payment (E&F) - E
Clients (11)	Cost Overrun (M&T) - I	Foreign Exchange & Convertibility (E&F) – E	Inflation & Interest Rate (E&F) - E
Contractors (41)	Late Payment (E&F) - E	Inflation & Interest Rate (E&F) – E	Cash Flow (E&F) - E
Consultants (24)	Cash Flow (E&F) - E	Inflation & Interest Rate (E&F) - E	Late Payment (E&F) - E

As it is seen, Economic and Financial risks' sub-categories have been mentioned as the first three risks by all the participants and also by each of the groups except the clients. Considering each cell in the table, dissimilarity of the clients can be discovered because all the three risks mentioned in the rows of overall, contractors and consultants are the same (only with different priorities) but the client's row is slightly different.

Expression of cash flow, inflation and interest rate, and late payment in three rows out of four in the table above confirms the criticality and significant influences of them on construction projects in Iran. Moreover by looking at the rows of consultants and overall, it can be realized that not only the three risks are the same but also they have got the same priority in terms of criticality. Referring back to the definitions provided for three groups of participants at the first of this chapter; similarities between consultants' opinion and the overall opinions can be argued. Clients and contractors are two sides of the contract, one is paying for the project and the other is expending that money for the execution of the project. They have different responsibilities and subsequently seeking different benefits from the project such as importance of social position for the clients or importance of financial benefits for the contractors. Therefore, this may result in stating personal opinions based on their benefits and values (for the contractors and clients) whereas these opinions may be more impartial for the consultants due to their position in the contract and also during the execution of the project. Consultant is neither responsible for paying the budget of the project nor expending the majority of that budget and is appointed as an intermediator between the client and the contractor. Hence, opinion of the consultants can be considered to be less influenced by the personal benefits and more based on the risks influencing the project in general and this can be assumed as a reason for the sameness of their opinions to the overall ones.

Focusing on the dissimilarity of the clients' opinions compared to the rest; still two out of three risks fall in Economic and Financial category but the responses are slightly different from others. Although the client has the greatest responsibility for economic aspects and budget allocation of the project, cost overrun (as a sub-category of Managerial and Technical risks) has been mentioned prior to Economic and Financial risks. According to the discussion provided in the Methodology chapter regarding the economic situation of Iran, existence of difficulties related to construction budget cannot be ignored. For that reason, ranking cost overrun as the most critical risk by clients can be assumed as an approach taken for lessening their responsibilities and putting the blame on:

- ❖ Consultants that have not measured the required budget for the project precisely, or
- ❖ Contractors that have exceeded the sufficient budget that was allocated for the project

When things go wrong everybody will find good reasons why it is somebody else's fault – that is human nature. The second and third risks from the clients' viewpoint are sub-categories of Economic and Financial risks which is similar to what was ranked by other groups.

Looking at the first three risks in table 4.9, Inflation and interest rate is the only risk mentioned by clients which is in common with other groups. Existence of this risk in all the rows of table establishes its criticality and high level of influences on the construction projects from everyone's viewpoint.

Considering other cells in table 4.9 and comparing them with the last four diagrams showing the criticality of 25 risks from all the groups' viewpoint; cost overrun as the most critical risk from client's viewpoint has been also mentioned in the first five risks for other groups. Whereas looking at other critical risks of the table 4.9, late payment has been mentioned in the first three risks by overall, contractors, and consultants but has been ranked as the eighth risk by the clients. This difference between clients and others for considering late payment much less critical can be resulted from the similar reasons discussed above. Since late payment is one of the important risks caused by the clients, it has been ranked as less critical by them in order to decline its significance to some extent because it is usually considered as their fault.

Apart from the critical risks argued above, that would also be interesting to look at the risk which was rated as the one with the lowest criticality out of 25 risks: Environmental Protection (figure 4.8). Different types of construction projects are being built in various parts of each country depending on the requirements of the people and society. Therefore, there is no doubt that sometimes location of the projects or some of the tasks undertaken during the execution of the projects can be harmful for different aspects of the environment. The reason for evaluating the impacts of the stringent regulations on the construction process as being non-critical by participants may be the fact that these regulations in Iran – compared to the developed countries – are not followed very strictly. Two recent examples of the environmental issues resulted from construction projects in Iran can be named as:

- ❖ The drying of the Urmia Lake because of the dams being built on it (UNEP Global Environmental Alert Service, 2012).

- ❖ Tehran-Shomal Freeway threatening the jungles and animals' survival in north of Iran (Peyvand Iran News, 2011).

Hence, even though construction projects may be sometimes harmful for the environment, it is not considered as a critical risk in Iran since the regulations are not very stringent.

Looking back at the figure 4.8 where the mean of all the 25 risks from the viewpoint of all the participants were shown in the diagram, table 4.10 can be drawn showing the frequency of each of the scales for all the risks and table 4.11 for the overall mean of them:

Table 4.10 Frequency of each of the scales for all the risks

Construction Risk

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly critical	7	9.2	9.2	9.2
	Somewhat critical	51	67.1	67.1	76.3
	Critical	17	22.4	22.4	98.7
	Very critical	1	1.3	1.3	100.0
	Total	76	100.0	100.0	

Table 4.11 Mean of all the risks

Construction Risk	Statistic
Mean	3.1263
Median	3.1400
Minimum	1.88
Maximum	4.52

As table 4.11 shows, mean of all the participants' viewpoints about the criticality of construction projects' risk equals to 3.1263 which represents a level higher than intermediate. Furthermore, the minimum rank determined for the construction risks equals to 1.88 and the maximum rank is 4.52. The histogram below (figure 4.12) clearly illustrates how this variable has been distributed according to the scale (1-5) that was provided for the criticality of the risks.

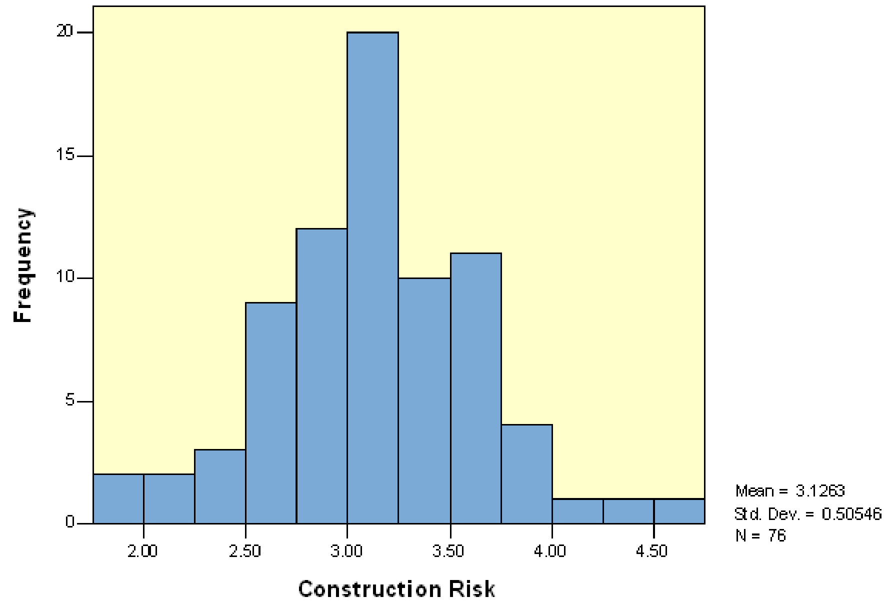


Figure 4.12 Distribution of construction risk

According to figure 4.12 - the mean of construction risk - and also based on the result of the *t*-test provided below; it can be said that (with 95% confidence interval) the level of criticality for the construction risks in Iran is more than intermediate.

Table 4.12 *t*-test for the construction risks

	Descriptives			Test Value = 3				
							95% Confidence Interval of the Difference	
	N	Mean	Std. Deviation	t	df	Sig. (2-tailed)	Lower	Upper
Construction Risk	76	3.1263	.50546	2.179	75	.033	.12632	.0108

After looking at the mean of construction risks from the viewpoint of all the respondents, analysis was continued to investigate existence of any difference between viewpoints of three individual groups of clients, contractors, and consultants. Therefore, mean of responses for each of these groups were measured and then ANOVA test was utilized in order to find out whether or not the means of these groups are equal. The results are shown in tables 4.13 and 4.14.

Table 4.13 Mean of responses for each group of participants

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Client	11	3.5345	.46347	.13974	3.2232	3.8459	3.12	4.52
Contractor	41	3.1259	.47637	.07440	2.9755	3.2762	1.96	4.04
Consultant	24	2.9400	.47869	.09771	2.7379	3.1421	1.88	3.80
Total	76	3.1263	.50546	.05798	3.0108	3.2418	1.88	4.52

Table 4.14 ANOVA test

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.666	2	1.333	5.900	.004
Within Groups	16.495	73	.226		
Total	19.162	75			

As the *p* value shown in table 4.14 is .004, it can be concluded that there is a statistically significant difference between at least two of the three groups of clients, contractors, and consultants. The result of the test demonstrated in table 4.15 ascertains that 'client' is the group which has slightly different opinions compared to the two other groups of contractors and consultants.

Table 4.15 Post Hoc Tests - Homogeneous Subsets

Tukey HSD

Job Title	N	Subset for alpha = 0.05	
		1	2
Consultant	24	2.9400	
Contractor	41	3.1259	
Client	11		3.5345
Sig.		.452	1.000

The line graph drawn in figure 4.13 depicts this difference clearly, showing that clients evaluate construction risks more critical than other groups. It also demonstrates that this evaluation is followed by the group of contractors and finally by the consultants as the group evaluating the construction risks less critical compared to the two other groups.

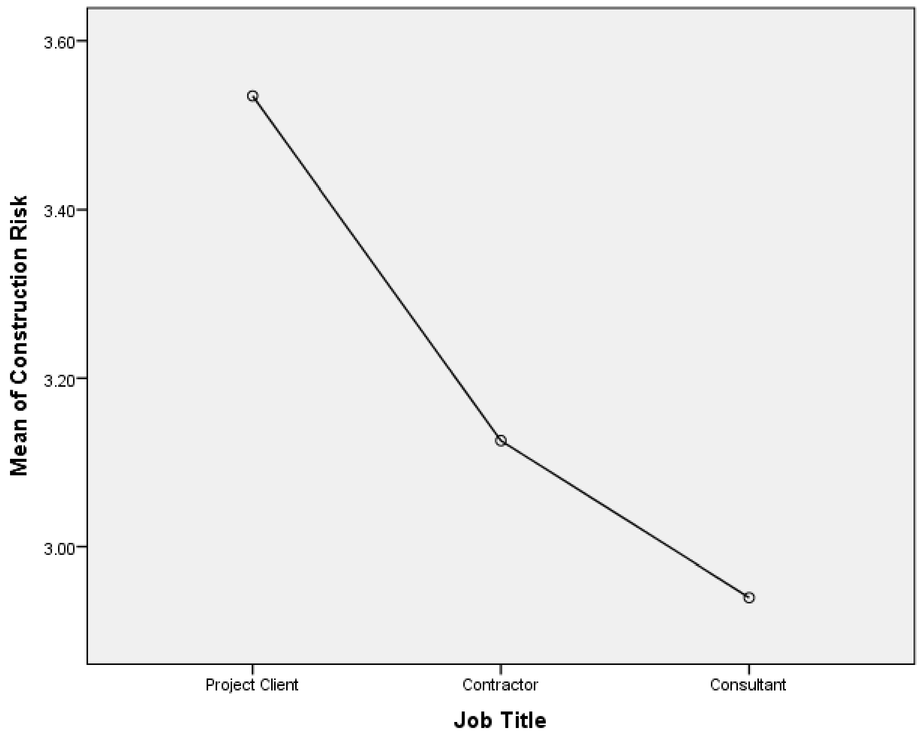


Figure 4.13 Evaluation of three groups of participants on construction risk

Different parties involved in a construction project usually have different perceptions of the risks associated with the project and are likely to have different objectives – or at least different priorities for their objectives. For contractor, the main objective is ultimately profit whereas for the client social position is more significant and the consultant usually has a mixture of these objectives. The difference in viewpoints of the clients for evaluating the risk more critical compared to others can be resulted from various reasons. The type of personality of the clients, as people who are employed to work in a governmental organization - according to the regulations and defined responsibilities - can be considered as less daring and adventurous compared to the two other groups. In construction projects, the contractor is the one who copes with the risk and the client pays for it. As a result, because the client is not the group who deals directly with the risk and due to their lower level of expertise; influences of risks may worry them more and consequently they assess the risk as more critical. Looking at the other groups in the diagram, it is not only the mentality which determines the differences between three groups and there are also other factors that may affect their opinion about the level of criticality of the risks. The dissimilarity between the contractors and consultants can be arisen from the extent to which they are influenced by the construction risks. These influences are discussed more fully below when each risk is analysed separately from the viewpoints of three groups.

So far, the evaluation of all the 25 risks was analysed from the viewpoint of all the respondents and then separately for each group. This section is now continued with analysis of each of the 25 risks individually from the viewpoints of three groups of participants using Chi-squared test. The risks will be tested in the same order as they were listed in the questionnaire. Analysis of the level of criticality still follows the same grouping shown earlier: 1 and 2 (Not Critical), 3 (Intermediate), 4 and 5 (Critical). The structure is explained first and then risks are discussed one by one.

Name of the risk (Level of criticality according to the table 4.4): Chi-squared test result

Name of the risk	Client	Contractor	Consultant
Not Critical	%	%	%
Intermediate	%	%	%
Critical	%	%	%
Total	100%	100%	100%

→ Distribution of each group's responses

p-value: further discussion about the differences in viewpoints is provided if *p*-value < 0.05, otherwise the table showing the distribution of responses for that risk can be found in Appendix F.

It needs to be explained that because of various number of the participants in each group and also fewer number of them in a group like client, the percentages (ratio of responses in cells of each column in the table above) were subject to change greatly with minor differences in the responses of only one or two of the respondents. Therefore, significance differences in responses are discussed but slight variations are considered as normal due to the diversity in experiences and viewpoints of the individuals and the results are only displayed with no further argument.

<u>1 - Approval and Permit</u> (Not Critical): $\chi^2 = 9.01$ df = 4 $p = 0.024$

Table 4.16 Distribution of responses for Approval and Permit

Approval & Permit	Client	Contractor	Consultant
Not Critical	18%	56%	63%
Intermediate	55%	17%	21%
Critical	27%	27%	17%
Total	100%	100%	100%

As it can be seen from the table, clients have considered this risk slightly more critical (55% intermediate) than contractors and consultants (56% and 63% not critical). Considering the execution of the construction project from the very first phase to the end of the project, the key permits are mostly obtained by the client. Client is responsible for obtaining a great portion of these principal permits even before the tendering phase when consultants and contractors are not involved in the project as much as the client. Therefore, clients have evaluated this risk slightly more critical than others who have got less responsibility for obtaining these permits during the project execution.

<u>2 - Change in Law</u> (Intermediate): $\chi^2 = 12.75$ df = 4 $p = 0.005$

Table 4.17 Distribution of responses for Change in Law

Change in Law	Client	Contractor	Consultant
Not Critical	9%	24%	46%
Intermediate	18%	22%	38%
Critical	73%	54%	17%
Total	100%	100%	100%

Looking at the table, clients and contractors have evaluated this risk more critical (73% and 54% critical) compared to the consultants (46% not critical). The reason could go back to the definitions provided earlier about the responsibilities of each group during the project life cycle. Since clients and contractors are two sides of the contract and have got much more responsibilities, changes in law and regulations would influence them much more than the consultants. For example, in a project money orders are subjected to be paid by the client to the contractor for some of the specific materials. Regulations may change and client is not paying those anymore and as a result contractors should pay much more in order to buy those materials. Considering this situation, who is influenced more? Clients since the project they were responsible for may not be finished due to the budget shortage or contractors as they may end up with less financial benefits for this project. In this situation, consultants are still being paid for what they are doing and influences of such a change in regulation are much less for them comparing to two other groups.

3 - Justice Enforcement (Critical): $\chi^2 = 10.98$ df = 4 $p = 0.011$

Table 4.18 Distribution of responses for Justice Enforcement

Justice Enforcement	Client	Contractor	Consultant
Not Critical	0%	20%	38%
Intermediate	55%	22%	33%
Critical	45%	59%	29%
Total	100%	100%	100%

The difference is between the opinions of the contractor (59% critical) and consultant (38% not critical). Considering the issues arising in a construction project where justice enforcement is required, it is mostly between the clients and contractors. The consultants are much less (compared to the number of times contractors may face these issues) involved in these situations and hence criticality of the risk is lower for them.

4 - Government Influence on Disputes (Intermediate): $\chi^2 = 6.98$ df = 4 $p = 0.053$

5 – Corruption (Intermediate): $\chi^2 = 9.37$ df = 4 $p = 0.021$

Table 4.19 Distribution of responses for Corruption

Corruption	Client	Contractor	Consultant
Not Critical	9%	37%	54%
Intermediate	18%	29%	17%
Critical	73%	34%	29%
Total	100%	100%	100%

In construction projects usually the project's financial statements are provided by the contractors for the consultants and once approved by them, will be sent to the client for the payment. As a result, it is expected that mostly corruption happens between the contractors and consultant (contractors paying consultants for approval of their statements). Since the definition of this risk in the questionnaire focuses on the corruption related to the government only, consultant evaluates it less critical as it rarely happens between them and the client (seldom in time of tendering). Client, as a governmental body, evaluates it more critical because they are aware of its existence between involved parties. Besides, they know that some of the regulations may be ignored because of the corruption happening between by parties (including themselves in relation to contractors).

6 - Expropriation (Critical): $\chi^2 = 15.92$ df = 4 $p = 0.001$

Table 4.20 Distribution of responses for Expropriation

Expropriation	Client	Contractor	Consultant
Not Critical	0%	15%	50%
Intermediate	27%	37%	25%
Critical	73%	49%	25%
Total	100%	100%	100%

Consultant has slightly different opinion about the expropriation than client and contractor as the influences are much less for them in case of expropriation in projects. Expropriation results in a great financial loss – even bankruptcy – for the contractors. For the clients, the result is either an incomplete project left for them or they need to go through the process of re-tendering for selecting a new contractor for continuing the project. Disadvantages are much less for the consultants especially since they mostly stay the same in case of re-tendering and hence continue executing the project – with a different contractor.

7 - Political Instability (Intermediate): $\chi^2 = 6.32$ df = 4 $p = 0.021$

Table 4.21 Distribution of responses for Political Instability

Political Instability	Client	Contractor	Consultant
Not Critical	0%	27%	50%
Intermediate	18%	32%	13%
Critical	82%	41%	38%
Total	100%	100%	100%

The criticality of this risk has been evaluated much more from clients' viewpoint than contractors and consultants. As discussed in Methodology chapter, public sector projects have been studied in this thesis and therefore the client is a governmental body here. For this reason, it is expected that clients assess political instability more critical since any changes in the political situation of the country may have direct intense influences on their roles and positions in the organization.

8 - Cultural Differences (Not Critical): $\chi^2 = 5.22$ df = 4 $p = 0.095$

9 - Human Resource (Intermediate): $\chi^2 = 5.61$ df = 4 $p = 0.084$

10 - Cash Flow (Critical): $\chi^2 = 5.86$ df = 4 $p = 0.077$

11 - Foreign Exchange and Convertibility (Critical): $\chi^2 = 10.56$ df = 4 $p = 0.013$

Table 4.22 Distribution of responses for Foreign Exchange and Convertibility

Foreign Exchange & Convertibility	Client	Contractor	Consultant
Not Critical	0%	24%	29%
Intermediate	9%	22%	38%
Critical	91%	54%	33%
Total	100%	100%	100%

Clients have evaluated this risk more critical compared to the two other groups. This may have been resulted from higher level of responsibilities of the client for providing financial budget for the projects. Therefore, fluctuations in currency exchange rate influence them more as they sometimes need to increase the budget for the project (which is not always possible) and that may also increase the duration of the project.

12 - Inflation and Interest Rate (Critical): $\chi^2 = 4.56$ df = 4 $p = 0.116$

13 - Cost Overrun (Critical): $\chi^2 = 7.08$ df = 4 $p = 0.051$

14 - Inadequate Design (Critical): $\chi^2 = 5.30$ df = 4 $p = 0.093$

15 - Low Construction Productivity (Intermediate): $\chi^2 = 0.58$ df = 4 $p = 0.109$

16 - Site Safety (Intermediate): $\chi^2 = 4.43$ df = 4 $p = 0.120$

17 - Late Payment (Critical): $\chi^2 = 1.63$ df = 4 $p = 0.180$

18 - Inadequate Quality Control (Intermediate): $\chi^2 = 8.15$ df = 4 $p = 0.034$

Table 4.23 Distribution of responses for Inadequate Quality Control

Inadequate Quality Control	Client	Contractor	Consultant
Not Critical	64%	29%	25%
Intermediate	0%	34%	42%
Critical	36%	37%	33%
Total	100%	100%	100%

Clients have considered this risk less critical compared to other groups even though controlling the quality of the project mainly falls under their responsibility. Thus, it can be assumed to be resulted from their confidence in their abilities to respond to their responsibilities.

19 - Inadequate Project Management (Critical): $\chi^2 = 4.01$ df = 4 $p = 0.134$

20 - Environmental Protection (Not Critical): $\chi^2 = 2.87$ df = 4 $p = 0.170$

21 - Public Image (Not Critical): $\chi^2 = 4.54$ df = 4 $p = 0.117$

22 - Intellectual Property Protection (Not Critical): $\chi^2 = 3.82$ df = 4 $p = 0.141$

23 - Force Majeure (Intermediate): $\chi^2 = 8.33$ df = 4 p = 0.032

Table 4.24 Distribution of responses for Force Majeure

Force Majeure	Client	Contractor	Consultant
Not Critical	55%	49%	54%
Intermediate	0%	17%	33%
Critical	45%	34%	13%
Total	100%	100%	100%

There is a slight difference in viewpoints of clients and consultants where consultants have evaluated this risk less critical. This risk is out of control of all the parties and is mostly covered by insurance to a great extent. Even though the financial losses may be covered by insurance, further consequences of this risk are much more significant for the contractors and clients compared to the consultants.

24 - Market Demand (Intermediate): $\chi^2 = 2.79$ df = 4 p = 0.172

25 - Competition (Intermediate): $\chi^2 = 1.71$ df = 4 p = 0.181

The results of Chi-squared test were shown above for each risk individually, below is a comparison of the results of this test for sub-categories of 5 main categories:

❖ *Political and Governmental (P&G):*

The *p*-value for 6 risks out of 9 risks of this category is less than 0.05, showing that three groups of participants have different opinions about the criticality of these risks. Approval and permit, change in law, justice enforcement, corruption, expropriation, and political instability are the risks where opinions are different. Looking at the above tables, it can be realized that the difference is mostly between the consultants for evaluating these risks less critical or the clients for evaluating them more critical than other groups. These results are similar to the content of following tables:

- Table 4.6: where clients had evaluated 3 risks from political and governmental category in their first 9 risks (P&G category had the second priority)

- Table 4.8: where consultants had ranked only 1 risk from political and governmental category in their first 9 risks (P&G category had the third priority)

The *p*-value for the other three risks of this category was not showing any significant difference between participants' opinions, these risks were: government influence on disputes, intellectual property protection, and competition.

❖ *Managerial and Technical (M&T):*

Only 1 out of 6 risks of this category had the *p*-value less than 0.05; inadequate quality control that was evaluated less critical by clients compared to others. Other risks of this category were assessed similar by all the participants, and these risks were: inadequate design, cost overrun, low construction productivity, site safety, and inadequate project management.

❖ *Economic and Financial (E&F):*

Same as the previous category, only 1 risk out of 5 risks of this category was evaluated differently by participants. The foreign exchange and convertibility risk which was considered to be more critical from clients' viewpoints. Other risks being evaluated similar by all the participants were: cash flow, inflation and interest rate, late payment, and market demand.

❖ *Cultural and Social (C&S):*

All three subcategories of this category were evaluated similarly by all the participants and these risks were: cultural differences, human resource, and public image.

❖ *Natural (N):*

For this category, 1 out of 2 risks, force majeure, was evaluated less critical by consultants than other groups. The other risk was environmental protection being evaluated as the least critical risk out of 25 by all the participants.

Therefore, as it is seen from the results of the comparisons above, the Political and Governmental risks category has the most differences between the participants' opinions and 6 out of 9 risks have been evaluated differently. However, other categories have only one risk being considered differently (M&T, E&F, and N) and in C&S category all the risks are similarly assessed. Since the client is a governmental body in this thesis, it can be concluded that the influences of the political and governmental risks are much more for them than others. Looking at the risks of P&G category and according to the discussions provided earlier for each risk, it can be understood that these risks have less influences on the consultants due to their responsibilities and level of involvement in those risks.

Considering the differences for all the risks, it can be realized that the different group was either client or the consultants. Except one risk – inadequate quality control – being evaluated less critical by client, all the other differences from client had been resulted from their evaluation to be more critical than others. When consultants were the different group, it was the result of their evaluation to be less critical than others.

Looking back at the figure 4.13 where the difference between the opinions of three groups of participants was shown, the major difference between the mean of responses from clients and consultants can be observed. Since contractors have a position between these two groups while evaluating risks, their responses for criticality of the risks were mostly similar to one of these groups or to both of them (when *p*-value was more than 0.05). For this reason, contractor was not the group having different opinion for any of the risks while considering the results of Chi-squared test.

Analysis of the 'evaluation of the criticality of 25 risks' section covered ranking of the 25 risks from the viewpoint of all the participants and then each group separately. It continued with evaluation of the overall mean of construction risk and again from each group's perspective distinctly. Each of the 25 risks was also analysed using Chi-squared test to identify the differences of opinions in three groups of participants and then the results of test were compared between the risks of each of the 5 main categories. This section is finished by utilizing ward-method for classification of 25 risks to figure out how the risks group themselves into two clusters.

The Dendrogram has been illustrated in figure 4.14 showing two clusters comprising 55 and 21 participants with the second cluster evaluating risk slightly more critical than the first cluster.

Allocation of the participants from the three groups into these two clusters is as follows:

55 participants = Lower Criticality 21 participants = Higher Criticality

Table 4.25 Number of participants in each of the clusters for evaluating the criticality of the 25 risks

Risks	Client	Contractor	Consultant	Total
Lower Criticality	2	32	21	55
Higher Criticality	9	9	3	21
Total	11	41	24	76

Table 4.26 Percentages of participants in each of the clusters for evaluating the criticality of the 25 risks

Risks	Client	Contractor	Consultant	Total
Lower Criticality	18%	78%	87.5%	72%
Higher Criticality	82%	22%	12.5%	28%
Total	100%	100%	100%	100%

As it is seen in the tables and the dendrogram, the percentages of the participants from each group follow the same proportion being perceived from figure 4.13 earlier. The majority of the clients, followed by the contractors and then only few numbers of the consultants fall in the second cluster (21 participants), evaluating the risk slightly more critical than the other cluster.

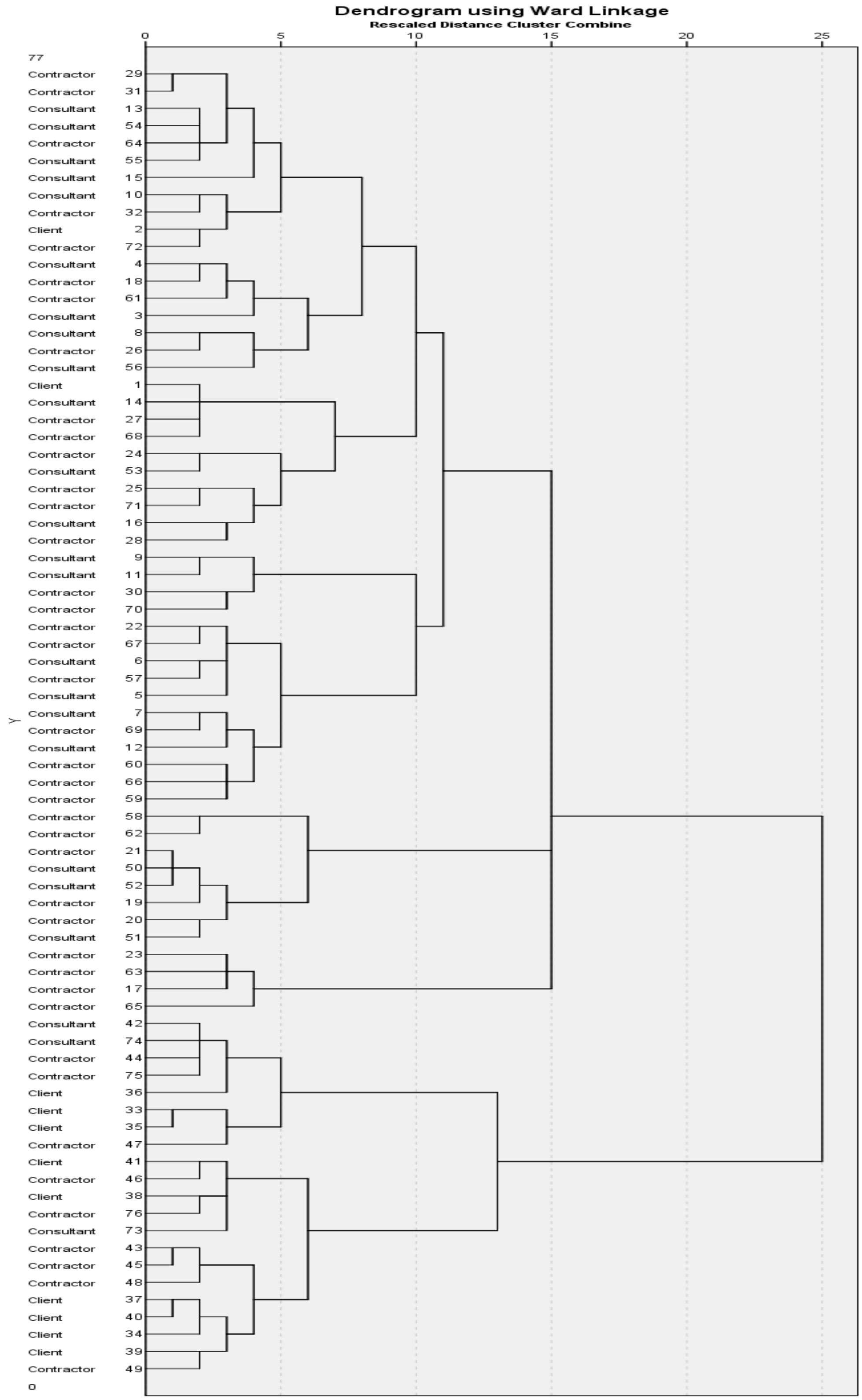


Figure 4.14 Two clusters of participants for evaluating the criticality of the 25 risks

4.2.4. Evaluation of the effectiveness of the 'Mitigation Strategies'

For each of the 25 risks discussed above, there were one or more mitigation strategies proposed by the researcher in the questionnaire and the participants were asked to rate the effectiveness of these strategies. There were also extra empty rows provided at the bottom of each table so participants could add any mitigation strategy assumed to be effective.

Similar to the numbers of the scale of criticality for the 25 risks which were grouped while analysing them in previous section; the scale related to mitigation strategies would be as follows for analysis:

1: Not effective at all
2: Slightly effective
3: Somehow effective
→ Not Effective

4: Effective
5: Very effective
→ Effective

Below is the structure showing how these strategies are discussed for each risk:

<u>Name of the risk</u> (Number of the mitigation strategies provided in the questionnaire)

- ❖ Discussion on how the mitigation strategies have been evaluated from the viewpoint of all the participants

M = Mitigation Strategy

1st Strategy

2nd Strategy

Name of the Risk	M(number of the risk).A	M(number of the risk).B
Not Effective	...	...
Effective	...	...
Total	76	76

❖ Further discussion if three groups have evaluated the mitigation strategies different from each other (using Chi-squared test)

M (number of the risk**).X:** $\chi^2 = \ldots$ df=…p=…

The Alphabet indicates which of the strategies from previous table is being analysed i.e. A

M (number of the risk**). X**	Client	Contractor	Consultant
Not Effective	..%	..%	..%
Effective	..%	..%	..%
Total	100%	100%	100%

❖ Defining any extra effective mitigation strategy for this risk proposed by participants

Looking at the evaluations of the three groups of participants in the tables below; it can be assumed that they may have evaluated these strategies from two distinct perspectives:

- How effective these strategies are - in theory
- To what extent these can be implemented depending on the situation of Iran - in practice

1 - Approval and Permit (2)

Table 4.27 Distribution of responses for mitigation strategies

Approval & Permit	M1.A	M1.B
Not Effective	29	18
Effective	47	58
Total	76	76

M1.A: Prepare and submit all necessary documents and feasibility study report in a timely manner to government departments. This strategy, on average, has been rated more as being effective by the participants but looking at each group separately, majority of the consultants have rated it as less effective.

$\chi^2 = 10.68 \quad df = 2 \quad p = 0.002$

Table 4.28 Distribution of responses for the first mitigation strategy of 'Approval and Permit' risk

M1.A	Client	Contractor	Consultant
Not Effective	9%	32%	63%
Effective	91%	68%	38%
Total	100%	100%	100%

Even though as discussed earlier in this chapter the key permits for the project are obtained by the client, preparing the necessary document for obtaining the approval falls under the responsibility of the consultants. Therefore, as it is the task they are mostly coping with, they may have not considered this strategy to be easily feasible.

M1.B: Maintain good relationship with government and higher officials. This strategy has been rated as effective by all three groups of participants since good relationship and connection usually help speeding the processes up.

$\chi^2 = 4.03 \quad df = 2 \quad p = 0.066$

Participants had also suggested other strategies for this risk:

- ❖ Conducting studies for getting familiar with the rules and regulations of the organizations that are related to the project
- ❖ Maintaining financial relationship with related organizations – Bribe

<u>2 - Change in Law</u> (2)

Table 4.29 Distribution of responses for mitigation strategies

Change in Law	M2.A	M2.B
Not Effective	32	22
Effective	44	54
Total	76	76

M2.A: Obtain government guarantee to adjust tariff. This strategy has been rated slightly more as ‘effective’ than ‘not effective’ but looking at the three groups, it can be seen that clients has considered it more effective than the other two groups.

$\chi^2 = 9.73$ df = 2 $p = 0.003$

Table 4.30 Distribution of responses for the first mitigation strategy of ‘Change in Law’ risk

M2.A	Client	Contractor	Consultant
Not Effective	0%	46%	54%
Effective	100%	54%	46%
Total	100%	100%	100%

Few numbers of the clients in this thesis cannot be ignored as a probable reason why for some of the strategies opinions of all of them fall in one group. Moreover, client as the party who is not coping with the risks directly may evaluate the mitigation strategies’ effectiveness in theory. However, contractors and consultants who are encountering more with the risks may consider the effectiveness of these strategies in addition to the feasibility of their implementation.

Therefore, clients have considered this strategy as more effective since they are providing these guarantees which sound effective in case of changes in rules. On the other hand, contractors and consultants have evaluated this strategy less effective as they may be aware of the difficulties in the process of obtaining these guarantees.

M2.B: Include clauses for the delays and additional payments in contract, which occur due to new rules or change in law. All the participants from three groups have rated this strategy as being effective.

$\chi^2 = 0.32$ df = 2 $p = 0.424$

Each project is unique and the content of General Conditions of the Contract may not cover all the specifications of the project. Therefore, parties should try to include as much as helpful clauses that they all agree on in the Special Conditions of the Contract for the project.

3 / 4 - Justice Enforcement / Government Influence on Disputes (2)

Table 4.31 Distribution of responses for mitigation strategies

Justice Enforcement / Government Influence on Disputes	M3/4.A	M3/4.B
Not Effective	36	25
Effective	40	51
Total	76	76

Since risks 3 and 4 were very similar, the mitigation strategies for them have been proposed in the same table.

M3/4.A: Provide dispute settlement clauses in the contract.

$\chi^2 = 4.44$ df = 2 $p = 0.054$

M3/4.B: Maintain good relations with concerned government officials and concerned authorities.

$\chi^2 = 3.66$ df = 2 $p = 0.080$

As it is seen, both strategies have been rated as effective for risks 3 and 4 which are referring to justice and disputes.

Also suggested by participants:

- ❖ Seeking impartial judges from more than one competent authority and from different levels of hierarchy. This can be useful for the times that parties are not happy with an authority's judgment on disputes and they can refer to other available people for judgment. As the position of these people goes up in the hierarchy, their competency and significance of their judgment also increase and therefore having access to these authorities in the project help parties to be more satisfied regarding the decision made.

5 - Corruption (5)

Table 4.32 Distribution of responses for mitigation strategies

Corruption	M5.A	M5.B	M5.C	M5.D	M5.E
Not Effective	33	43	40	38	22
Effective	43	33	36	38	54
Total	76	76	76	76	76

Due to the political instability in Iran - as discussed in the Methodology chapter - rules and regulations change frequently and the consequences would be application of individual opinions by managers (client) instead of application of rules in many cases. Having considered this fact; although bribing is against the morality and results in ignoring the regulations, its existence in the society has been accepted as a reality since occasionally having relations works better than obeying regulations. Therefore, parties believe that it can be an effective strategy taken for some of the risks i.e. it was suggested by four of the participants as an effective strategy for the Approval and Permit risk mentioned earlier. Hence, some of the strategies provided for the corruption could be evaluated from two completely different perspectives: accepting the existence of corruption and bribing; either trying to eliminate that or trying to learn how and when to pay that. Positions of each of the parties in relation to corruption would be helpful to be explained (considering their job responsibilities):

- Client is always the one who either accept or reject the bribes and does not need to pay that to other parties
- Contractor is the one who mostly pays it to consultant or client depending on the situation and is not being paid any bribe due to the nature of their role
- Consultant - usually having a position between the two other - may either pay the bribe to client or being paid by contractor. It is required to emphasize that consultant is being appointed by client for supervising contractors' execution of the project and for this reason their reliability has a high level of significance. Therefore, it makes sense that consultants hardly offer the bribe to client so not to ruin their trustworthiness. However, accepting it by them from contractor is still quite common.

M5.A: Set aside a budget for unavoidable expenses

$\chi^2 = 13.78$ df = 2 $p<0.001$

Table 4.33 Distribution of responses for the first mitigation strategy of 'Corruption' risk

M5.A	Client	Contractor	Consultant
Not Effective	0%	41%	67%
Effective	100%	59%	33%
Total	100%	100%	100%

Looking at the differences in opinions of the three groups, it can be discussed depending on two distinct perspectives mentioned above for the strategies of this specific type of risk. 'Unavoidable expenses' can be perceived as bribe, or as the money which can be spent during the execution of the project to implement the required tasks in order to eliminate the need for bribery. All the clients have evaluated this strategy as effective; believing that if contactors and consultants set aside a budget for the tasks they are responsible for and execute those, there will not be the need for corruption. There is also the probability that some of them think about it from the first aspect, believing that if other parties offer them bribe would be effective as the client may deal with their request more quickly and better. However, even if clients consider bribery as being effective, the probability for admitting this and then declaring it in a questionnaire is very low. Therefore, it can be assumed that clients have most probably evaluated this strategy from the perspective that was explained first which is the expectation from other parties to do their tasks properly in order to reduce the level of corruption.

Contractors have evaluated this strategy as being effective; considering both perspectives this strategy would be helpful for them.

Consultants, compared to contractors have evaluated this strategy less effective. This can be resulted from either their pretence for denial of accepting the bribes or the less number of cases they encounter in which they need to bribe especially since the focus here is on governmental corruptions.

M5.B: Cultural and commercial awareness training to management and key personnel who may have to deal with corrupt officials. This strategy has been assessed as less effective by all three groups of participants.

$\chi^2 = 0.50$ df = 2 p = 0.388

Bearing in mind the two perspectives mentioned above, training can be perceived as either teaching how to stop the bribery or how to pay that and when. For training how to stop it, this strategy has been evaluated as being less effective because as stated before existence of bribery in Iranian society has been accepted as an effective method to some extent. For training how to pay that, this strategy is again less effective since there are no specific rules for these types of situations and it is usually learned from experience for people to know how to behave.

M5.C: Try to work directly with the business connections, i.e. do not hire a broker or middleman. This strategy has been assessed as less effective since it is not always possible to work directly with all employees, specifically in higher levels and therefore unavoidable existence of other people in between may increase the chances for bribery.

$\chi^2 = 1.40$ df = 2 p = 0.247

M5.D: Obtain all necessary approvals in timely manner to minimize chance for corrupt individual to obstruct work.

$\chi^2 = 4.09$ df = 2 p = 0.064

Evaluation of this strategy has been divided exactly into two equal groups. It may have been assumed that obtaining approvals may minimize the corruption depending on the situation but on the other hand it is not always possible to obtain all the approvals without the demand for bribe from authorities.

M5.E: Maintain good relations with relevant government officials and relevant authorities. This strategy has been evaluated more as being effective by three groups of participants.

$\chi^2 = 1.56$ df = 2 p = 0.228

Even though maintaining good relations with relevant authorities were assessed as an effective strategy for other risks, for the corruption risk it may again indicates two perspectives. Maintaining good relations may result in either occurrence of bribery easier with less fear between parties, or the need for that get reduced. In both cases explained, this strategy can be effective since it helps parties to carry on.

6 - Expropriation (2)

Table 4.34 Distribution of responses for mitigation strategies

Expropriation	M6.A	M6.B
Not Effective	35	22
Effective	41	54
Total	76	76

M6.A: Develop contingency plans and obtain insurance for expropriation possibility.

$\chi^2 = 7.12$ df = 2 $p = 0.014$

Table 4.35 Distribution of responses for the first mitigation strategy of 'Expropriation' risk

M6.A	Client	Contractor	Consultant
Not Effective	9%	51%	54%
Effective	91%	49%	46%
Total	100%	100%	100%

This strategy has been assessed more as being effective on average but looking at three groups distinctly, it can be seen that clients have considered it more effective compared to the other two groups. This can be resulted from the diverse perspectives argued earlier for the mitigation strategies where clients may evaluate the effectiveness of this strategy in theory but the other groups may also be concerned about the possibility of implementing this strategy. Hence, contractors and consultants have assessed this strategy less effective since they may be familiar with the difficulties associated with these processes.

M6.B: Include clauses in contract where client is obliged to give reason or getting approval from relevant parties and authorities in time of expropriation.

$\chi^2 = 2.48$ df = 2 $p = 0.144$

This strategy has been ranked more as being effective by all groups because as it was discussed earlier, including as much as relevant clauses regarding different aspects of each project in its Special Conditions of the Contract would be useful for all the parties.

7 - Political Instability (3)

Table 4.36 Distribution of responses for mitigation strategies

Political Instability	M7.A	M7.B	M7.C
Not Effective	52	22	57
Effective	24	54	19
Total	76	76	76

M7.A: Develop own contingency plans for possible political instability, such as plan for emergency evacuation. This strategy has been assessed as less effective by all three groups. Considering the level of instability in political situation of Iran; feasibility of prediction of these instabilities and then developing contingency plans for them may have been considered to be low.

$\chi^2 = 3.17$ df = 2 $p = 0.102$

M7.B: Seek incorporation of termination or delay clauses in contract. Similar to other strategies that suggest inclusion of clauses in the contract, this strategy has also been evaluated as an effective one by all three groups of participants.

$\chi^2 = 2.48$ df = 2 $p = 0.144$

M7.C: Be informed of political developments by using information sources like risk assessment companies

$\chi^2 = 5.41$ df = 2 $p = 0.033$

Table 4.37 Distribution of responses for the third mitigation strategy of 'Political Instability' risk

M7.C	Client	Contractor	Consultant
Not Effective	73%	66%	92%
Effective	27%	34%	8%
Total	100%	100%	100%

The strategy, on average, has been assessed to be less effective and looking at the table above there is a slight difference between contractors and consultants where a higher percentage of the latter have evaluated it as less effective. Considering the political situation of Iran, this ranking was expected to be seen from the participants since these information sources are few and besides it is difficult to trust the information provided by them. Hence, it can be considered as a risky risk mitigation strategy!

Participants had also suggested the strategies below in order to get less influenced by political instabilities and their sudden consequences:

- Trying to finish the project as early as possible
- Trying to execute the projects with shorter duration

8 - Cultural Differences (5)

Table 4.38 Distribution of responses for mitigation strategies

Cultural Differences	M8.A	M8.B	M8.C	M8.D	M8.E
Not Effective	54	52	59	41	38
Effective	22	24	17	35	38
Total	76	76	76	76	76

M8.A: Undertake comprehensive negotiations and agreement with government and partners.

$\chi^2 = 8.28$ df = 2 $p = 0.007$

Table 4.39 Distribution of responses for the first mitigation strategy of 'Cultural Differences' risk

M8.A	Client	Contractor	Consultant
Not Effective	36%	73%	83%
Effective	64%	27%	17%
Total	100%	100%	100%

The above strategy and the one below have been evaluated as less effective on average but looking at the groups individually, clients have considered them to be more effective and this difference may be resulted from their job responsibilities which influence their viewpoint. As discussed before, client may have evaluated the effectiveness of these strategies in theory whereas the other two are coping with these risks and as a result may have evaluated the feasibility of implementing these strategies to be low.

M8.B: Devise unambiguous and agreed risk sharing code at the time of contract

$\chi^2 = 11.19$ df = 2 $p = 0.001$

Table 4.40 Distribution of responses for the second mitigation strategy of 'Cultural Differences' risk

M8.B	Client	Contractor	Consultant
Not Effective	27%	71%	83%
Effective	73%	29%	17%
Total	100%	100%	100%

M8.C: Try to have as large an equity share as possible. The strategy has been evaluated as being less effective on average with a minor difference between clients and consultants where a higher percentage of the latter have assessed it as less effective.

$\chi^2 = 4.72$ df = 2 $p = 0.047$

Table 4.41 Distribution of responses for the third mitigation strategy of 'Cultural Differences' risk

M8.C	Client	Contractor	Consultant
Not Effective	55%	78%	88%
Effective	45%	22%	13%
Total	100%	100%	100%

This can be resulted from presence of contractors and consultants in the construction site compared to clients and therefore their direct encounters with these issues.

M8.D: Provide dispute settlement clauses in the contract. The difference between the viewpoint of the client and the other two groups can be again assumed as the extent to which they deal with these risks and therefore their familiarity with the effectiveness of these strategies in practice. However, contractors and consultants do not consider existence of these clauses in the contract as very effective strategy.

$\chi^2 = 7.14$ df = 2 $p = 0.014$

Table 4.42 Distribution of responses for the fourth mitigation strategy of 'Cultural Differences' risk

M8.D	Client	Contractor	Consultant
Not Effective	18%	63%	54%
Effective	82%	37%	46%
Total	100%	100%	100%

M8.E: Try to have contracts which may face less cultural differences during project execution. i.e. employing local contractors/sub-contractors. This strategy, comparing to other strategies suggested for this risk, has been assumed to have more effectiveness.

$\chi^2 = 0.28$ df = 2 $p = 0.434$

Generally, the strategies proposed for the cultural differences have been evaluated to be less effective since construction projects are being executed in different cities of the country with different cultures. As a result, negotiations and inclusion of contract clauses have not been evaluated as effective strategies since human related risks may still occur. However, it is required to be reminded that cultural differences risk was considered as a not-critical one earlier and therefore affects the project much less compared to other risks.

9 - Human Resource (4)

Table 4.43 Distribution of responses for mitigation strategies

Human Resource	M9.A	M9.B	M9.C	M9.D
Not Effective	44	21	25	14
Effective	32	55	51	62
Total	76	76	76	76

M9.A. Undertake comprehensive negotiations and agreement with other companies and partners about obeying rules and avoiding harmful competitions. Due to the nature of the strategy proposed, it was expected to see less effective ranking for that. Negotiation is useful but if it was very effective, it would reduce influences of many risks but what is important is that to what extent parties behave according to the results of the negotiations being undertaken.

$\chi^2 = 2.60$ df = 2 $p = 0.135$

M9.B: Sign formal employment contract with all staff. This strategy has been evaluated as an effective one on average with all the clients considering it as effective. It can be assumed that it has been resulted from similar reasons argued earlier; few numbers of clients, and the extent to which they confront with these risks.

$\chi^2 = 6.57$ df = 2 $p = 0.018$

Table 4.44 Distribution of responses for the second mitigation strategy of 'Human Resource' risk

M9.B	Client	Contractor	Consultant
Not Effective	0%	27%	42%
Effective	100%	73%	58%
Total	100%	100%	100%

M9.C: Offer training to new and existing staff

$\chi^2 = 3.68$ df = 2 $p = 0.079$

M9.D: Offer better remuneration/incentive packages to staff

$\chi^2 = 1.08$ df = 2 $p = 0.290$

These last two strategies suggested for the human resource risk have been evaluated more as being effective by all three groups.

<u>10 - Cash Flow</u> (4)

Table 4.45 Distribution of responses for mitigation strategies

Cash Flow	M10.A	M10.B	M10.C	M10.D
Not Effective	17	22	43	46
Effective	59	54	33	30
Total	76	76	76	76

M10.A: Examine the client's financial viability and capability for paying on time

$\chi^2 = 0.18$ df = 2 $p = 0.454$

M10.B: Employ contractors with higher level of financial viability

$\chi^2 = 1.34$ df = 2 $p = 0.255$

The first two strategies suggested for this risk have been evaluated more as being effective since obtaining information about partner's accounts usually helps them to mitigate the financial related risks.

M10.C: Have clear contractual terms and conditions, agree on one accounting standard and define clear authority and responsibility in contract

$\chi^2 = 0.90$ df = 2 $p = 0.318$

M10.D: Define clearly the merging scope of assets, employees, shares, organization, and strategies when merging with a partner

$\chi^2 = 0.20$ df = 2 $p = 0.450$

The last two strategies have been ranked as less effective which can be assumed to be the result of evaluation of the feasibility of the strategies to be implemented in Iran.

11 - Foreign Exchange and Convertibility (2)

Table 4.46 Distribution of responses for mitigation strategies

Foreign Exchange and Convertibility	M11.A	M11.B
Not Effective	28	20
Effective	48	56
Total	76	76

M11.A: Obtain government guarantee of exchange rate and convertibility, e.g. fixed rate for long period or less fluctuation.

$\chi^2 = 4.23$ df = 2 $p = 0.060$

M11.B: Materials and facilities which are related to foreign exchange should be bought as early as possible in case of available budget for the project

$\chi^2 = 0.48$ df = 2 $p = 0.393$

Both strategies have been evaluated as effective by participants for mitigating this risk.

Participants had also suggested two more strategies to be effective for this risk:

- ❖ Trying to increase the usage of domestic (local) materials which have got the required standards
- ❖ Including clauses in contract for allocating the full responsibility of buying the materials related to foreign exchange to clients

12 - Inflation and Interest Rates (3)

Table 4.47 Distribution of responses for mitigation strategies

Inflation & Interest Rate	M12.A	M12.B	M12.C
Not Effective	29	31	22
Effective	47	45	54
Total	76	76	76

M12.A: Obtain payment and performance bonds from banks

$\chi^2 = 0.03$ df = 2 $p = 0.491$

M12.B: Adopt alternatives to contract payment, e.g. land development rights, resource swap

$\chi^2 = 2.85$ df = 2 $p = 0.119$

M12.C: Specify extension or compensation clauses in contract for payment

$\chi^2 = 2.55$ df = 2 $p = 0.139$

All three strategies have been considered to be effective for the inflation which has got a high level and also high fluctuation in Iran.

13 - Cost Overrun (7)

Table 4.48 Distribution of responses for mitigation strategies

Cost Overrun	M13.A	M13.B	M13.C	M13.D	M13.E	M13.F	M13.G
Not Effective	25	28	28	25	21	23	38
Effective	51	48	48	51	55	53	38
Total	76	76	76	76	76	76	76

M13.A: Measure and price bills of quantities properly during biding phase

$\chi^2 = 3.14$ df = 2 $p = 0.103$

M13.B: Develop a clear and appropriate plan and control schedule and cost

$\chi^2 = 0.93$ df = 2 $p = 0.313$

M13.C: Secure standby cash flow in advance

$\chi^2 = 4.52$ df = 2 $p = 0.052$

M13.D: Incorporate escalation clauses for interest, inflation rates and delays in contract

$\chi^2 = 4.66$ df = 2 $p = 0.048$

Table 4.49 Distribution of responses for the fourth mitigation strategy of 'Cost Overrun' risk

M13.D	Client	Contractor	Consultant
Not Effective	9%	32%	46%
Effective	91%	68%	54%
Total	100%	100%	100%

M13.E: Specify extension or compensation clauses in contract for payment

$\chi^2 = 3.07$ df = 2 $p = 0.107$

M13.F: Enter into fixed rate loan contract with lending banks

$\chi^2 = 5.65$ df = 2 $p = 0.029$

Table 4.50 Distribution of responses for the sixth mitigation strategy of 'Cost Overrun' risk

M13.F	Client	Contractor	Consultant
Not Effective	0%	37%	33%
Effective	100%	63%	67%
Total	100%	100%	100%

M13.G: Sign fixed or pre-determined prices with material and accessory facilities suppliers

$\chi^2 = 5.34$ df = 2 $p = 0.034$

Table 4.51Distribution of responses for the seventh mitigation strategy of 'Cost Overrun' risk

M13.G	Client	Contractor	Consultant
Not Effective	18%	54%	58%
Effective	82%	46%	42%
Total	100%	100%	100%

Except the last strategy which has got the equal ranking as being a more/less effective strategy, other strategies have been assessed more effective. Looking at the tables above, majority of the clients have assessed the strategies more effective than other groups. Referring back to the comparison provided earlier in this chapter regarding the criticality of the 25 risks, cost overrun had the highest criticality from client's viewpoints. Therefore, this contradiction in clients' evaluation of this risk and its strategies can be considered as a support for the discussion provided on the idealistic viewpoint of the clients about other risks' strategies as well. If these strategies are very effective in practice (not only in theory), the probability of ranking the cost overrun as the most critical risk (out of 25) by the clients would be reduced.

14 - Inadequate Design (5)

Table 4.52 Distribution of responses for mitigation strategies

Inadequate Design	M14.A	M14.B	M14.C	M14.D	M14.E
Not Effective	21	33	26	25	27
Effective	55	43	50	51	49
Total	76	76	76	76	76

M14.A: Introduce adjustment clauses in contract to review plan and constructability. Since this strategy has been evaluated as effective by all on average and separately by each group, slight difference in clients' opinion where all of them have fallen in one group can be resulted from similar previous reasons argued before. From this strategy onward if all the groups have assessed the strategy as effective and a higher percentage for the clients (sometimes 100%) has changed the *p*-value to be less than 0.05, reasons are assumed as what was discussed earlier. Therefore, the table is only displayed and no further discussion is provided unless a different concept - as a probable reason for diversity in viewpoints - is required to be argued.

$\chi^2 = 4.93$ df = 2 $p = 0.042$

Table 4.53 Distribution of responses for the first mitigation strategy of 'Inadequate Design' risk

M14.A	Client	Contractor	Consultant
Not Effective	0%	32%	33%
Effective	100%	68%	67%
Total	100%	100%	100%

M14.B: Arrange and undertake comprehensive site investigation before construction phase

$\chi^2 = 0.05$ df = 2 $p = 0.487$

M14.C: Specify construction extension clause in contract

$\chi^2 = 4.52$ df = 2 $p = 0.052$

M14.D: Organize for appraisal/vetting of drawings and design criteria by at least one independent engineering / architect consultant

$\chi^2 = 0.08$ df = 2 $p = 0.478$

M14.E: Review plans jointly with partners to determine changes

$\chi^2 = 4.48$ df = 2 $p = 0.052$

15 –Low Construction Productivity (4)

Table 4.54 Distribution of responses for mitigation strategies

Low Construction Productivity	M15.A	M15.B	M15.C	M15.D
Not Effective	20	27	43	19
Effective	56	49	33	57
Total	76	76	76	76

M15.A: Adopt proper quality control procedures

$\chi^2 = 5.24$ df = 2 $p = 0.036$

Table 4.55 Distribution of responses for the first mitigation strategy of ‘Low Construction Productivity’ risk

M15.A	Client	Contractor	Consultant
Not Effective	0%	34%	25%
Effective	100%	66%	75%
Total	100%	100%	100%

M15.B: Adopt proper safety control program

$\chi^2 = 7.08$ df = 2 $p = 0.014$

Table 4.56 Distribution of responses for the 2nd mitigation strategy of ‘Low Construction Productivity’ risk

M15.B	Client	Contractor	Consultant
Not Effective	0%	41%	42%
Effective	100%	59%	58%
Total	100%	100%	100%

M15.C: Incorporate weather impacts into project schedule

$\chi^2 = 4.51$ df = 2 $p = 0.052$

M15.D: Apply innovative production concepts/philosophies like Lean Construction, Just in Time and Total Quality Management, to decrease variability and rework during construction

$\chi^2 = 2.38$ df = 2 $p = 0.151$

All strategies for this risk have been evaluated more as being effective expect the third one since incorporation of weather impacts may not be a very effective strategy for increasing the productivity of the construction in Iran.

16 - Site Safety (2)

Table 4.57 Distribution of responses for mitigation strategies

Site Safety	M16.A	M16.B
Not Effective	15	21
Effective	61	55
Total	76	76

M16.A: Get Third Party Insurance for compensation to general public and staff

$\chi^2 = 0.93$ df = 2 $p = 0.313$

M16.B: Adopt proper safety control program, management system, supervision, incentives and preventive measures

$\chi^2 = 4.93$ df = 2 $p = 0.042$

Table 4.58 Distribution of responses for the second mitigation strategy of 'Site Safety' risk

M16.B	Client	Contractor	Consultant
Not Effective	9%	22%	21%
Effective	91%	78%	79%
Total	100%	100%	100%

17 - Late Payment (3)

Table 4.59 Distribution of responses for mitigation strategies

Late Payment	M17.A	M17.B	M17.C
Not Effective	20	15	22
Effective	56	61	54
Total	76	76	76

M17.A: Examine the financial resources liability / clients' financial viability

$\chi^2 = 3.15$ df = 2 $p = 0.103$

M17.B: Inquiring client's reputation in payment

$\chi^2 = 0.03$ df = 2 $p = 0.491$

M17.C: Review the contract properly to allocate extra budget in bidding phase

$\chi^2 = 0.77$ df = 2 $p = 0.339$

Moreover, two more strategies were suggested by participants for this risk:

- Including clauses in the contract for the financial resources to be provided by the bank loans
- Further cooperation of insurance companies in relation to late payments

<u>18 - Inadequate Quality Control</u> (3)

Table 4.60 Distribution of responses for mitigation strategies

Inadequate Quality Control	M18.A	M18.B	M18.C
Not Effective	26	25	35
Effective	50	51	41
Total	76	76	76

M18.A: Adopt proper quality control procedures and cooperation with supervision system. The contractors have assessed this strategy differently where a great portion of them compared to the other two groups have evaluated this strategy as less effective. Since supervision system is usually the client or the consultant - as the representative of the client - in the construction projects; contractors may have not found this cooperation to be easily feasible whereas the supervision system itself has considered it as an effective strategy. Contractors' viewpoint may have also been resulted from the probable conflicts between their opinions and the supervision's opinion about the details of the work and consequently their lack of interest in maintaining this cooperation.

$\chi^2 = 8.85$ df = 2 $p = 0.005$

Table 4.61Distribution of responses for the first mitigation strategy of 'Inadequate Quality Control' risk

M18.A	Client	Contractor	Consultant
Not Effective	9%	49%	21%
Effective	91%	51%	79%
Total	100%	100%	100%

M18.B: Adopt proper incentives for personnel and staff for improving the quality

$\chi^2 = 6.75$ df = 2 $p = 0.017$

Table 4.62 Distribution of responses for the second mitigation strategy of 'Inadequate Quality Control' risk

M18.B	Client	Contractor	Consultant
Not Effective	0%	41%	33%
Effective	100%	59%	67%
Total	100%	100%	100%

M18.C: Review plans jointly with partners to determine changes

$\chi^2 = 7.12$ df = 2 p = 0.014

Table 4.63 Distribution of responses for the third mitigation strategy of 'Inadequate Quality Control' risk

M18.C	Client	Contractor	Consultant
Not Effective	9%	51%	54%
Effective	91%	49%	46%
Total	100%	100%	100%

Also suggested by participants:

- ❖ Offer training to employees and staff on quality control methods

19 - Inadequate Project Management (3)

Table 4.64 Distribution of responses for mitigation strategies

Inadequate Project Management	M19.A	M19.B	M19.C
Not Effective	13	19	25
Effective	63	57	51
Total	76	76	76

M19.A: Hire competent project management team

$\chi^2 = 2.67$ df = 2 p = 0.131

M19.B: Clear definition of each staff's scope of work

$\chi^2 = 1.36$ df = 2 p = 0.252

M19.C: Provide clauses on schedule delay, construction extension and additional payment if caused by client

$\chi^2 = 6.48$ df = 2 p = 0.019

Table 4.65Distribution of responses for the third mitigation strategy of ‘Inadequate Project Management’ risk

M19.C	Client	Contractor	Consultant
Not Effective	0%	37%	42%
Effective	100%	63%	58%
Total	100%	100%	100%

<u>20 - Environmental Protection</u> (4)

Table 4.66 Distribution of responses for mitigation strategies

Environmental Protection	M20.A	M20.B	M20.C	M20.D
Not Effective	43	45	30	38
Effective	33	31	46	38
Total	76	76	76	76

M20.A: Investigate comprehensive site investigation for environmental issues related to the project before signing the contract and starting the project.

$\chi^2 = 5.33$ df = 2 $p = 0.034$

Table 4.67Distribution of responses for the first mitigation strategy of ‘Environmental Protection’ risk

M20.A	Client	Contractor	Consultant
Not Effective	27%	66%	54%
Effective	73%	34%	46%
Total	100%	100%	100%

The difference of opinions can be seen between clients and contractors where high percentages of the clients have considered it as an effective strategy and many of the contractors have evaluated it as being less effective. The environmental issues related to the construction projects can be considered to be usually different for these two groups. Client mostly investigates the location of the project and its harms for the environment depending on its type such as drying of the lake and requires obtaining the related approvals for that. Contractor mostly deals with the issues which may happen during the actual construction of the project such as pollution or noises. Therefore, investigating the environmental issues before starting the project is more feasible for the clients than contractors who may cope with new issues arising as the project progresses.

M20.B: Adopt strict pollution control measures. The difference in viewpoints of clients compared to contractors and consultants may be assumed to be resulted from the evaluation on the possibility of this strategy. Since it is the responsibility of contractors and consultants during the execution of the project to adopt these measures, they may have considered its difficulties, costs and also availability of the facilities for measurements in various parts of the country.

$\chi^2 = 9.92$ df = 2 $p = 0.003$

Table 4.68 Distribution of responses for the second mitigation strategy of 'Environmental Protection' risk

M20.B	Client	Contractor	Consultant
Not Effective	18%	71%	58%
Effective	82%	29%	42%
Total	100%	100%	100%

M20.C: Include disclaimer in contract for present pollution level

$\chi^2 = 3.20$ df = 2 $p = 0.100$

M20.D: Include clauses in contract where client is responsible for environmental problems, negotiations with related organizations & obtaining the approvals

$\chi^2 = 8.64$ df = 2 $p = 0.006$

Table 4.69 Distribution of responses for the fourth mitigation strategy of 'Environmental Protection' risk

M20.D	Client	Contractor	Consultant
Not Effective	9%	56%	58%
Effective	91%	44%	42%
Total	100%	100%	100%

21 - Public Image (2)

Table 4.70 Distribution of responses for mitigation strategies

Public Image	M21.A	M21.B
Not Effective	44	29
Effective	32	47
Total	76	76

M21.A: Comply with civil laws and standards, social and cultural values. There are usually laws and standards for different aspects of the project, but complying with those is not easily feasible otherwise many other issues arising in the projects would be eliminated.

$\chi^2 = 2.85$ df = 2 $p = 0.119$

M21.B: Maintain good reputation and image to the public

$\chi^2 = 9.40$ df = 2 $p = 0.004$

Table 4.71 Distribution of responses for the second mitigation strategy of ‘Public Image’ risk

M21.B	Client	Contractor	Consultant
Not Effective	0%	39%	54%
Effective	100%	61%	46%
Total	100%	100%	100%

22 - Intellectual Property Protection (4)

Table 4.72 Distribution of responses for mitigation strategies

Intellectual Property Protection	M22.A	M22.B	M22.C	M22.D
Not Effective	43	34	22	26
Effective	33	42	54	50
Total	76	76	76	76

M22.A: Exploit legislation to get protection against unauthorized use of confidential information. The difference between the opinions of the clients and consultants can be assumed as the evaluation on the characteristics of legislations(by clients) and their level of effectiveness (by consultants).

$\chi^2 = 7.30$ df = 2 $p = 0.012$

Table 4.73 Distribution of responses for the first mitigation strategy of 'Intellectual Property Protection' risk

M22.A	Client	Contractor	Consultant
Not Effective	27%	54%	75%
Effective	73%	46%	25%
Total	100%	100%	100%

M22.B: Confirm whether a good intellectual property protection scheme is in place for the key intellectual property like trademark, patent or copyright law

$\chi^2 = 10.49$ df = 2 $p = 0.002$

Table 4.74 Distribution of responses for the 2nd mitigation strategy of 'Intellectual Property Protection' risk

M22.B	Client	Contractor	Consultant
Not Effective	0%	54%	50%
Effective	100%	46%	50%
Total	100%	100%	100%

M22.C: Insist on having trustworthy people on key places

$\chi^2 = 0.01$ df = 2 $p = 0.495$

M22.D: Intellectual property rights training to all key employees by sending them to seminars

$\chi^2 = 6.73$ df = 2 $p = 0.017$

Table 4.75 Distribution of responses for the 4th mitigation strategy of 'Intellectual Property Protection' risk

M22.D	Client	Contractor	Consultant
Not Effective	0%	39%	42%
Effective	100%	61%	58%
Total	100%	100%	100%

Other strategies suggested by participants were:

- Contributing the key employees to the profit of the company / offering them rewards
- Placing restrictive covenants (promises) in the contracts of employees

23 - Force Majeure (5)

Table 4.76 Distribution of responses for mitigation strategies

Force Majeure	M23.A	M23.B	M23.C	M23.D	M23.E
Not Effective	43	21	10	20	28
Effective	33	55	66	56	48
Total	76	76	76	76	76

M23.A: A party which fails to meet his contractual obligation due to force majeure must notify the other one within a reasonable time. The evaluation of this risk as less effective makes sense since notifying other parties is good but would not mitigate the consequences (usually physical) resulted from this type of risk very much.

$\chi^2 = 0.64$ df = 2 $p = 0.361$

M23.B: Obtain government guarantee to adjust tariff or extend concession period

$\chi^2 = 2.33$ df = 2 $p = 0.155$

M23.C: Insure all of the insurable force majeure risks

$\chi^2 = 2.00$ df = 2 $p = 0.183$

M23.D: Obtain government's guarantee to provide financial help when needed

$\chi^2 = 5.48$ df = 2 $p = 0.032$

Table 4.77 Distribution of responses for the fourth mitigation strategy of 'Force Majeure' risk

M23.D	Client	Contractor	Consultant
Not Effective	0%	27%	38%
Effective	100%	73%	63%
Total	100%	100%	100%

M23.E: Include delay clauses for contingency plan in contract

$\chi^2 = 4.25$ df = 2 $p = 0.059$

24 - Market Demand (1)

Table 4.78 Distribution of responses for mitigation strategy

Market Demand	M24.A
Not Effective	19
Effective	57
Total	76

M24.A: Employ reputable third party consultant to forecast market demand

$\chi^2 = 4.62$ df = 2 $p = 0.049$

Table 4.79 Distribution of responses for the first mitigation strategy of 'Market Demand' risk

M24.A	Client	Contractor	Consultant
Not Effective	0%	27%	33%
Effective	100%	73%	67%
Total	100%	100%	100%

25 – Competition (1)

Table 4.80 Distribution of responses for mitigation strategy

Competition	M25.A
Not Effective	37
Effective	39
Total	76

M25.A: Conduct market study and obtain exact information of competitive projects

$\chi^2 = 2.99$ df = 2 $p = 0.111$

Proposing mitigation strategies for risks - especially the external risks - is not easy since it is for an unpredictable event. Moreover, as it was seen above sometimes the strategies are effective in theory but not in practice depending on the situation of a country. Considering the evaluations of mitigation strategies above, it can be realized that including clauses in the Special Conditions of the Contract for projects was considered as an effective strategy for many of the risks. Due to the uniqueness of the projects, the content of General Conditions of the Contract would not be sufficient for executing all the projects. Therefore, adding relevant clauses with agreement of all the parties to the Special Conditions of the Contract for each project would help mitigating some of the risks associated with that specific project to some extent.

Furthermore, maintaining good relationship with governmental bodies was also assessed as an effective strategy. According to the discussion provided on political instability of Iran in Methodology chapter, commonly inexpert managers are appointed for governmental positions (which also include client in this thesis). As a result, they may apply their individual opinions instead of obeying rules and whenever regulations lose their importance, relations get more significant. For this reason, maintaining good relationship with governmental bodies and relevant authorities was evaluated to be effective when proposed for the risks.

Same as the 25 risks' section, analysis of the mitigation strategies section is finished by utilizing ward-method for classification of the strategies to determine how these strategies group themselves into two clusters. The Dendrogram has been demonstrated in the next page showing two clusters comprising 49 and 27 participants with the first cluster evaluating the proposed mitigation strategies slightly more effective than the second cluster. Allocation of the participants from the three groups into these two clusters is as follows:

49 participants: Higher Effectiveness 27 participants: Lower Effectiveness

Table 4.81 Number of participants in each of the clusters for evaluating the effectiveness of strategies

Mitigation Strategies	Client	Contractor	Consultant	Total
Low Effectiveness	0	18	9	27
High Effectiveness	11	23	15	49
Total	11	41	24	76

Table 4.82 Percentage of participants in each of the clusters for evaluating the effectiveness of strategies

Mitigation Strategies	Client	Contractor	Consultant	Total
Low Effectiveness	0%	44%	37.5%	36%
High Effectiveness	100%	56%	62.5%	64%
Total	100%	100%	100%	100%

The percentages of participants from each group in the two clusters are almost in agreement with the previous discussions provided on the diverse viewpoints of the participants while analysing the effectiveness of proposed mitigation strategies.

All the clients are in the same cluster, evaluating the effectiveness of the mitigation strategies slightly higher than the other cluster and it can be presumed to be resulted from two assumptions. Firstly, there are fewer numbers of the clients compared to the other groups and it may therefore reduce the diversity in their viewpoints and place their opinions much closer to each other. Moreover, they are not coping with the risks directly (compared to contractors and consultants) during the execution of the project due to the type of their responsibilities. This may influence their perspective for evaluating the effectiveness of the mitigation strategies more in theory than in practice.

Contractors have much closer percentages being allocated to each of the two clusters. This party is the one who deals directly with almost all the risks provided in the questionnaire when executing the projects. Therefore, it can be considered that their perspective is more realistic and they may be evaluating the feasibility of implementing these strategies in addition to their effectiveness in theory.

Consultants' viewpoint is rather between two other groups which can be assumed to be the result of their position in the construction project - an intermediator between the client and the contractor. Consultants also cope directly with the risks of the project to some extent, especially since they are supervising the contractors' execution of the work. Therefore, their evaluation of the mitigation strategies may have also considered the feasibility of implementation of them in Iran as well as assessment of their effectiveness.

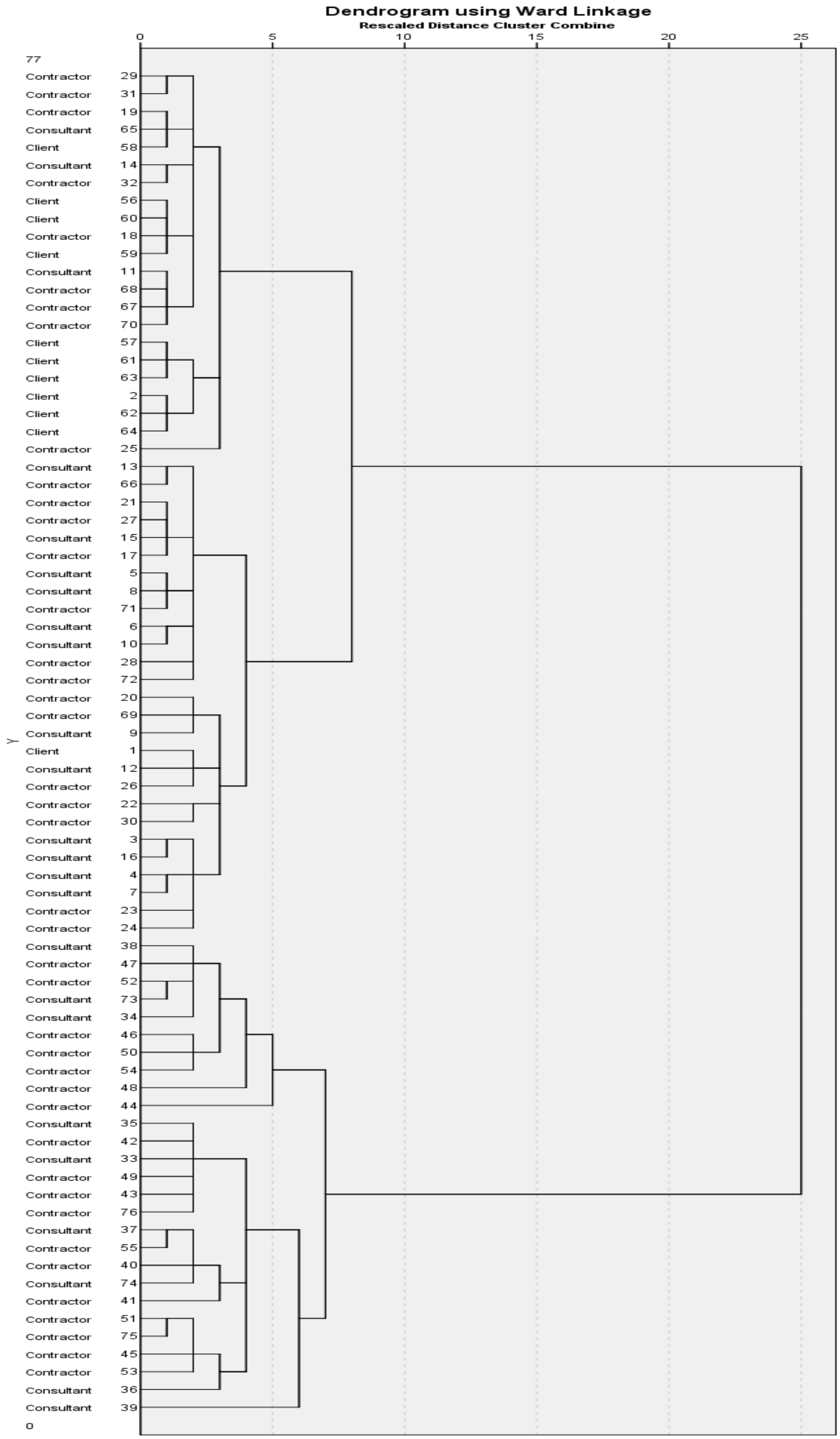


Figure 4.15 Two clusters of participants for evaluating the effectiveness of mitigation strategies

4.2.4.1. Cross-cluster: evaluation of risks and mitigation strategies

After utilizing the Ward-method for classification of the risks and mitigation strategies, the results of these two classifications were mixed and named as ‘Cross-Cluster’.

Referring back to figure 5.14 which shows two clusters for risks, cluster 1 (55 participants) had evaluated the criticality of the risks slightly lower than cluster 2 (21 participants). Looking at figure 5.15 for the clusters of mitigation strategies, cluster 1 (49 participants) had rated the strategies as being slightly more effective than cluster 2 (27 participants). Combination of the results of these two figure resulted in 4 different clusters for the cross-cluster which is the participants’ overall evaluation of risks and mitigation strategies:

1. Evaluating risks as less critical and mitigation strategies as more effective
2. Evaluating risks as less critical and mitigation strategies as less effective
3. Evaluating risks as more critical and mitigation strategies as more effective
4. Evaluating risks as more critical and mitigation strategies as less effective

The proportion of participants in each of these clusters is in accordance with the arguments provided earlier for each of the classifications individually (for risks and mitigation strategies) about the participants’ types of personality, perspectives, job responsibilities, the level of involvement and extent to which each party may cope directly with the risks. Number of participants from each group for each of the 4 clusters has been shown in the tables below:

Table 4.83 Number of participants in each of the clusters for evaluating the criticality of risks and effectiveness of mitigation strategies

Risks & Mitigation Strategies	Client	Consultant	Contractor	Total
1 - Low Criticality & High Effectiveness	2	14	16	32
2 - Low Criticality & Low Effectiveness	0	7	16	23
3 - High Criticality & High Effectiveness	9	1	7	17
4 - High Criticality & Low Effectiveness	0	2	2	4
Total	11	24	41	76

Table 4.84 Percentage of participants in each of the clusters for evaluating the criticality of risks and effectiveness of mitigation strategies

Risks & Mitigation Strategies	Client	Consultant	Contractor	Total
1 - Low Criticality & High Effectiveness	18%	58%	39%	42%
2 - Low Criticality & Low Effectiveness	0%	29%	39%	30%
3 - High Criticality & High Effectiveness	82%	4%	17%	22%
4 - High Criticality & Low Effectiveness	0%	8%	5%	5%
Total	100%	100%	100%	100%

4.2.5. Evaluation of the level of agreement with construction related statements

Final section of the questionnaire to be analysed is the one including 50 statements related to different aspects of construction projects. These statements have been allocated to 10 different topics for analysis (each one or more statements to one topic) and participants were asked to select their agreement choice for these statements from a 1-6 scale provided. The numbers of this scale were grouped while analysing (same as the scale of 25 risks and their mitigation strategies) and are shown below:

1: Strongly Disagree
2: Disagree
→ Disagree

3: Neutral → Neutral

4: Agree
5: Strongly Agree
→ Agree

6: Do Not Know → DNK

The 10 topics are listed one by one comprising their related statements (from the 50 statements) and the ranking of the participants for them. Further tables may also be provided illustrating the three groups of participants individually and their evaluation in order to figure out the dissimilarities.

Before listing the topics, it needs to be explained that choosing the opinion of 'neutral' for some of the statements can be considered to be resulted from two assumptions:

1. They neither agree nor disagree with a statement, meaning that they think it is sometimes true and sometimes false; or it is sometimes happening and sometimes not happening depending on the situation, type of the project, its location, and involved parties.
2. Measurement scale cannot be easily defined and perceived for some of the statements including words such as familiarity, expensive, enough, and even effectiveness. As a result, agreement and disagreement with such statements would make more sense if they get compared to something else with similar specifications. Hence, the participants may choose neutral since people's perception about these concepts are different.

1. *Risk Management*

Table 4.85 Distribution of responses for 'Risk Management' statements

Risk Management	Disagree	Neutral	Agree	DNK
S1	1%	0%	99%	0%
S2	1%	1%	97%	0%
S3	0%	3%	96%	1%
S4	24%	29%	43%	4%

S1: Managers' proficiency in risk management plays an important role in project management activities

S2: Iranian contractors urgently need risk management knowledge and expertise in managing construction projects

S3: Risk management can effectively protect the contractors' interest

S4: Risk management will be involved in considerable extra cost of management expense and time

As the table above shows, more than 95% of the participants agree with the first three statements related to the risk management of construction project. Therefore, although they are aware of the advantages of the risk management on managing the projects and protecting the interest of contractors, they declare the lack of knowledge and expertise in this field in Iran.

For the Fourth statement, still the highest percentage agrees with involvement of extra cost and time with risk management. The responses for neutral (29%) may have been resulted from different perceptions of participants from the time and cost involved in the risk management process. Since 97% of the participants agree with the second statement, asserting the lack of expertise in risk management in Iran, the level of disagreement (24%) for the fourth statement can be assumed to be the result of their unfamiliarity with the details of the process.

Distribution of the opinions for the fourth statement has been illustrated below for three groups of participants:

Table 4.86 Distribution of responses for the fourth statement (from Risk Management statements)

S4	Client	Contractor	Consultant
Disagree	18%	24%	25%
Neutral	27%	29%	29%
Agree	55%	42%	42%
DKN	0%	5%	4%

2. *Insurance*

S5: Construction insurance can protect contractors' interest effectively

S6: In Iran, insurance companies are familiar with the background of construction projects

S7: Construction insurance against risk is expensive due to high premiums in Iran

S8: The services of claim from insurance companies in Iran are standard

S9: Insurance claims are difficult and wordings are complicated, therefore contractors have to turn to an intermediary (e.g. agents, brokers, loss adjusters)

S10: Contractors can retain the premium and manage the risks by themselves effectively

S11: A contract of works in Iran should contain strict and clearly defined insurance terms

S12: Insurance companies in Iran could not provide risk management service effectively even at extra charge

S13: Underwriters should give contractors premium discount in consideration of construction companies' good risk management practice

Table 4.87 Distribution of responses for 'Insurance' statements

Insurance	Disagree	Neutral	Agree	DNK
S5	5%	13%	82%	0%
S6	40%	30%	18%	12%
S7	20%	32%	36%	13%
S8	8%	12%	76%	4%
S9	58%	24%	9%	9%
S10	46%	17%	37%	0%
S11	4%	9%	82%	5%
S12	13%	25%	49%	13%
S13	29%	26%	24%	21%

As the table of responses shows, although parties agree with the effectiveness of insurance for protecting the interests, they believe that insurance companies are not very familiar with the nature of the risks associated with construction projects. Participants consider the construction insurance as being somehow expensive and despite of these extra charges they are still not providing an effective service. The service of claim from insurance companies sounds to be up to an acceptable standard level from participants' viewpoint.

A slight contradiction can be seen between the opinions about statements 10 and 11. Although a high percentage of the participants assert the necessity of the inclusion of insurance terms in the contract (S11), nearly 37% of them believe that they can manage the risks themselves without the insurance (S10). This can be assumed to be resulted from two reasons:

- ❖ Participants believe that despite of expensive insurance, this service is not satisfactory and therefore they prefer to retain that premium and manage the risks themselves
- ❖ Lack of knowledge about risk management may generate the mentality for believing that they can manage the risks of the project on their own and by utilizing their experience

Looking at the responses on providing premium discount indicated in the statement 13, nearly quarter of the respondents have selected 'do not know' option which shows their lack of knowledge about the services and details of the insurance companies. The responses of the rest of participants have been distributed almost equally between agreement, neutral and disagreement. This can be resulted from existence of different types of insurance companies in Iran: public, private and mixed. Each of these types is providing various services and some may provide this discount for the construction companies. Therefore, this distribution of responses can be caused by unawareness of the participants about all the services provided by different types of insurance companies since they may have worked only with specific companies for the insurance of their projects.

3. *Finance*

Table 4.88 Distribution of responses for 'Finance' statements

Finance	Disagree	Neutral	Agree	DNK
S14	4%	8%	87%	1%
S15	0%	3%	97%	0%
S16	12%	20%	61%	8%
S17	4%	13%	80%	3%

S14: There are significant fluctuations in the progress payment exchange rate of the projects in Iran

S15: There are significant fluctuations in the inflation rate of Iran

S16: Immature economic and banking systems adversely affect projects

S17: Financial condition of the client is not well known

According to the discussion provided in the Methodology chapter about the economic situation of Iran, a high level of agreement was expected to be seen for these statements. Most of the participants agree with instable economy resulting in fluctuations of inflation rate and exchange rate in addition to relatively unknown financial conditions of the clients which affect the construction projects adversely. High level of agreement with this topic's statements is in accordance with diagrams provided earlier for 25 risks which were showing the criticality of Economic and Financial risks to be higher than other risks.

4. *Politics and Government*

Table 4.89 Distribution of responses for 'Politics and Government' statements

Politics & Government	Disagree	Neutral	Agree	DNK
S18	1%	9%	88%	1%
S19	5%	16%	79%	0%
S20	7%	26%	66%	1%
S21	3%	29%	59%	9%
S22	4%	9%	87%	0%
S23	7%	17%	72%	4%

S18: Political instability results in financial problems

S19: Political instability results in planning problems

S20: Political instability results in day-to-day changes in policy which influence the construction projects negatively

S21: There are problems in the import and export regulations of Iran

S22: Occurrence of long delays resulted from bureaucracy

S23: There is a considerable problem of bribery and corruption in Iran

Same as the statements related to finance in previous section; due to political instability of Iran discussed earlier, a high level of agreement was also expected to be seen for the statements in this section. Instability in the political situation of a country and consequently its government would intensely influence the economic situation and predominant regulations of the country. Therefore, frequent changes in policies and regulations would change the plans of any construction project and may also increase the bureaucracy which in turn may increase the duration of the project as well as the probability of the occurrences of the bribery.

5. *Experience / Communication between Parties*

Table 4.90 Distribution of responses for ‘Experience / Communication between Parties’ statements

Experience / Communication Between Parties	Disagree	Neutral	Agree	DNK
S24	42%	25%	26%	7%
S25	57%	17%	17%	9%
S26	45%	22%	24%	9%
S27	24%	17%	55%	4%
S28	39%	18%	41%	1%
S29	34%	26%	38%	1%
S30	43%	20%	37%	0%
S31	25%	18%	57%	0%
S32	49%	21%	29%	1%

S24: The system of communication about the nature of risks within the organization is effective

S25: The system of communication about the risk mitigation strategies within the organization is effective

S26: The system of communication about any project changes within the organization is effective

S27: There is a communication gap between the contractor and the client

S28: There is a communication gap between the contractor and consultant

S29: There is a communication gap between the client and the consultant

S30: Clients pay enough attention in choosing the consultants and trust them in project's procedures and decision makings

S31: The manager hasn’t got enough experience in project management

S32: Contractors are not able to gain sufficient experience through executing similar works

For the first three statements of this section, a higher level of disagreement can be seen on the effectiveness of communication within the participants' organization. This assertion of dissatisfaction from the quality of communication had been also illustrated in the diagrams showing the results of 'company's information' section.

The relatively close percentages for the level of agreement and disagreement with the next three statements demonstrate the existence of communication gap to some extent between the three groups involved in the execution of the construction project: client, consultants, and contractor. Looking at the statement 27 which is about the communication gap between the client and contractor, a higher level of agreement is seen compared to the statements 28 and 29. This difference determines that the communication gap between the consultant and the other two groups is less than the communication gap between the contractor and client. This can be assumed to be the result of the position of consultants as the link between contractors and clients who have direct communication with both. However, for the contractors and clients who usually communicate via the consultants, the quality of the communication has been assumed to be less.

The table below illustrates the responses of each group separately for the statement 30. As it is seen, majority of the clients have agreed which shows their confidence in choosing the consultants and trusting them. However, more than 50% of the consultants have disagreed which can be considered as being the result of their dissatisfaction about the level of trust they feel from clients about their responsibilities.

Table 4.91 Distribution of responses for the thirtieth statement (from Experience/Communication between Parties statements)

S30	Client	Contractor	Consultant
Disagree	9%	46%	54%
Neutral	27%	22%	13%
Agree	64%	32%	33%
DKN	0%	0%	0%

Responses on the statement 31 indicate the lack of experience of the managers and since people are normally happy with their own knowledge and experience, it can be presumed that each group of participants has evaluated the experience of managers of other parties or the management level above themselves.

For the last statement the level of disagreement is higher, showing that nearly half of the participants believe that contractors are able to gain sufficient experience. Some of clients only accept the contractors who have the experience of working in similar types of project to enter the tendering process of any new project they are about to start. According to this rule, contractors would be able to execute similar projects and gain the experience from similar processes and risks which may happen during these projects. On the other hand, responses on neutral and agreement can be considered to be the result of two assumptions. Firstly, some of the clients do not have this regulation regarding the obligation of having the experience of executing similar works for the contractors who want to start the new project and any new contractor with other specifications may replace the ones having experience of similar works. Secondly, due to existence of unsound competition and instabilities in political and economic situation of the country, many contractors may prefer to start new types of project - different from what they have experience in - just to keep the company working.

6. *Market / Materials / Human Resource*

Table 4.92 Distribution of responses for 'Market / Material / Human Resource' statements

Market / Materials / Human Resource	Disagree	Neutral	Agree	DNK
S33	29%	22%	37%	12%
S34	46%	16%	37%	1%
S35	51%	18%	30%	0%
S36	57%	24%	17%	3%
S37	32%	8%	59%	1%
S38	54%	29%	14%	3%
S39	8%	9%	83%	0%

S33: There are problems in availability of construction plant and spare parts

S34: There are problems in the availability of subcontractors

S35: There are problems in the availability materials

S36: There have been frequent occurrences of strikes in the construction market

S37: There are problems in the availability of Labour / Foreman

S38: Labour rates are high in Iran

S39: Efficiency / Productivity of local labour is low

As the table of responses for this section demonstrates, there are rather problems in availability of construction plants, materials and subcontractors. Moreover, there are more problems related to availability of labours and their productivity is relatively low in Iran.

7. *Construction Site*

Table 4.93 Distribution of responses for ‘Construction Site’ statements

Construction Site	Disagree	Neutral	Agree	DNK
S40	62%	16%	20%	3%
S41	17%	18%	63%	1%
S42	43%	17%	39%	0%

S40: Natural disasters are frequently observed in the geographical area where the project is implemented

S41: Construction site is not very secure

S42: It is almost impossible to stock materials on the site

Responses for this topic demonstrate that natural disasters are not influencing the construction projects in Iran strongly. Despite of this fact, construction site have not been considered to be very safe which therefore refers to the level of robbery. For this reason, it should not be very safe to stock materials on the site but existence of the word ‘impossible’ in the last statement could be assumed to be the result of 43% of disagreement.

8. *Contract*

S43: Drawings and the contract are not in sufficient detail

S44: Applying the clauses of the contract is not such easy

S45: In the contract agreement, the function and the responsibility of the client and the contractor is not clearly stated in sufficient detail

S46: Contractual clauses about the claims and arbitration are not seem to be fair from the contractors perspective

S47: There is not enough information about the ground conditions

Table 4.94 Distribution of responses for 'Contract' statements

Contract	Disagree	Neutral	Agree	DNK
S43	20%	13%	67%	0%
S44	13%	15%	72%	0%
S45	26%	24%	49%	1%
S46	5%	22%	67%	5%
S47	39%	12%	45%	4%

As demonstrated in the table above, there are issues regarding the contracts of the construction projects. Drawings, responsibilities and some other clauses in the contract are not very clear and in sufficient detail, and at some points not fair from contractors' perspective. It can be considered that due to the dissatisfaction of the parties from the existing contracts and clauses, inclusion of clauses about different aspects of the project to its contract was mostly evaluated as an effective strategy in the previous section of the questionnaire.

9. *<u>Project Bidding</u>*

Table 4.95Distribution of responses for 'Project Bidding' statements

Project Bidding	Disagree	Neutral	Agree	DNK
S48	11%	9%	80%	0%
S49	3%	0%	97%	0%

S48: Due to lack of time for preparation of the tender, the contractor has not worked in detail for the project bid

S49: Due to competition factor in preparation of the tender, the contractor has not considered all the costs related to risks

The high level of agreement with these two statements indicates the existing difficulties associated with tendering especially high level of influences of competition on it. Therefore, apart from the instable situation of the country which may increase the criticality of the risks for construction projects, lack of consideration in tendering regarding details of the work may also increase this criticality.

10. Time

Table 4.96 Distribution of responses for 'Time' statements

Time	Disagree	Neutral	Agree	DNK
S50	8%	7%	86%	0%

S50: It is almost impossible to finish the constructions works on time

Finally, the last statement is showing high level of agreement with the occurrences of delay in construction projects. Discussing the situation of Iran and evaluating the level of criticality of the risks; delay can be considered as an inevitable risk in construction projects of Iran.

4.3. Conclusion

This chapter analysed the quantitative data collected for this thesis via questionnaire. Five sections of the questionnaire were analysed through different methods and the results were shown, a summary of them is provided below:

- 76 participants comprised the three groups involved in the construction projects: clients (11), consultants (24), and contractors (41). All these participants were involved in the governmental public projects, and more than 50% of them had minimum of 10 years of experience working in construction industry. However, looking at the details of their companies a great number of them did not have risk managers in their company. This lack of knowledge about the formal risk management process had resulted in high level of dissatisfaction about the company's risk management strategy.

- Analyzing the evaluation of the criticality of the risks by participants both in the first table of the questionnaire and the table of 25 risks illustrates the high criticality of Economic and Financial risks. First three risks evaluated as critical by all the participants were the sub-categories of Economic and Financial risks and this was the same for contractors and consultants but slightly different for clients. Clients had ranked cost overrun - a sub-category of Managerial and Technical risks - as the most critical risk but again the second and third risks were financial related.

- Considering the 9 risks assessed as critical out of 25 risks, it could be seen that the highest frequency was for Economic and Financial risks, followed by Managerial and Technical risks and then the Political and Governmental risks. It established the greater influences of external risks on construction projects than the internal ones. Moreover, lower criticality of sub-categories of Cultural and Social risks and Natural ones was illustrated since they were not mentioned in the groups of critical risks by any of the participants.

- Evaluating the opinion of all the participants about the risks, it could be ascertained that the level of criticality for the construction projects' risks in Iran is more than intermediate. Furthermore, three groups of participants had evaluated the risks slightly different from each other due to their types of personality, job responsibilities and the extent to which they cope directly with the risks. The clients had evaluated the risks rather more critical than contractors followed by consultants as the group considering the risks relatively less critical than the two other groups.

- The difference between the viewpoints of three groups of participants was also demonstrated when comparing the results of Chi-squared test for the risks. The difference was mostly between the opinions of the clients for evaluating the risks as more critical and the consultants for evaluating them as less critical compared to others. This difference in opinions was observed much more in the Political and Governmental risks than other categories of risk. It therefore shows the higher influences of Political and Governmental risks on clients compared to the consultants.

- Analyzing the evaluation of effectiveness of mitigation strategies, there were again differences in viewpoints of participants to some extent where clients had evaluated the strategies more effective than other groups. As discussed earlier, it could be the result of evaluation of the strategies from two diverse perspectives: their effectiveness in theory, and the feasibility of their implementation in Iran – in practice.

- And finally, analyzing the level of agreement with the construction related statements in the last section of the questionnaire verifies the results realized from previous sections of it. High level of agreement was observed on instabilities of economic and also political situation of Iran and the great influences of them on construction projects. Moreover, dissatisfaction of participants with the risk management knowledge of the parties and also the communication between them was understood. This section similarly demonstrated other aspects of the construction projects and the issues related to them in Iran from participants' viewpoints.

Next chapter, Interview Analysis, is the continuation of this chapter and is exploring the qualitative data collected for this thesis via conducting interviews with participants. The chapter may also refer back to this chapter whenever required in order to discuss the similarities and differences of participants' opinions about the risks of construction projects in Iran.

5 – Data Analysis: Interview

5.1. Introduction

The previous Chapter, Questionnaire Analysis, covered the analysis of the quantitative data that was collected via questionnaires. It included the evaluation of the participants in the criticality of the risks of construction projects and the effectiveness of the mitigation strategies proposed for them.

This chapter is the analysis of the qualitative data collected through conducting interviews. It analyses the content of questions one by one and if required the discussions provided by three groups of participants are analysed individually for each group. There are 24 interviews and the number of participants from each group follows the same ratio as their numbers in questionnaire: 2 Clients (CL), 5 Consultants (CS), and 17 Contractors (CR). Coding schemes are shown for each question and quotations from participants (followed by the interviewee's ID in brackets) may also be presented while discussing their responses.

5.2. Question 1: What is the nature of the projects you are doing and their sizes?

As mentioned in the Methodology chapter, all the participants chosen for this thesis were executing public governmental projects – the client in these projects is a governmental organization. Therefore, the 'nature of the projects' in this question refers to different types of construction projects and the 'size' refers to their monetary value. The reason behind asking this question as the first question was making the participants feel relax because they all knew the answer - the types of projects they are executing and their monetary value. Even though the participants were managers of big companies and quite confident, this question was asked so they can easily provide the answer without the need to think very much. The size of their projects was known to some extent before they attend the interviews since the annual turnover was asked in the questionnaire and it approximately determines the monetary value of the projects. The types of projects the participants had executed before or were executing in the time of interview sessions comprised projects from majority of the types: road and highway, tower, university, housing complex, shopping mall, prison, hospital, sports facility, dam, tunnel, bridge, school, students' accommodation, oil refinery, warehouse.

The locations of these projects were in different cities of Iran such as: Tehran, Mashhad, Tabriz, Sabzevar, Birjand, Asaluyeh, Esfahan, Kish, Chabahr, Kerman, Shiraz, Torbat.

5.3. Question 2: What do you consider as 'risk' in construction projects?

In the questionnaire, there was a table in the first page asking the participants to write any risk related to construction project, and there were also 25 risks listed so they could evaluate their criticality. Therefore, for this question interviewees may have only stated the risks they consider as more significant for the construction projects and may have not repeated themselves since they had mentioned some of the risks in the questionnaire before.

The responses provided by interviewees to this question were coded using the 5 main categories of risk proposed in the Methodology chapter: Political and Governmental risks, Managerial and Technical risks, Economic and Financial risks, Cultural and Social risks, and Natural risks. The coding schemes have been provided below resulted from the responses provided by interviewees - 4 separate schemes each illustrating one category.

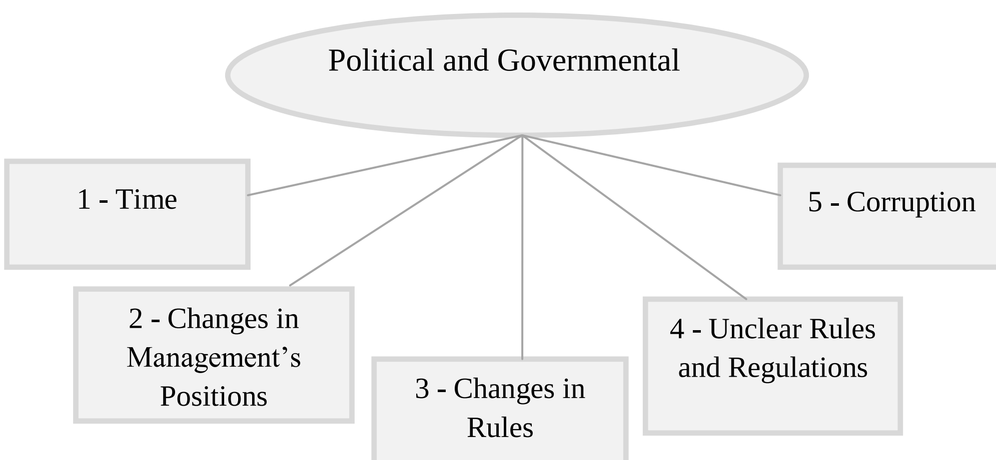


Figure 5.1 Political and Governmental category of risk and its sub-codes

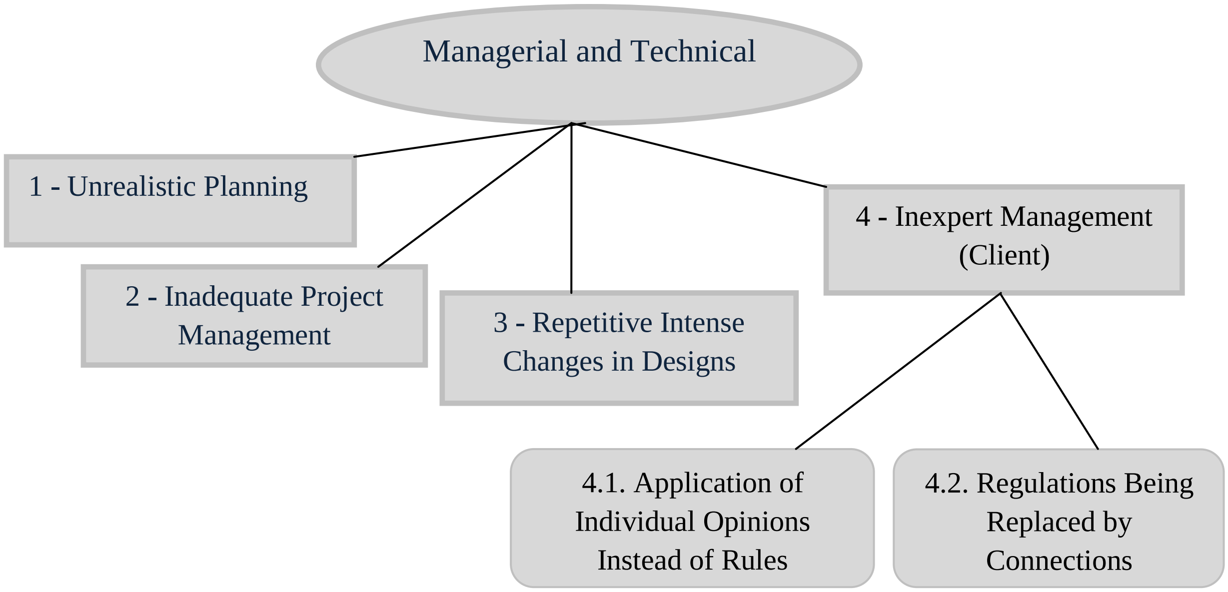


Figure 5.2 Managerial and Technical category of risk and its sub-codes

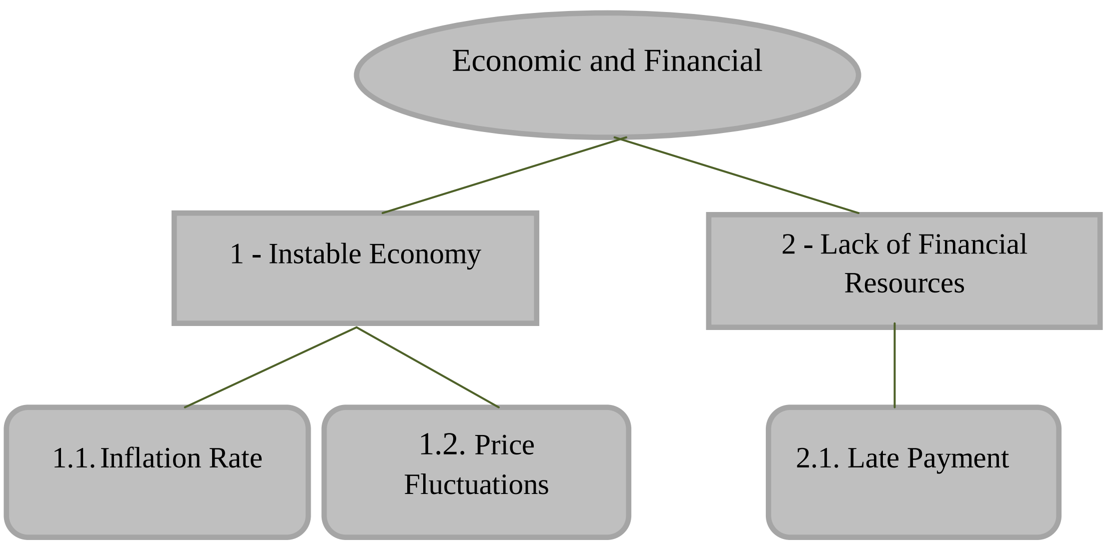


Figure 5.3 Economic and Financial category of risk and its sub-codes

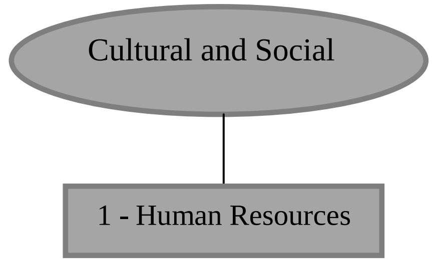


Figure 5.4 Cultural and Social category of risk and its sub-code

Table 5.1 demonstrates the codes and sub-codes shown in the four previous diagrams in its first row (grey), and the first column (pink) illustrates the three groups of interviewees and their numbers. The sub-codes specified by each of the interviewees have been marked in the table in their associated row; they have either stated the exact word or have meant that through explaining the concept.

Before discussing each cell individually, the overall responses by each group to the four main codes are looked at. It is required to mention that the table below includes four main codes out of five categories of risk proposed by the researcher earlier since none of the interviewees stated any risk related to category of Natural risks for this question.

Table 5.2 shows sum of all the sub-codes mentioned by each group of interviewees for each category of main codes. Clients have mentioned 6 sub-codes from E&F category, 5 from P&G, 4 from M&T, and 1 from C&S. The order of these frequencies supports the result of clients' evaluation on criticality of the risks in questionnaire which was shown in the table 4.6 on page 101. Consultants have mentioned 16 sub-codes from E&F category, 15 from M&T, 9 from P&G, and 2 from C&S. The priority of M&T risks for consultants after the E&F risks but before P&G risks was also illustrated in table 4.8 on page 103. Finally, contractors have mentioned 54 sub-codes of E&F category, 23 of P&G, 19 of M&T, and 5 of C&S and same as the two other groups of interviewees their responses are in agreement with their results in questionnaire shown in table 4.7 of page 102.

Table 5.1 the sub-codes mentioned by interviewees (Question 2)

Q2 / Participants	Risks	P&G					M&T						E&F					C&S
		1	2	3	4	5	1	2	3	4			1			2		1
											1	2		1	2		1	
Client	CL1	■	■							■					■	■	■	
	CL2	■	■			■	■			■	■			■	■	■		■
Consultant	CS1		■	■		■	■			■	■		■		■	■	■	
	CS2	■	■		■			■		■	■	■	■	■	■	■	■	■
	CS3		■					■				■	■		■	■		■
	CS4						■			■	■					■	■	
	CS5			■	■				■	■	■				■	■		
Contractor	CR1		■							■	■				■	■	■	
	CR2		■	■	■			■		■		■			■	■	■	■
	CR3		■					■			■				■	■	■	
	CR4	■		■	■		■								■	■	■	
	CR5	■													■	■	■	■
	CR6														■	■	■	
	CR7			■				■							■	■	■	■
	CR8		■			■				■					■	■	■	
	CR9				■										■	■	■	
	CR10								■						■	■	■	
	CR11	■										■	■	■	■	■	■	
	CR12					■									■	■	■	
	CR13	■	■	■				■							■	■	■	■
	CR14				■			■							■	■	■	
	CR15					■			■		■	■	■		■	■	■	
	CR16		■		■						■				■	■	■	
	CR17					■		■							■	■	■	■

Table 5.2 Sum of the sub-codes mentioned from each main category of risk (Question 2)

Q2	P&G	M&T	E&F	C&S
Client	5	4	6	1
Consultant	9	15	16	2
Contractor	23	19	54	5
Total	37	38	76	8

Looking at the Total row in table 5.2, it is seen that the highest frequency falls under E&F category followed by M&T, P&G, and lastly C&S. Considering the evaluation of criticality of 25 risks in the questionnaire ranked by participants, the order of the frequencies was the same and the table 4.5 on page 99 demonstrates this similarity.

Even though the number of interviewees from each group is different from the numbers who have completed the questionnaires, the ratio is still the same. Therefore, similarity between their responses in questionnaire and interview (when discussing the risks of different categories and their ranking) certifies the level of influences of these risks on each of these groups of participants.

Clients

Looking at their rows (related to the column of P&G), it can be seen that both of them have mentioned P&G 1 (time), which refers to the delays in execution of the projects. Delays can be resulted from many issues during the execution of a project such as inadequate time management (as part of project management) which is a sub-category of Managerial and Technical risks or lack of financial resources as a sub-category of Economic and Financial risks. However, time has been allocated to the main code of Political and Governmental risks in the coding scheme since delays in construction projects of Iran are mainly generated from some root issues. As discussed in the Methodology chapter, existence of inexpert managers in client's organizations and also the frequent changes in management positions result in inconsistency between the managers. Therefore, due to lack of knowledge and lack of consideration on available resources incorrect decisions are made for the new projects to get started.

Every project may face various difficulties and risks during its execution which may result in delays but these may increase in Iran due to instabilities of economic and political situation pointed out before. It can now be perceived why incorrect decisions made by clients about the new projects to be started would intensely lengthen the construction projects; because not only the risks during the execution of the projects may be more critical in Iran compared to other countries but also even the start of the project in many of the cases can be considered as an incorrect decision which therefore adds extra difficulties and lengthens the projects.

Moving to the next column in table 5.1, it can be seen that again both of the clients have mentioned P&G 2 (changes in management's positions). The clients for the projects being studied in this thesis are governmental organizations under supervision of different ministries of the country. The ministers are usually appointed based on president's selection and the votes from parliament. Each minister has his own under-secretaries and this hierarchy goes down to the top managers of the governmental organization, their vice-chancellors and so on. The top managers of the organizations are frequently getting changed by the ministers' under-secretaries and accordingly top managers may change their vice chancellors. These changes are usually based on the individual opinion of upper levels and also existence of connections and therefore may result in irrelevant expertise or lack of expertise of the new people appointed for these roles. Moreover, sudden intense changes in the overall structure of some ministries and governmental establishments would also cause these changes in the management positions in addition to some other changes related to the regulations.

Recent examples can be provided in addition to the quotations from interviewees regarding the changes in ministries, large governmental establishments and changes in their management positions.

Two principal ministries namely Ministry of Housing and Urban Development and Ministry of Roads and Transportation were merged and established Ministry of Transportation and Housing in June 2011. The apparent outcome was omission of one of the ministers and subsequent changes in lower levels of management. Moreover, the projects being executed by these two ministries were also affected since responsible employees for some of the projects got changed in the middle of the projects' execution and resulted in further difficulties for executing them.

Regarding the expertise of the ministers, their under-secretaries and the top managers, the example can be referred to a military person as the minister of Ministry of Petroleum. Usually, people appointed these roles are educated in political sciences and other related subjects (depending on their roles) but irrelevancy of expertise of these people in Iran may regularly happen.

A quotation from one of the clients (CL2) regarding changes in management positions and the associated outcomes is written below:

"*Management and Planning Organization of Iran (MPO), formerly known as Plan and Budget Organization (PBO) was the organization responsible for preparing the budget of the country. In 2007, this organization was divided to two deputies and the one mainly responsible for the budgets is the President Deputy Strategic Planning and Control. As the result, the overall structure of such a large governmental establishment changed intensely and subsequently regulations, people, their management style, and their perspective changed. It has been one of the main reasons causing budget shortage and lack of financial resources for the construction projects in recent years.*"

Another risk in the category of Political and Governmental risks mentioned by a client was corruption. According to the discussion provided in the questionnaire about this concept, clients can refer to it as the bribery between other parties or between another party and themselves.

Looking at the Managerial and Technical risks, M&T 1(unrealistic planning) has been mentioned which is interrelated to P&G 1 (time). According to the interviewees, when clients want to start a project they usually plan unrealistically for the duration of the project, which therefore lengthens the execution of the project. For instance, a big project may take 2 years to be over from contractors' viewpoint considering all the details in every phase and all the required tasks, but the client may tender this project with only 8 months for its execution. This type of planning without considering the details accurately will be added to other problems argued above (for P&G 1) and hence can be assumed as one of the main reasons for lengthening the duration of the project. The consequences of unrealistic planning were also seen in the last statement of questionnaire where 86% of the participants had agreed with impossibility of finishing the construction projects on time in Iran.

The next risk mentioned by both clients is M&T 4 (inexpert management) which has got a strong interrelation with P&G 2 (changes in management's positions) mentioned by them. As discussed earlier, the frequent changes in management's positions in governmental organizations - clients - usually happen according to the opinion of the levels above them and also existence of connections. For this reasons, in many cases their expertise is less significant and may not be relevant to the responsibilities of the job they have been allocated to. When managers change, they may apply their individual opinions instead of rules (M&T 4.1) due to different factors:

- ❖ They do not have adequate expertise for their new job
- ❖ They want to ignore whatever previous managers have done to show their own competency
- ❖ They do not have enough motivation since they know that they may also get changed soon (lack of job security)

Inexpert management of clients and application of their individual opinions would also lengthen the project execution since the consultants and contractors may have to change what they have done before according to different requirements of the new managers.

Referring back to the questionnaire, maintaining good relationship with governmental managers and authorities was evaluated as an effective strategy for mitigating some of the risks. Since they may ignore some of the regulations and apply their opinions, having a good relation with them may help decreasing the problems arising from the application of their opinions to some extent. However, changes in their positions would completely destroy the relationship that other parties had maintained with them. Hence, parties should continue working with new managers and their old relationships are useless since previous managers usually have no further responsibilities for the job that parties are doing.

Looking at the E&F column of table 5.1, it should be explained that the risks in this category are intensely interrelated and in a sense all the sub-codes in this column can be considered to be the consequences of instable economy. As discussed in the Methodology chapter, economy of Iran is bad and apparent outcomes would be the high inflation rate and intense price fluctuations. Moreover, issues occur regarding the budget of the country and in turn the construction projects' budgets. When the budget allocated to the construction projects cannot be realized, this would result in client's inconsistency of payment which most of the time is delays in payments to contractors and consultants. As it is seen the clients have mentioned majority of the codes in E&F column and although the people in clients' organizations are being paid a fixed salary on a monthly basis, still these sub-codes are declared by them since the projects are influenced greatly by these risks.

Finally, C&S 1 (human resource) has been stated referring to issues regarding lack of expert human resources in some aspects of the construction projects.

Consultants

Looking at the table 5.1, it can be seen that all the sub-codes of P&G category have been mentioned by consultants at least once: time, changes in management's positions, changes in rules, unclear rules and regulations, and corruption. Externally imposed changes such as changes in management's positions and changes in rules would influence projects greatly since they are external risks which may frequently happen and change many aspects of any plan related to the projects. Apart from changes in rules, the ambiguity of the existing rules and regulations such as details of the contract or approvals and permits has been stated as a risk influencing the progress of projects to some extent.

M&T is the category having more significance for the consultants after the E&F category. Consultants similar to contractors are mostly expert people who are more familiar with the details of the construction project and its execution. Therefore, client's unrealistic planning for the projects has been stated by them as a risk since they are aware of its consequences on almost all the aspects of the projects.

Inadequate project management including different parts of it such as human resource management, time management, and project control has been mentioned which is demonstrating lack of knowledge about management in different levels. Repetitive intense changes in design (M&T 3) can be assumed to be one of the results of changes in management's position and in turn different requirements of the new managers which demand the designs to be changed.

M&T 4 and its sub-codes M&T 4.1 and 4.2 have been stated by consultants regularly which are client's inexpert management, application of their individual opinions instead of rules and consequently regulations that are being replaced by connections (Relations). The relative significance of these risks for consultants may be the result of their closer relationship with clients. Hence, any variations in their requirements change the responsibilities of consultants such as changes in designs.

One of the consultants (CS3) has mentioned an example regarding the changes in design which is quoted below:

"*We had designed the maps and plans for a shopping mall in Mashhad and the infrastructure was 9000 square meters. Due to existence of inexpert client and also their lack of consultancy with expert people, after a month they changed the infrastructure to 3000 square meters. They do not consider all the details about the projects they want to build and such a massive change means that we had to change our designs completely and do it all over again.*"

E&F sub-codes - similar to clients - have been mentioned more than sub-codes of other categories by consultants; determining the level of criticality and significance of these risks for the construction projects. Looking at the C&S sub-code which is the human resources, it can be realized that lack of inexpert human resources is also important for the consultants.

Contractors

All the sub-codes of P&G category have been mentioned by contractors at least four times and examples have been explained regarding some of these risks which are quoted below.

Frequent statistics announced by President Deputy Strategic Planning and Control demonstrate the high percentage of the projects which have been lengthened much more than the planned time of the project. Almost all the interviewees had at least one example of the projects which had taken much longer than the specified time and one of them has been written below (CR5):

"*Amphitheatre Hall of Ferdowsi University of Mashhad was an incomplete project since 1977, only the foundation was completed and after that the project was suspended for nearly 22 years. We won the tender for completion of this project and the duration was 18 months. Realistically this time was not adequate for this huge hall and besides many other issues such as late payment from client caused delays in our execution. We could finally finish this project in 6 years and this sort of long delays normally happens for most of the construction projects."*

P&G 2 (changes in management's positions) has been repeated the most - 6 times - compared to other sub-codes of P&G category. It therefore shows the level of influences on the contractors when the managers get changed in client's organization because many other factors may also change: their lower level employees, opinions, behaviours, and requirements. Moreover, the relationship that they may have maintained with previous managers is gone. Two examples related to frequent changes in management's positions and subsequent termination of a good relationship with client because of changes have been quoted below from a contractor (CR12):

"*There are frequent changes in the position of top managers in governmental organizations and our company has experienced various difficulties arising from these changes. We were building a prison in Torbat Heydarieh and it took nearly 7 years, and during this period the top manager of Bureau of Prisons changed 4 times. These frequent changes rarely happen in other countries; with each new manager we were suffering from new issues and that was one of the main reasons why the project took a long time to be completed*."

"*One of the projects our company was executing was another prison in Birjand which was located in Khorasan province. I - as the chief executive of the company – used to go to our client's bureau every single day, I was so close to them and almost everyone working there knew me and I had maintained a very good relationship with the client. Although the project was not in my city, the Bureau of Prisons of Khorasan was located in my city, Mashhad, since it was the capital of the province. In the middle of our project (2004), Khorasan province was divided to three individual provinces: North Khorasan, Razavi Khorasan, and South Khorasan. Bureau of Prisons we were working with was allocated to Razavi Khorasan and two new bureaus were created for two other provinces. The prison we were building was in South Khorasan and suddenly a completely new organization with* *new managers and employees was created and appointed as our client. The entire relationship was gone, I had to cope with new people and new requirements and since it was not in my city anymore I was not able to go there quite often. The problem was not only the new bureau and new people but also their lack of expertise; because a totally new bureau was created in a short time and in a small city like Birjand and hence it is not easy to find adequate expert people for all these new roles. Except from the delays occurred in our project, we had different issues with the new client since they wanted to deny most of the tasks requested by our previous client and apply their own requirements. We ended up with approximately half of the financial benefit we had planned for this project*."

One same example was provided about the changes in rules by 11 contractors out of 17 which shows the level of significance of this change on their projects and is quoted below from one of the contractors (CR4) who explained the details:

"*Adjustment tariff used to be applied on majority of the construction projects with Billed Rates contract type and was covering the price fluctuations for the period contractors were executing the projects. Therefore, if the prices had changed (increased/decreased) from the Bill of Material you had based your contract on; the client was responsible to pay you the difference. In 2007, this regulation was cancelled for all the buildings less than 10,000 square meters and majority of these projects had to be executed based on the Fixed Price contract. Due to the high level of inflation and intense price fluctuations, cancellation of this rule was very harmful for contractors because they have to consider all these fluctuations (which are not precisely predictable) in the time of tendering. If the contractors cover all these differences in the price they calculate for the tender, they will not win it, and if they do not include them in their price they most probably end up with major financial losses, what should they do? These unfair changes in rules sometimes change people's career and life*."

P&G 5 (corruption) being mentioned by at least one interviewee in each of the three groups of participants declares high level of corruption which was also discussed in the questionnaire. The recent corruption perceptions index released by the Transparency International (the global coalition against corruption) in 2012 has been shown below.

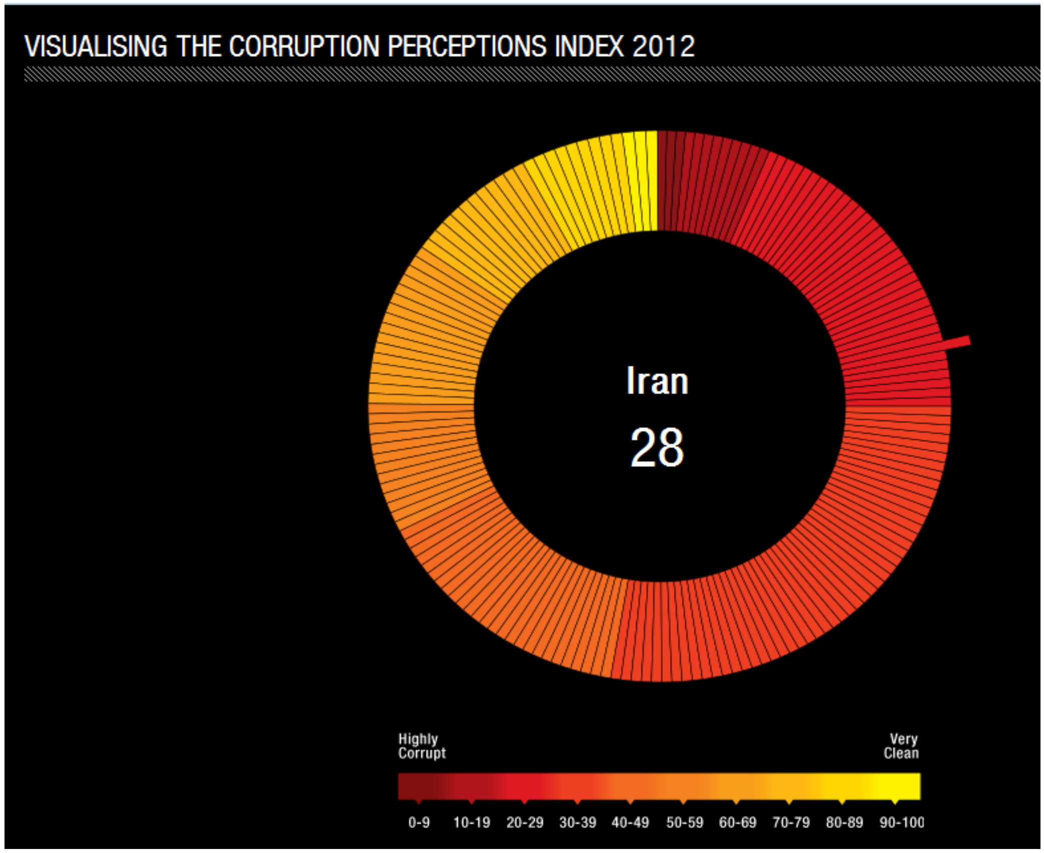


Figure 5.5 Corruption perceptions index – Iran (Transparency International, 2012)

As it is seen in this figure (5.5), in the perceived levels of public sector corruption in 176 countries/territories around the world, Iran has been ranked as 133 with the score of 28. This certifies the high level of corruption in the country which obviously includes construction industry as well.

Figure 5.6 illustrates the corruption perceptions index of four other countries than Iran. The two countries on top are scored in two extremes of the scale; Denmark with the score of 90 is the cleanest country and Somalia with the score of 8 is the highest corrupted country. Two other countries in the bottom of the figure show United Kingdom (with the score of 74) and Greece (with the score of 36). Comparing the scores of countries, it can be perceived that level of corruption in Iran is fairly high which leads to further issues in the situation of the country.

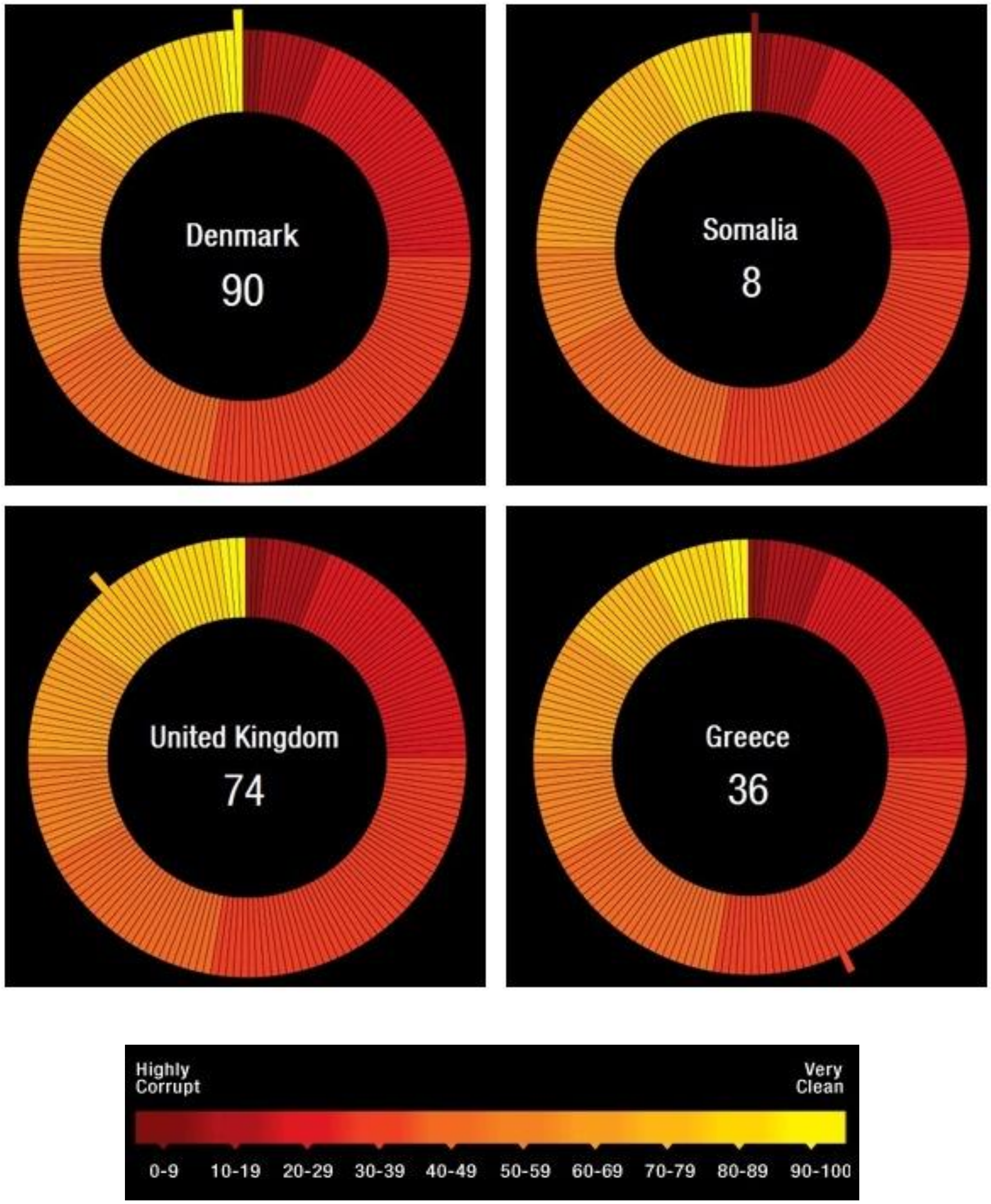


Figure 5.6 Corruption perceptions index of various countries (Transparency International, 2012)

Looking at the M&T column, contractors have again mentioned all the sub-codes. As discussed earlier, M&T 1(unrealistic planning) is so interrelated to P&G 1(time) because apart from the issues happening during the project, a short duration planned for a massive project lengthens its execution. Various examples were provided by interviewees about the short times being allocated for the big governmental projects and one example from a contractor (CR3) was, "*Our client had planned 10 months for the duration of the Provincial*

Governor's Office in Birjand with 8000 Square meter infrastructure. Anyone familiar with the details of the construction would know that it is not possible to build such a massive project in 10 months and in the best-case scenario this would take at least 2 years. This project like many other projects was planned unrealistically by the client but we started the project and now after 4 years only 70% of the work has been progressed."

M&T 2 (inadequate project management) has been also mentioned by contractors that shows lack of 'management' knowledge for the managers at various levels. Managers in contractor or consultant offices are normally Civil engineers and Architects and they may rarely be educated in project management field. Recently short courses related to management are offered for these people so they learn the science of management formally. However, not everyone attends these courses since there are still gaps in the culture where many managers think that management is only based on experience and there is no need for studying it.

M&T 3 (repetitive intense changes in design) is another sub-code mentioned by contractors. Although changes in design fall under the responsibilities of consultants, the contractors should also apply those changes in their actual building. When designs change, if contractors have already built according to the previous design they need to demolish and re-do it and if they have not built it yet, they need to wait for a time until the new designs get ready by the consultants; both cases are disadvantageous for them. An example has been quoted from one of the contractors (CR7):

"*In 2002, we were building a 5 story garrison in Birjand, and at the same time 19 same projects were being executed in other cities of the country by other contractors. Each of these 19 projects was in a different phase of their construction when the client stopped all the projects since they had noticed that garrison building should not be 5 stories due to different factors. All the contractors were wondering why the client had noticed such an obvious rule so late! All the projects were paused for 8 months until the new designs got ready and at the end we built 5 one story buildings for this garrison*."

Looking at the M&T column for the contractors, it can be seen that M&T 4 and its sub-codes M&T 4.1 and 4.2 have been stated more than other risks. It shows that inexpert managers are usually appointed in client's organizations and application of their opinions instead of rules is quite common. When regulations are less followed, individual relations and connections are replaced and these are considered as important risks influencing construction projects. An example was provided by one of the contractors (CR6) regarding application of individual opinions by clients:

"*Many of the risks are imposed on the projects; contractors are neither creating them nor are able to mitigate them. Our company was executing two projects in Shahid Beheshti University of Tehran and at the same time 6 other projects were running in this university and therefore all these projects had one client. I would say projects were progressing quite well but suddenly the executive of construction projects of the university (highest person in our client's establishment) changed. Lack of expertise and his new requirements resulted in catastrophic situation for all the 8 projects: 3 projects ended up with expropriation, we tried our best to finish our 2 projects but we ourselves paid for them with a major financial loss at the end, and the 3 other projects are suspended. If the previous person was still there, most probably these 8 projects would have been completed by now but the change in position of only one person turned out to be a disaster for all these contractors including us*."

The E&F column for the contractors illustrates the level of criticality of the financial risks for the contractors and as it is demonstrated price fluctuations, lack of financial resources, and late payment have been mentioned by 17 contractors out of 17. It determines that the most important risk for the construction projects can be considered as financial risks especially since 90% of the contractors mentioned these sub-codes prior to any other risk when responding to question 2.

Finally, the sub-code of last column which is related to C&S category has been also mentioned by contractors. The party who is executing the actual construction of the project is the contractor and therefore is interacting more with people from different levels. Finding expert human resources in various places where projects are being executed and managing these people may not be easy all the time.

Looking at the table 5.1 vertically, the first three sub-codes which have been mentioned more than other sub-codes can be realized:

1. E&F 2: Lack of financial resources
2. E&F 1.2: Price fluctuations

3. E&F 2.1: Late payment

Same as the results of questionnaire shown in figure 4.8 on page 97, the top three risks mentioned by interviewees are also sub-codes of Economic and Financial risks. By comparing different columns of table 5.1, apart from too much emphasize on the three risks mentioned above, some other strong interrelations can be observed between sub-codes of different categories.

P&G 2 (changes in management's positions) and M&T 4 (inexpert management – client) and its sub-codes M&T 4.1 (application of individual opinions instead of rules) and M&T 4.2 (regulations being replaced by connections) are mostly mentioned together. It shows that interviewees not only believe that there are frequent changes in client's management's positions but also these managers are usually inexpert. As a result, significance of individual opinions and connections may become more than significance of rules and regulations.

Moreover, M&T 2 (inadequate project management) and C&S 1(human resources) have been mostly stated together. It can be assumed that the interviewees who have mentioned these sub-codes together, may have considered the reasons for the inadequate project management to be mostly internal - human resources - and not much external factors are influencing the adequacy of project management.

The sub-codes for question 2 were deigned based on the responses of the interviewees (shown in figures 5.1 to 5.4) and they had either mentioned the exact code itself or had meant the concept indirectly. Few more general phrases were also stated by four of the interviewees before they list their risks, showing their perceptions about the dependency of criticality of the risks on the situation and environment:

- "*All the aspects of the project can be considered as risk based on the time and situation*"
- "*Almost all the aspects of the project can be assumed as risk in Iran*"
- "*Anything that harms the project can be considered as risk*"
- "*It depends on the existing tensions in the country*"

These statements are discussed more fully in next questions when interviewees explain them further.

5.4. Question 3: Regardless of the type of the project, what are your broad organizational processes and policy documents which may create risk?

The responses of interviewees to this question have been coded and the coding scheme has been shown below followed by a table marking the codes mentioned by each of the interviewees from three groups of participants:

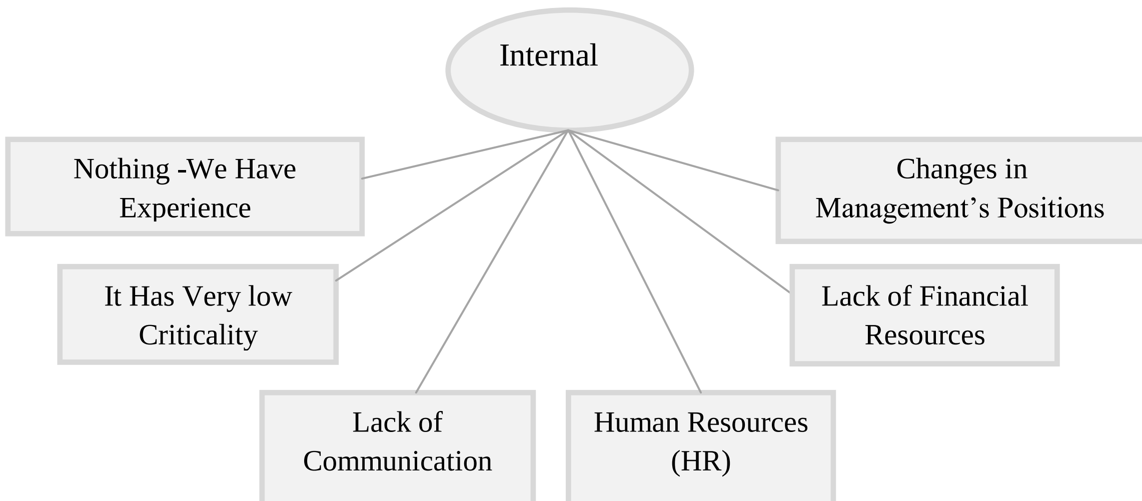


Figure 5.7 Sub-codes of internal risks of organization

Although the clarity of all the questions had been evaluated by the researcher and two other persons by the time of designing, as explained in the Methodology chapter this question was confusing for majority of the interviewees. As a result, researcher gave them hint and rephrased the question as: "What do you consider as risk inside your organization?"

As it is seen in the coding scheme, figure 5.7, the codes have been assumed to be 'Internal to the organization' since the question has referred to the risks which are internal to interviewees' organizations.

Looking generally at the table 5.3, it can be seen that low criticality of the risks inside the organization and also human resources have been mentioned by many of the interviewees. It indicates that the criticality of the risks inside the organization has been evaluated to be low by the interviewees compared to risks outside of the organization (external). Moreover, the risk which has been mentioned the most is the human resources that may include human resource management, inexpert human resources, and lack of human resources.

Table 5.3 Sub-codes mentioned by interviewees (Question 3)

Q3	Risks	Nothing -We Have Experience	It Has Very low Criticality	Lack of Communication	Human Resources (HR)	Changes in Management's Positions	Lack of Financial Resources
Participants							
Client	CL1						
	CL2						
Consultant	CS1						
	CS2						
	CS3						
	CS4						
	CS5						
Contractor	CR1						
	CR2						
	CR3						
	CR4						
	CR5						
	CR6						
	CR7						
	CR8						
	CR9						
	CR10						
	CR11						
	CR12						
	CR13						
	CR14						
	CR15						
	CR16						
	CR17						

Looking at each group of participants separately, other risks have been also stated:

Clients

Except from human resources mentioned by one of the clients, changes in management's positions have been stated by both clients. This risk which was an external risk (sub-code of P&G category) in previous question is now internal for the organization of the clients. Their upper level managers or they themselves may get changed frequently and these changes would influence them internally. Besides, one client has also referred to lack of financial resources as a risk inside their organization. Although the construction projects' budgets may be allocated from the top levels of governmental organizations for majority of the projects, sometimes managing that budget and dividing it between projects fall under the responsibilities of clients. Therefore, budget management and allocation of it on the right time for the projects can be assumed as internal risks when considering the client's organizations.

Consultants

As explained above, consultants have evaluated the criticality of internal risks to be low and the risks related to human resources are the only risks mentioned by them.

Contractors

Same as the consultants, many of the contractors have also referred to low criticality of internal risks and the human resources risk has been mentioned as the most important risk inside their organizations. Two of the contractors have declared that since they have experience, they do not have any risk in their organizations which shows their confidence in the structure of the organization, employees and responsibilities. Although the appropriate structure and experienced people in the organization can mitigate the risks to a great extent, but stating the word 'nothing' can be considered to be in contrast with the concept of risk. Internal risks have been evaluated as low critical risks by many of the interviewees and this criticality can be even less in many organizations according to the experience and expertise of the managers and employees and also the structure of their organization. However, the researcher does not agree with contractors saying they have no risk at all in their organization since risk in a sense is an unpredictable event. Therefore, they cannot be sure about its absence in their organization and they would have better evaluated it as very low critical risk than nothing.

Another risk mentioned by contractors as an internal risk inside their organization is lack of communication and this communication can be about the progress of the projects, their details, changes, and risks. This dissatisfaction with the level of communication inside the organizations was also shown in the results of analysis of the statements related to communication in the last section of the questionnaire.

So, the risks inside the organizations of the interviewees have been evaluated as low critical risks and mostly related to different aspects of human resources in various levels. The experience and expertise of employees, and also the management and the structure governed in the organization can mitigate these risks to a great extent. Moreover, it was mentioned by three interviewees that, "*Since these risks are under control of ourselves, they are more manageable and most of the current critical risks are externally imposed on us.*"

5.5. Question 4: What processes does the organization have for managing/mitigating risks?

Question 5: How do you develop the contingency plans? In which phase?

Questions 4 and 5 are analysed together since concepts of 'processes for managing/mitigating risks' and 'contingency plans' are strongly interrelated. Besides, responses of interviewees are similar to these questions and have been repeated at some points. The process for managing/mitigating risks – Risk Management Process – can be considered as a systematic way of looking at risks (unpredictable events) and deciding how to develop appropriate responses to each. As Chapman and Ward (1997) have stated "Risk management is usually associated with the evaluation and development of contingency plans supporting the base plan." Therefore, risk management process and contingency plan are linked together and plan for responding to unplanned events. Below there is a discussion on how the interviewees get proactively prepared for managing the risks and develop plans and strategies for various situations. Responses of each group of interviewees are analysed separately and an overall conclusion is provided before moving to next question for discussing the similarities and differences.

Clients

Since there were only two clients and there was no similarity between their responses, each one is discussed individually:

Client 1

Start of the project ➡ Try to plan realistically for the project (measure time and cost precisely)

During the project ➡ Review the plans on a regular basis and try to finish the project on its defined time

Client 2

No formal process for managing risk and therefore keep confronting with similar risks

Think of a plan only when the risk has happened

As it is seen, client 1 has stated that they plan to manage the risks at the start of project by trying to measure the time and cost precisely and they review the plans during the project for application of any changes. Moreover, they control other parties' progress in order to finish the project on its defined time. However, client 2 has stated that their organization does not have any processes for managing the risks and they think of a solution whenever risks are materialized.

Consultants

The responses provided by consultants are quite similar and all five have mentioned that they start to manage and mitigate the risks before signing the contract. They try to know the clients more and examine their financial viability and budget of the project. They also conduct studies about the project's specification by investigating its location, availability of local human resources, availability of required materials, and also possibility of transferring the materials to the project's location.

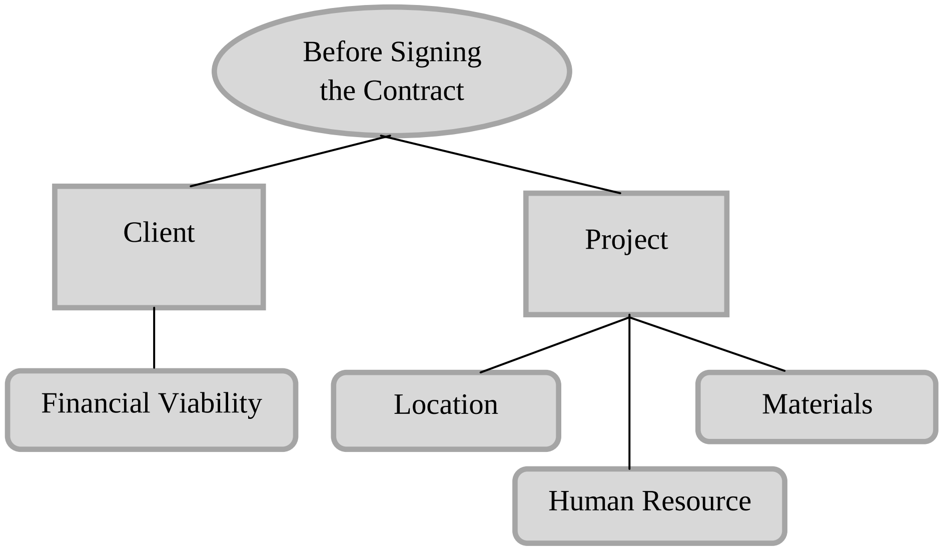


Figure 5.8 Consultants' Risk management strategies / Contingency plans

They have mentioned that they try to review their plans parallel to the project progress in order to apply the changes. Two of them have also stated another process for managing the risks during the project execution:

- ❖ Regular think tank: reviewing the project and thinking about its plans and the required changes

Contractors

More diversity could be seen in contractors' responses compared to consultants. Three contractors have the same opinion with client 2, stating that they do not have any formal processes in their organization for managing/mitigating the risks. They have referred to lack of expert risk manager as the reason for not planning proactively and have mentioned that they would react whenever they confront with the risks.

The responses provided by the other 14 contractors have been coded and are shown below; two coding schemes are illustrated for the processes they have (1) before starting the project and (2) during its execution:

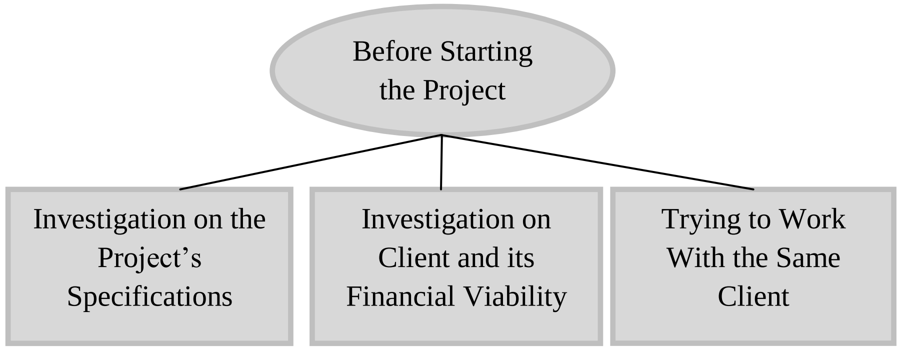


Figure 5.9 Contractors' Risk management strategies / Contingency plans (Before starting the project)

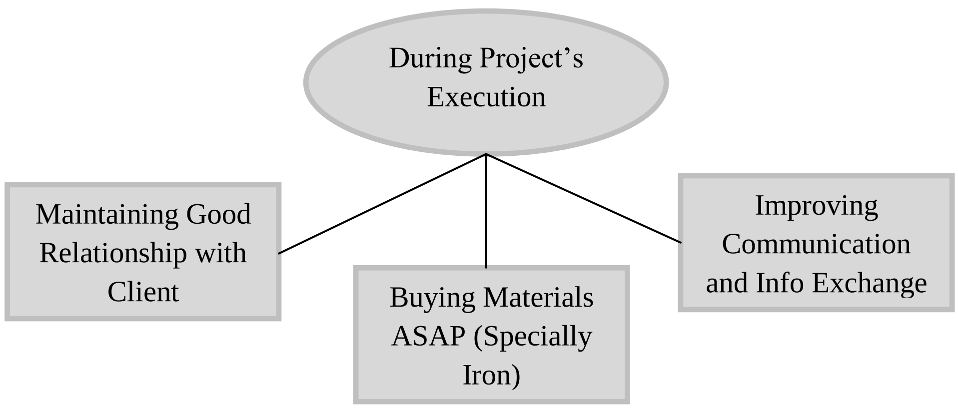


Figure 5.10 Contractors' Risk management strategies / Contingency plans (During project's execution)

As it is seen in table 5.4, sub-codes of "Before Starting the Project" have been mentioned slightly more than the sub-codes of "During the Project's Execution". Contractors have stated 'investigation on the project's specifications' so that they can plan according to the distinctive specifications of the project before starting it. Since every project is unique, planning its management processes based on its details would also help mitigating the associated risks to some extent.

'Investigation on client and its financial viability' has been mentioned more than all the codes by the contractors. Referring back to the responses provided for question 2 of interview; lack of financial resources and client's late payments were two critical risks. Therefore, knowing the clients more, examining their financial viability, and inquiring their reputation in payment would help the contractors to plan for the financial risks of the project. Moreover, 'trying to work with the same client' has been declared by two contractors for mitigation of the risks. As client and contractor know each other based on their previous experiences of working together, it would be easier for them to work on a project than two new parties working together for the first time.

Table 5.4 Sub-codes mentioned by contractors (Questions 4 & 5)

Risk Management Processes and Contingency Plans		**Before Starting the Project**			**During Project's Execution**		
		Investigation on the Project's Specifications	Investigation on Client and its Financial Viability	Trying to Work With the Same Client	Marinating Good Relationship with Client	Buying Materials ASAP (Specially Iron)	Improving Communication and Info Exchange
Contractor	CR1	■	■		■		
	CR2	■					
	CR3					■	
	CR4	■	■				
	CR5					■	
	CR6		■				
	CR7					■	
	CR8		■		■		
	CR9						■
	CR10	■	■	■	■		■
	CR11	■	■		■		
	CR12			■	■		
	CR13		■				■
	CR14		■				

'Maintaining good relationship with client' has been mentioned as a strategy taken during the project execution. Referring back to table 5.1, application of individual opinion by clients was mentioned as a risk for contractors and therefore having a good relationship with them may be effective to mitigate this risk to some extent.

As discussed in the Methodology chapter, there are intense price fluctuations for construction materials and it was also mentioned as a critical risk in table 5.1 in this chapter. Therefore, ‘buying materials as soon as possible’ could help the contractors to be less involved in these fluctuations. There was also an emphasize on buying the iron and ironware earlier stating that these materials are used very much in construction projects and their prices also vary intensely so it is better to buy them as early as possible.

Finally, ‘improving communication and exchanging information’ in the organization was mentioned as an effective strategy that can mitigate the risks. When employees communicate on project progress, risks, and changes and provide each other with the required information on an appropriate time, risks may be mitigated since they can plan for them as soon as they get aware of changes.

Two of the contractors from table 5.4 have mentioned that every phase in the construction project is associated with its own risks. Therefore, except the contingency plans that are developed before starting the project, planning and re-planning should be involved in all the phases. However, some of the contractors have stated that many of the risks are mitigated based on their experience since they cannot plan for any of the external risks and are only trying to mitigate the internal risks. The response of one of the contractors (CR9) to this question has been quoted below:

“*Due to the intense price fluctuation, we can only buy the materials as soon as we can in order to mitigate its risks. We do not have any other specific strategy or plan for mitigating the risks since the critical risks are external and are imposed on us. Therefore, there is nothing we can do about them and we only try to manage them based on our experience. In Iran majority of the critical risks are external and out of our control; we cannot have an idea about their probability or impact.”*

Looking back at the table 5.1 where risks have been mentioned by the interviewees; there are many external risks influencing the construction projects in Iran. Hence, some of the interviewees have mentioned utilizing experience as an effective strategy for managing risks when they occur because before the risk materializes they do not know its probability or impacts. Moreover, investigation on the project and client has been stated for having as much as information about them but still some of the risks are out of their control. For example, "changes in management's positions" of client was declared as an important risk earlier but which of the parties can do something for it? They can only wait for its impacts in case of occurrence and then decide to change their plans according to the new situation.

As the processes and plans mentioned by the interviewees indicate, parties are not able to develop contingency plans (proactive) effectively due to the high volatility of the situation. They have to wait in most of the cases until the risk occurs and the impacts get determined and then decide on how they can manage it appropriately (reactive).

5.6. Question 6: What mechanisms are there for keeping the contingency plans on the review? And who is responsible for evaluation of the effectiveness of the contingency plans?

For this question, the three contractors in the previous question who had mentioned that they do not have any specific process for managing the risks; have again declared that they do not have any mechanism for reviewing the plans. In addition to those three, four other contractors in this question have stated the same and therefore seven contractors in this question have stated, "*We do not have any mechanism for reviewing the plans.*"

The responses of other 17 interviewees about the mechanism are:

- ❖ The mechanism mentioned by 15 interviewees ➡ Reviewing and analyzing the project monthly and updating the plans according to the changes
- ❖ The mechanism mentioned by 2 interviewees (contractor) ➡ Regular think tank

The responses about the person who is responsible for evaluation of the plans are:

- ❖ Both clients, 1 consultants, and 1 contractor ➡ Project Control Specialist
- ❖ 4 consultants, and 9 contractors ➡ Project Manager

Therefore, it is mostly the project manager responsible for evaluating the effectiveness of the plans they have developed before, and the common strategy used by majority of the interviewees is reviewing the project progress monthly and updating the plans.

Looking at the responses and comparing them with the responses to the previous question; client 2 who had mentioned they do not have any formal process for managing the risks, have mentioned they have project control specialist for reviewing the plans. However, he has explained it further saying that these specialists are responsible for reviewing the plans but due to lack of expertise they are not able to do that and similar risks happen regularly. Lack of expertise in client’s organization had been also stated in question 2 and hence many of the appointed employees may not be able to implement their responsibilities properly.

Consultants seem to be more disciplined for the plans they develop for managing the risks and also for reviewing them monthly compared to the contractors. This can be assumed to be the result of the difference in their perceptions of risk and its level of criticality depending on its influences on them. Managerial and Technical risks have got more significance for the consultants after Economic and Financial risks (according to the results of questionnaire and also table 5.1 in this chapter). Therefore, managing these internal risks could be considered to be more under their control compared to the external risks which have more influences on the contractors. Except from the level of significance of external risks for contractors, another reason for having no formal processes for managing the risks and no mechanism for reviewing their effectiveness (stated by 7 contractors) can be referred back to the results of questionnaires. According to the results of different sections of the questionnaire, there is lack of risk management knowledge in construction industry in Iran and therefore risk management processes are not implemented systematically.

5.7. Question 7: At the end of the project, is there any learning process of what has happened during the project? How?

The responses of interviewees to this question have been coded to three different responses as shown in figure 5.10. The frequency of each code for different groups of participants has been illustrated in the table 5.5. Definition of the codes and discussion on the responses of each group are provided below.

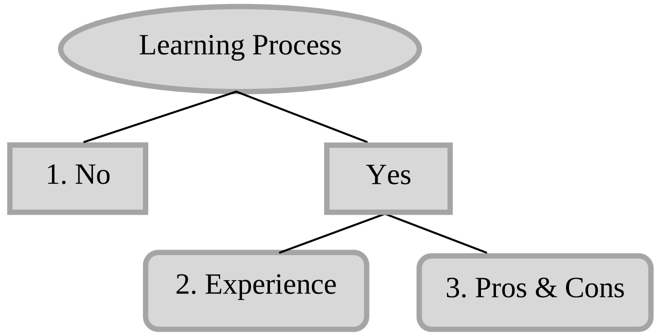


Figure 5.11 Sub-codes for existence of learning process at the end of project

1. No: the interviewees have no learning process at the end of the project for evaluating what has happened during the project
2. Yes – Experience: the interviewees do not review the projects systematically at the end. However, they believe that by executing the projects some experiences are achieved by individuals which are helpful for future projects
3. Yes – Pros and Cons: the interviewees systematically review and analyze the strengths and weaknesses of the project when it is over; they try to enhance the strengths and prevent the weaknesses in future projects

<u>*Clients*</u>

Although both clients have mentioned that they have the learning process through evaluation of the pros and cons of each project; the explanations provided by both of them refer to the same problem (overlooking the lessons by top levels) and is quoted from one of them (CL1):

"*We have specific section and people responsible for reviewing the previous projects, evaluating the positive and negative points and providing relevant information for new projects. However, top managers and people in higher levels of clients' organizations do not consider the recommendations / warnings presented by these responsible people based on the lessons learned from previous projects. For example, a governor may decide to build a steel factory in a city which is located in the province he is governing. He may get informed that due to the specific conditions required for executing this project, this city is not appropriate for this project. However, the project may still get started since what is* *important is that the governor has decided to build this project in that city and the information transferred to him about problems of this project may be overlooked*.”

Table 5.5 Sub-codes mentioned by interviewees (Question 7)

Q7	Learning Process	No	Yes	
Participants			Experience	Pros & Cons
Client	CL1			
	CL2			
Consultant	CS1			
	CS2			
	CS3			
	CS4			
	CS5			
Contractor	CR1			
	CR2			
	CR3			
	CR4			
	CR5			
	CR6			
	CR7			
	CR8			
	CR9			
	CR10			
	CR11			
	CR12			
	CR13			
	CR14			
	CR15			
	CR16			
	CR17			

Consultants

Three interviewees in this group have a structured learning process when a project is finished. They review the strengths and weaknesses of different aspects such as human resources, management strategies, and financial issues in order to learn from what has happened during the project. However, two of them believe that experiences are obtained automatically when people are involved in a project even if a systematic process does not happen at the end of the project.

Contractors

Nearly half of the contractors have mentioned that they do not have any learning process after the projects; saying that construction projects are so different from each other in Iran and it is not possible to apply the experiences on any new project. Three quotations from the contractors who have responded 'No' to this question have been quoted below:

- "*Each project has its own risks and problems since these are mostly external; we neither create them nor are able to manage or solve them*."
- "*Risks of each project are quite unique to that project because the situation changes intensely from project to project*."
- "*Each project is a new experience. In Iran, risks of construction projects are 80% related to finance and 20% related to individual opinions of the client and changes in project's definition*."

Three of the contractors do not have a defined learning process for their project. However, they believe that individuals do learn lessons and obtain experiences when they execute a project, stating that it is the human nature. The rest of the contactors review the project when it is completed and evaluate its various aspects in order to utilize the lessons learned for future projects.

5.8. Question 8: How is your relationship with contractor/consultant/client? Do they also mitigate the risks or all the existing risks will be shifted under your responsibilities?

Since this question is asking the interviewees of each group about their relationship with the two other groups, the responses of each group may be different due to their expectations from the other groups' behaviours and responsibilities. Therefore, the responses of each group have been coded separately and are discussed from their perspectives. The coding scheme comprises both parts of the question: the relationship, and the risks.

- ❖ Relationship: how the interviewees consider their working relationship with other groups
- ❖ Risk: how they evaluate the criticality of existing risks for each group / how other groups may cause or increase the risks for them

Clients

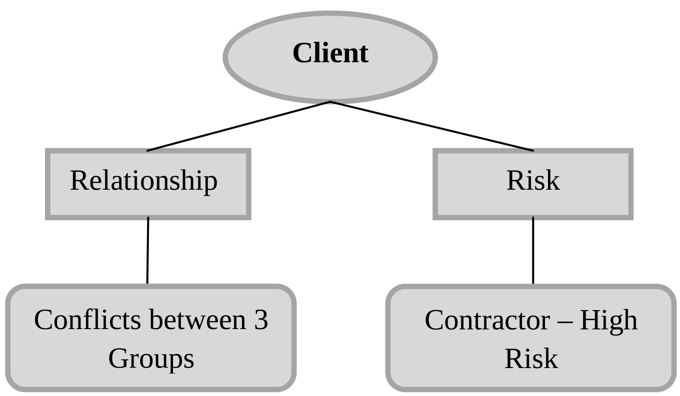


Figure 5.12 Relationship and risks from clients' viewpoint

Clients have only mentioned that there are almost always conflicts between three categories of actors in construction projects and no further discussion has been provided by them. It was suggested by one of the clients that executing projects based on the EPC (Engineering, Procurement, and Construction) contracts would reduce the existing conflicts between groups to a great extent. EPC refers to a type of contract in which the contractor (who is called the EPC contractor) is responsible for designing the installation, procuring the materials and building the project (Avazkhah and Mohebbi, 2010). In other words, responsibilities of contractor and consultant are merged in this type of contract and the EPC contractor is responsible for all those responsibilities. Therefore, executing projects through EPC contract may offer some advantages for involved groups:

- Lower level of conflict since the contractor and consultant have been merged
- Higher level of communication since the client is only contacting one group – the EPC contractor
- Higher level of quality because of more compatibility between design and construction

Moreover, it was mentioned by the other client (in terms of risks) that in construction projects the contractor is more prone to risks and criticality of different risks are much higher for them compared to the client and consultant.

No more details were provided by clients about the risks that they may be responsible for or are more critical for them. The reason can be assumed as lower influences of risks on the people who are working in client's organizations. Moreover, according to the responses of question 2 many of the risks associated with construction projects have been considered to be caused by clients and hence the clients may have preferred not to talk about them.

Table 5.6 Sub-codes mentioned by clients (Question 8)

Q8	Relationship & Risk	Relationship	Risk
		Conflicts between 3 Groups	Contractor – High Risk
Client	CL1	■	
	CL2	■	■

Consultant

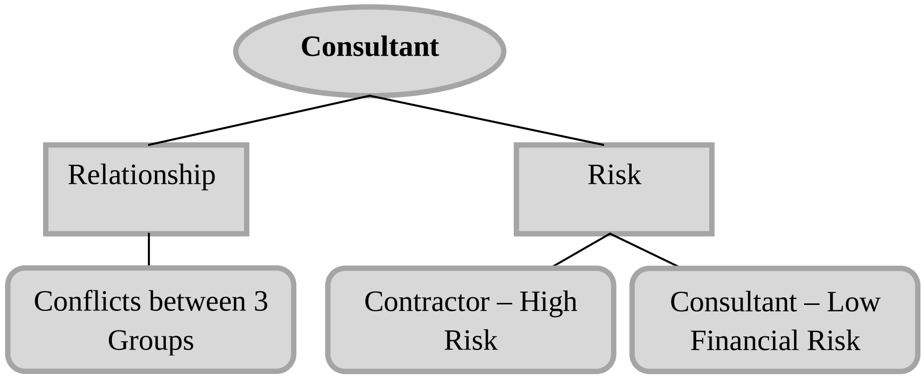


Figure 5.13 Relationship and risks from consultants' viewpoint

As it is seen in the table 5.7, same as the clients all the consultants have also mentioned that there are almost always conflicts between three categories of actors in construction projects in Iran. Executing construction projects based on an EPC contract was also suggested by three out of five consultants as an effective strategy for reducing these conflicts. It was explained that the contractor and consultant should get merged since many risks and delays in project progress are resulted from lack of compatibility between designs and construction. Therefore, if they act as one party and evaluate the strengths and weaknesses of the project from both perspectives, it would increase the consistency of their responsibilities.

For the risks, three consultants have mentioned that the contractor is the party who is coping with a high level of risk in construction projects. Furthermore, two of the consultants have stated that the criticality of economic and financial risks is very low for them. Further discussion is provided in the next group's responses about the reasons why the level of criticality of risks may differ for these categories of actors.

Table 5.7 Sub-codes mentioned by consultants (Question 8)

Q8	Relationship & Risk	Relationship	Risk	
		Conflicts between 3 Groups	Contractor – High Risk	Consultant – Low Financial Risk
Consultant	CS1			
	CS2			
	CS3			
	CS4			
	CS5			

Contractors

Since more explanations were given by contractors for this question, two separate coding schemes (figure 5.14 and 5.15) have been drawn for the ‘relationship’ and the ‘risks’ asked in the question. The codes are discussed while considering how each of the contractors has mentioned them as shown in table 5.8 on page 208.

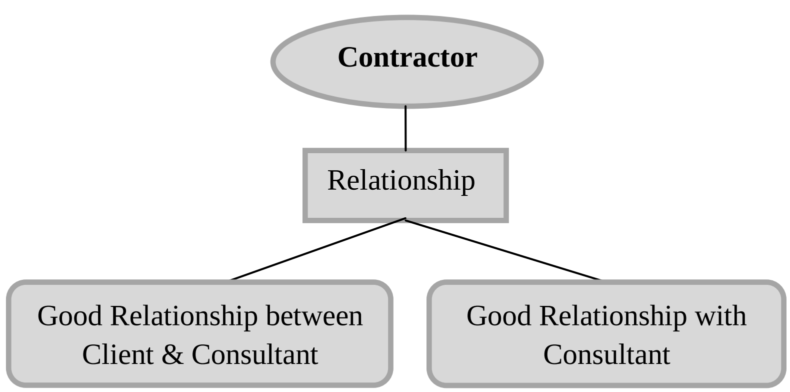


Figure 5.14 Relationship from contractors’ viewpoint

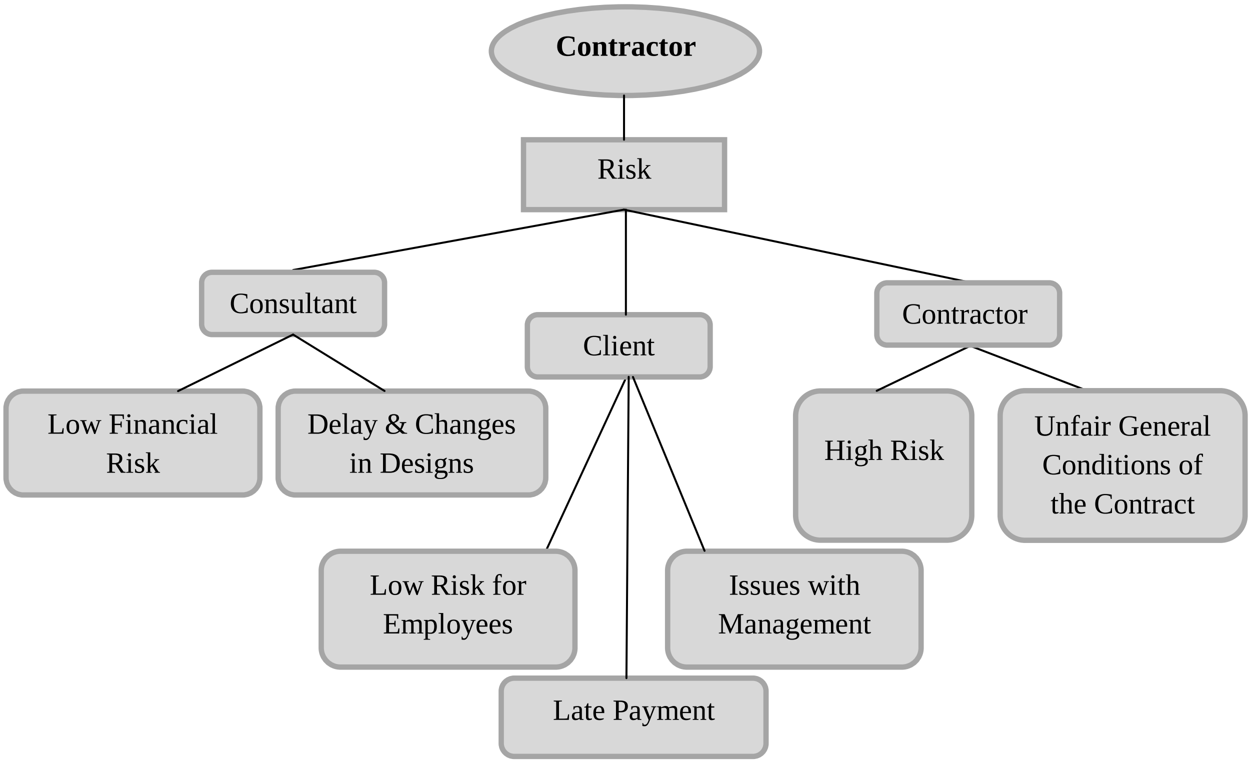


Figure 5.15 Risks from contractors' viewpoint

The remarkable point in responses of the contractors was that even though the risk was asked after the relationship (in second half of the question); all the contractors mentioned the similar phrase right after the question was asked, "*The contractor is the one who is suffering from majority of the risks in construction projects*." After that, they started to explain their relationship with other groups and also types of risk those groups may cause for them.

Although contractors referred to the usual existing conflicts between the three groups, the relationship of them with the two other groups has been looked at from two diverse perspectives by some of the contractors and is argued below:

1. Good relationship between client and consultant
2. Good relationship with consultant

1 - Some contractors have stated that there is a good relationship between the client and consultant and position of those two is against the contractor. The client is always one side of the contract and therefore has a position against the contractor. Consultant is appointed

by client for supervising the contractor's execution of the work and has been assumed to be the client's assistant and therefore in a position against the contractor as well.

2 - Couple of other contractors have stated that they have a good relationship with consultant and it is only client who is in a position against them. Despite the other perspective (1) explained above, here contractors have mentioned that consultants and them have similarities such as: being private companies, being educated and expert in their fields, getting paid by the client, and these similarities make them closer in their relationship.

Hence, contractors either have a good relationship with consultant or consider consultant as the client's assistant and therefore in a position against them. However, as it is seen contractors have never mentioned a good relationship with the client. Due to the nature of the work and since they are two different sides of the contract this can be assumed to be normal but couple of the contractors have stated one similar issue with the client which has been quoted below:

"*Client and contractor are two sides of the contract and should work together for the execution of the construction project, but in Iran the contractor works 'for' the client and not 'with' the client. The behaviour of the client with contractor is not acceptable and even though they are mostly not expert, they comment on contractor's work and sometimes making unnecessary changes to it*."

The responses provided by contractors to this question were quite similar and the answers quoted from one of them (while discussing a specific code) more or less cover what others have explained when they have mentioned that code. Looking at the risks in table 5.8, some of the contractors have mentioned the low financial risk of consultant and all of them have mentioned the high level of risk for contractors; the reasons have been explained comprehensively by one of the contractors (CR2) and are quoted below:

"*One of the most critical and significant risks in construction project is the financial risk and it is the contractor who is suffering from it the most. The reason is simply the difference in the nature of the job and responsibilities of contractors and consultants. A great part of the payment received by consultant is for the designs which do not need much expenditure for the required tools. Therefore, the great part of expenditure for the consultant is mostly the human resources who are making these designs and plans ready.*

However, human resource can be considered as lesser amount of expenditure for the contractor since materials and machineries are required which are expensive and also the prices are fluctuating very much. Moreover, client has serious weakness in supplying the financial resources and late payments are quite common and this also increases the risks for contractor to a great extent. Although the consultant is also being paid by the same client and late payments are risky for them as well; they can manage this risk much easier since the scale is smaller. Besides, as I said earlier expenses for the consultant are more related to human resource and therefore managing it would be easier compared to contractor who is buying the materials with high fluctuations in prices."

Table 5.8 Sub-codes mentioned by contractors (Question 8)

Q8	Relationship & Risk	Relationship		Risk						
				Consultant		Client			Contractor	
		Good Relationship between Client & Consultant	Good Relationship with Consultant	Low Financial Risk	Delay & Changes in Designs	Low Risk for Employees	Late Payment	Issues with Management	High Risk	Unfair General Conditions of the Contract
Contractor	CR1									
	CR2									
	CR3									
	CR4									
	CR5									
	CR6									
	CR7									
	CR8									
	CR9									
	CR10									
	CR11									
	CR12									
	CR13									
	CR14									
	CR15									
	CR16									
	CR17									

For the risks that other parties may increase for contractors, they have referred to delays and changes of consultant's designs. They have explained that delays in making the designs ready lengthen the execution of the work of contractors. Some of the contractors have also stated that major changes in the designs by consultants may sometimes even result in demolition and re-doing the work.

Apart from low financial risks of consultants, some contractors have mentioned the low risk for the client's employees as well. They have stated that client's establishments may only be influenced by bad reputation when the projects are not progressing well and there is no harm for the employees. According to one of the contractors (CR16), "*the client's managers and employees are rarely expert and hence subject to be replaced after a short time, so they do not have the motivation for working appropriately. More importantly, all those people are being paid a fixed salary each month and that is the most significant reason why they do not care about the financial issues of the project because there is no harm for themselves*."

The quotation provided above also covers the code 'issues with management' which has been declared as a risk from client's side that is influencing the contactors. Inexpert management and changes in management's positions in client's organizations were also stated over and over again by interviewees while responding to other questions as risks which are influencing the construction projects in Iran.

The contractors believe that the financial risk for the client and consultant is very low due to the reasons explained above. As a result, those two groups are not influenced much by financial risks but may only be worried about their reputation and prestige if the project does not progress well. However, majority of the risks - with financial risks being the most critical - are impacting contractors and the two other groups may also increase these risks according to the codes discussed. Above all, some of the contractors have referred to the General Condition of the Contract, declaring that it is not fair for the contractor and many of the clauses are advantageous for the client only. Different examples were given regarding the unfair clauses of the General Conditions of the Contract and the one which was repeated by three contractors has been written below. The clause has been translated from the General Conditions of the Contract document and the explanation is quoted from one of the interviewees about it.

Clause 30 - alteration to duration of the contract:

If the client cannot provide the financial commitments according to the dates inserted in the documents of the contract, contractor can request extension for the duration of the contract. Contractor should present the request in addition to justified calculations and reasons to the consultant. Consultant reviews the document and if accepted would report it to the client and will then inform the contractor with the client's decision about this request (General Conditions of the Contract, 2010).

According to one of the contractors (CR5), "*The clauses in the General Conditions of the Contract are not fair for the contractors. Late payment is one of the worst risks contractors are dealing with and is the client's fault but the only clause related to it in the General Conditions of the contract (clause 30 explained above) does not do anything for the contractor. If the client does not pay the contractor on time; there is no penalty or fine for the client, no interest is being paid to the contractor for the time the payment was delayed and the only option left for the contractor is the 'request' for extending the duration of the project (authorized delay). In some cases even that 'request' is not accepted by consultant and client, and that is an example explaining why there are not much beneficial clauses for the contractor in this document. Considering the high inflation in Iran; when payments are delayed for two or three years and then just the payment is paid with no interest, the received money has greatly lost its value and the purchasing power of the contractor has also been reduced.*"

As it can be seen from the more variety of codes mentioned by the contractors and also the quotes written above; many of the risks are more critical for this group. Besides, consultants and clients are also increasing some risks for the contactors due to the reasons discussed above and therefore it can be stated that contractors are more at risk compared to the two other groups.

Even though executing construction projects based on EPC contract was not mentioned by any of the contractors, it can be considered as an effective solution for decreasing the code "delays and changes in designs" stated by them as a risk consultants are causing for them. Hence, if contractor and consultant work together these types of risks will not influence the project as much as it is influencing now but the EPC contractors are not much in Iran yet.

5.9. Question 9: In your questionnaire, you have ranked (… and …) as the most important risks; what is your opinion about effective mitigation strategies for them?

Referring back to the questionnaire, there was a table provided in its first page asking participants to write the risks they consider as critical and then rank them. This question reminds the interviewees about the two most critical risks they had mentioned in that table and after that asks them the mitigation strategies that they think would be effective for those risks.

As explained earlier in the Questionnaire Analysis chapter, the first table provided in the questionnaire was left empty for the participants so they can think independently and write the risks from their own opinions before listing any risk for them. Having this in mind, presence of only four risks mentioned by them as the codes of this question highlights the high criticality of these risks in construction projects of Iran.

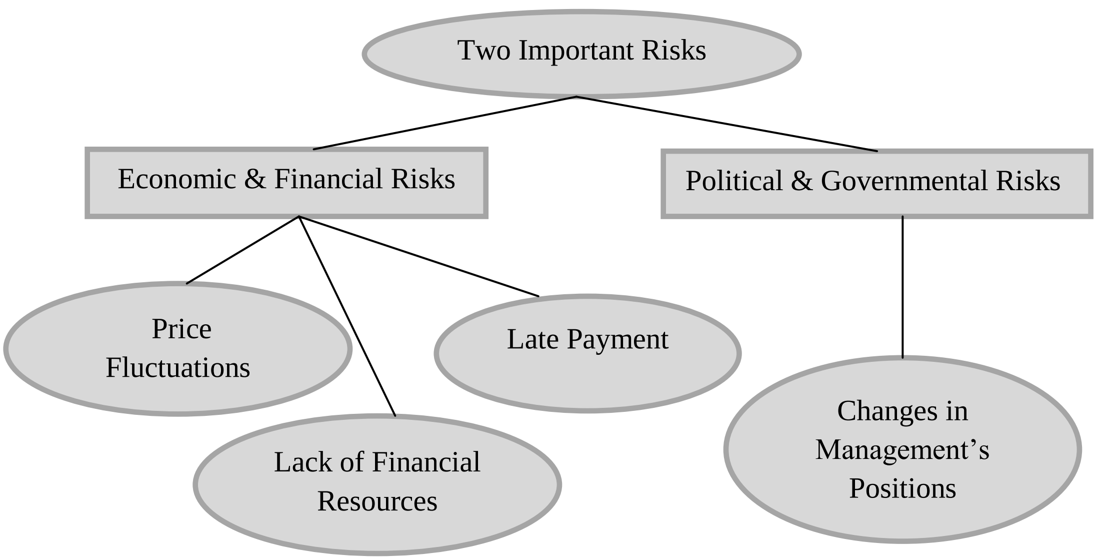


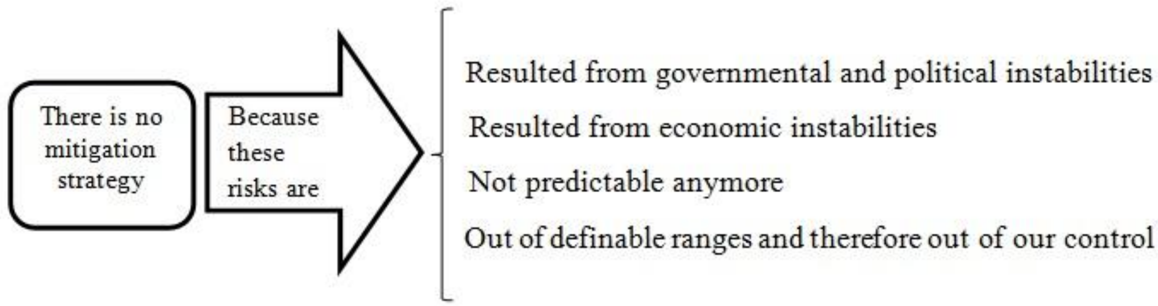
Figure 5.16 Two important risks of construction projects

Figure 5.16 illustrates the codes (utilizing five main categories of risk used before) and table 5.9 shows the two risks that have been mentioned by each of the interviewees.

Table 5.9 Two risks mentioned by interviewees (Question 9)

Q9	Risks	P&G	E&F		
Participants		Changes in Management's Positions	Price Fluctuations	Lack of Financial Resources	Late Payment
Client	CL1				
	CL2				
Consultant	CS1				
	CS2				
	CS3				
	CS4				
	CS5				
Contractor	CR1				
	CR2				
	CR3				
	CR4				
	CR5				
	CR6				
	CR7				
	CR8				
	CR9				
	CR10				
	CR11				
	CR12				
	CR13				
	CR14				
	CR15				
	CR16				
	CR17				

Similar to the results of questionnaire and question 2 of interview, sub-codes of Economic and Financial risks have got the higher frequency. However, the mitigation strategies proposed by the interviewees demonstrate that they consider the highly critical risks associated with construction projects to be external and therefore difficult to be mitigated. The following statements were repeated by interviewees of different groups for the risks of table 5.9 (sub-codes of Economic and Financial risks and also Political and Governmental risks):



No other strategies were suggested for Political and Governmental risks and few were recommended for Economic and Financial risks (by contractors only) as follows:

- Stop working for a while until the situation becomes more stable
- Executing projects which have shorter durations
- Not executing governmental projects for the moment, only executing private projects
- Buying materials as early as possible
- Investigation on client and its financial viability
- Investigation on project's specification
- Establishing agent bank

As it can be understood from mitigation strategies provided by interviewees, they evaluate the existing significant risks as external and not much effective strategies have been suggested by them due to intense changes and high instability of the situation of the country. Looking at the strategies, it was advised not to work for a while since the contractors consider the economic and political situation of the country as very unstable. Therefore, they think that by executing construction projects in the current situation not only they do not make any financial benefits but also there is a high probability of financial loss or even bankruptcy.

Executing projects with shorter duration can then be a good solution since predicting different aspects of the situation for longer time horizon would be much more difficult, for example changes in inflation and also price fluctuations may be (not necessarily) more limited in shorter time horizons.

Contractors have also mentioned that due to the current economic situation of the country, many of the governmental establishments do not have adequate budget for construction projects and even if they have the budget, it may not be appropriately allocated to different projects. Therefore, executing private projects where the client is a private organization with the required budget would reduce the financial risks of the projects to a great extent.

Buying materials as early as possible, investigation on project's specifications, client and its financial viability have been suggested as strategies for mitigating the financial risks and have been discussed earlier in responses of question 4/5.

Finally, the last suggestion was establishing agent bank which was mentioned by one of the contractors and according to his explanations this strategy has been discussed between them and couple of clients; has been evaluated as an effective strategy and therefore may get implemented in near future. Agent bank is a governmental bank in which construction budget will be saved each year when the country's budget is allocated to different sections and industries. Therefore, whenever contractor submits the project's financial statement and it is approved, contractor will be paid by agent bank on behalf of client. Since this is a governmental bank, it can work easier with government compared to contractors and because the money is saved there and cannot be spent on other requirements of the country (in case of budget shortage), a great part of financial issues and late payments of the construction projects can be reduced.

5.10. Question 10: Please feel free to provide me with your opinion about any existing issue in construction industry in Iran which was not mentioned in this interview.

In this question, opinion of the interviewees has been asked about anything related to construction industry and therefore no coding scheme can be drawn for the responses due to variety of them. Some of the interviewees have emphasized on risks associated with construction projects and the effective strategies for mitigating them which were argued earlier for other questions but they have mentioned them again. So, the following discussion may be repetitive at some points but merges and summarizes the opinion of all the interviewees stated for this question:

Construction projects are associated with high level of risk in Iran and majority of the risks are external and mostly related to political, governmental and economic situation of the country. The current risks of construction projects are commonly resulted from instable economy, construction budget, and lack of planning because due to high inflation and intense price fluctuations, planning means nothing in Iran.

Consultants and contractors are expert people since certificates and experiences of employees should be verified so they can get the required grades for their companies. However, clients mostly have inexpert managers and therefore when the head of the system (client) is not expert, the rhythm of the work is not consistent any more. These inexpert managers apply their individual opinion while rules and regulations should be followed. Expert and experienced people should be appointed for management positions of the construction projects or at least training sessions, workshops, and seminars should be offered to these people in order to improve the efficiency of the work and the communication between three groups. At the moment, maintaining a good relationship with the clients and their employees can be considered as the only option available in order to lessen their power for regular unnecessary changes to the construction projects.

Above all, there is a serious need in Iran for the project manager even in the consultant and contractor's companies. Most of the top managers are civil engineers and architects in these companies while there should also be managers in these companies who have studied the science of management. This is even worse for the field of risk management which is rarely utilized and not much risk management experts are working in this industry. The concept of risk is getting more significant in Iran and experts are required for managing risks. The manager plays an important role for construction projects and according to the situation of Iran they need to make different decisions in each situation based on various aspects. However, managers of contractor and consultant companies are dealing with financial issues of the projects most of the time and this reduces their time for coordinating and managing their companies, employees, the work being executed and the decisions which should be made.

5.11. Conclusion

This chapter has discussed the responses of interviewees to 10 questions of the interview. Each question was analysed separately and responses of three different groups of interviewees were coded individually for some of the questions due to their different perspectives. Responses provided for the last question more or less cover the risks argued in previous questions but these results are fully discussed in the next Chapter - Discussion. Next chapter also includes a review of literature, contextual data, and questionnaire results in addition to the results of interview and concludes the overall results of this thesis.

6 – Discussion

6.1. Introduction

The last two Chapters, Questionnaire and Interview Analysis, covered the results of data collected via completing questionnaires by three categories of actors in construction projects and also conducting interviews with them. The results of questionnaires and interviews were analysed and discussed in each chapter separately in addition to the required tables, figures and quotations from interviewees.

This chapter, Discussion chapter, reviews the results of two previous chapters and analyse them together in relation to the findings of other authors argued in Literature Review chapter and contextual data about Iran discussed in Methodology chapter. Research questions provided in the Literature Review chapter are answered here which would reveal the results found about managing risk of construction projects in Iran. It is then continued with proposing guidelines which may be useful for other countries with volatile situations similar to Iran and finally the results are discussed in relation to the contingency theory (the theoretical framework of this thesis).

The research questions are recalled below:

6.2. Research questions

Using a case study of Iran:

1. **What are the processes of risk identification for construction projects?**
   - ❖ *Identification and evaluation of internal and external risks*
   - ❖ *The nature and strength of interaction between various risks*
2. **How is the knowledge about construction risks utilized in managing risks in line with contingency theory?**

These research questions are investigated in relation to the possible differing perspectives of the three main categories of actors in construction projects: client, consultant, and the contractor.

6.2.1. What are the processes of risk identification for construction projects?

This question has been divided into two sections for clarification because for identifying the risks in any project, expect from categorizing them there is a need to find out the interaction between them.

- *Identification and evaluation of internal and external risks*

The risks which are discussed for this question are mostly extracted from the results of first table of questionnaire, second table listing 25 risks, and questions two and three of the interview. The participants for this thesis were from three categories of client, consultant and contractor. These categories may have different perceptions of risk due to their different knowledge and also different objectives. Therefore, as their responses may differ, three categories' opinions may be argued individually for some parts of the answers.

As discussed in the Questionnaire Analysis chapter, setting the boundary between internal risks and external ones is quite difficult due to the complexity of the subject. However, the 'project' was considered as the concept which determines internality and externality for these categories. Any project is being executed by one or more organizations which are in turn located in an environment. The project, organization and the environment have their own specifications and there is a strong interdependency between them and consequently influence each other. Therefore, due to the existing interaction some of the risks can be considered to be both internal and external to the project especially since the client is the government for the projects being studied in this thesis. As a result, any risk related to the client can be considered as internal to the project (as an involved party) and also as external since it is the government.

For allocating the risks mentioned in the questionnaire and interview to more detailed and specified categories (than just internal and external), five main categories were proposed by the researcher for this thesis as follows:

1. Political and Governmental (P&G) = External (E)
2. Managerial and Technical (M&T) = Internal (I)
3. Economic and Financial (E&F) = External (E)
4. Cultural and Social (C&S) = Internal (I)
5. Natural (N) = External (E)

The same issues discussed above for division of internal and external categories apply here and these five categories are not absolutely distinct from each other; they are interrelated and may function interdependently. As argued earlier in the Questionnaire Analysis chapter; due to the strong interrelation of these categories in the philosophical context, some of the risks may have the potential to be fitted in more than one of these categories.

Internal and external risks are evaluated from questionnaires (first table and table of 25 risks) and interviews (questions 2 and 3).

Questionnaire:

The first three risks mentioned by participants in the first table were (table 4.2 on page 93):

1. Project Finance and Cash Flow (E&F)
2. Price Fluctuation (E&F)
3. Managerial (M&T)

As it is seen, the first two are sub-categories of Economic and Financial risks (external) and the third one is a sub-category of Managerial and Technical risks (internal).

From the next table of questionnaire (list of 25 risks), 9 risks were evaluated as critical (table 4.4 on page 99) that are presented below with the first three risks being sub-categories of Economic and Financial risks and therefore external:

- Cash Flow (E&F)
- Inflation and Interest Rate (E&F)
- Late Payment (E&F)
- Cost Overrun (M&T)
- Inadequate Project Management (M&T)
- Justice Enforcement (P&G)
- Foreign Exchange and Convertibility (E&F)
- Expropriation (P&G)
- Inadequate Design (M&T)

It can be ascertained that among the 9 critical risks, Economic and Financial risks have got the highest frequency followed by Managerial and Technical risks, and then Political and Governmental risk. It establishes the greater influences of external risks on construction projects than the internal ones. Referring back to the table 4.9 on page 103 where three critical risks evaluated as critical by all and each group individually are shown, a slight difference can be seen. Except clients, average of all the responses in addition to the responses of contractors and consultants for the first three critical risks fall in the category of Economic and Financial risks. However, cost overrun as the first risk mentioned by client is a sub-category of Managerial and Technical risks which was appointed to internal risks; though, according to the discussion provided earlier about the interdependency of these categories it can also be considered as an external risk. Cost overrun is a risk related to management but if it specifically refers to clients' management and their unrealistic planning and budget allocation which was discussed in Interview Analysis chapter, it can be assumed to be external as well because the client is government (external to the project).

Table 6.1 summarizes the frequency of each of the five main categories of risk for the 9 critical risks mentioned by participants. The average of all the responses which is shown in the first row of the table (overall) can be considered to be the criticality of the risks and influences of them on construction projects.

Table 6.1 Frequency of each of the five main categories of risk for the 9 critical risks

9 Critical risks	P&G	M&T	E&F	C&S	N
Overall (project)	2	3	4	0	0
Client	3	2	4	0	0
Consultant	1	4	4	0	0
Contractor	3	2	4	0	0

Following point can be concluded from the bale:

- External risks are more critical than internal risks
- E&F is the most critical category for the construction projects and all the groups
- C&S and N categories of risk are not critical for construction projects
- After E&F category, client and contractor are influenced more by P&G category (external) whereas project and consultant by M&T category (internal) – however, it needs to be explained again that since client is government and therefore can also be considered as external for the project, some of the sub-categories of M&T group

which relate to clients' management may also be assumed as external as well as internal for the project

Considering the evaluation of all the risks, it can be stated that the level of criticality for the construction risks in Iran is more than intermediate. However, three groups of participants assess these risks different from each other; clients evaluate the risks more critical and the evaluation is followed by the contractors and finally the consultants. As mentioned above, these groups may have different perceptions of risks based on their knowledge and also their objectives. Moreover, the difference between the evaluations of these groups can be the result of the types of their personality as well as the level of influences of these risks on them.

Comparing evaluations of three groups more specifically for five main categories, P&G was the category showing more differences in opinions about the criticality of its sub-categories. The difference was mostly between the consultants for evaluating these risks less critical or the clients for evaluating them more critical than other groups. Since the client is a governmental body in this thesis, it can be concluded that the influences of the political and governmental risks are much more for them than others.

Interview:

Apart from the two tables of the questionnaire, risks associated with construction projects were also asked from participants in the interview and the results are looked at below.

Different risks were mentioned for the question 2 of the interview and coding schemes were provided for the responses (table 5.1 on page 174). Looking at the three codes which were mentioned the most, it can be seen that all three are sub-categories of Economic and Financial risks:

1. E&F 2: Lack of financial resources
2. E&F 1.2: Price fluctuations
3. E&F 2.1: Late payment

The sum of all the sub-codes mentioned for each of the categories shows the priority of categories as: E&F, M&T, P&G, and C&S. Since many of the sub-codes of M&T category are related to clients' inexpert management and the issues with them, this category can be considered to be external to a great extent as well as internal. Therefore, the results of this question confirm the higher influences of external risks on construction projects and the involved parties than the internal risks.

Question 3 of the interview asked about the risks inside the organization (internal to the organization). Some of the risks which were considered to be internal to the project can be assumed to be external when considering each organization individually. Therefore, each of the organizations, their management, and the tasks they are responsible for can be considered as external to others (while they were all internal when project was considered). Human resources (managing them and also their expertise) was the risk being mentioned the most for this question and was considered to be more under control of managers compared to external risks.

As it is seen from the results of questionnaires and interviews, the critical risks are mostly sub-categories of Economic and Financial risks. As Chapman and Ward (1997) have stated; even though the cost curve's shape may significantly differ from one project to another, the execution phase is associated with the majority of the expenditure. Therefore, as the contractor is the party dealing with the execution stage, the influences of these risks would be much more critical for them compared to the consultant and client.

According to the result of the research conducted by Zou *et al*. (2006), generally the construction risks are related to contractors, followed by clients, consultant and few to the governmental bodies. The findings of this thesis demonstrate nearly similar ranking for the association of the groups to the risks. Contractors as parties being involved and influenced greatly by construction risks have got the same position – the highest in the ranking. It is then followed by the consultants for this thesis since these people are more challenger than the clients and seeking financial benefits from the project as well. However, the tasks they are involved in (compared to the contractors) are not much influenced by the risks and as the result the impacts are much less for them. The last group in ranking would be the client because they are not coping with the risks directly and therefore not much influenced especially financially. Comparing this ranking with the one provided by Zoe *et al.*; it can be seen that governmental bodies are not dealing with the risks very much. Hence, as the client in this thesis is the government it can also be concluded that they are not coping with many of the risks and this can be considered as another reason why the consultant has got the higher position than the client in the ranking of this thesis.

Great influences of lack of financial resources and the late payment of client as its most significant outcome have been also revealed in other studies about Iran. As discussed in the Literature Review chapter, the first three causes of delay (out of 10) found by Pourrostam and Ismail (2011) in their research on identification of the main causes of delay in construction projects of Iran are: poor site management and supervision, delay in progress payment by clients, change orders by client during construction. As it is seen, delays in payment has been evaluated as the second most important risk causing delays in construction projects of Iran. However, it is required to emphasize that delay can only be one of the outcomes of the late payment and it may also influence other aspects of the project specially its cost and budget.

Comparing the results of this thesis with the papers reviewed in the Literature Review chapter summarized in table 2.1 on page 41, high criticality of the risks from Economic and Financial category cannot be seen as the top risks associated with construction projects in the countries where the authors have conducted their research in. As it can be realized from the samples of table 2.1 (page 41), critical risks for construction projects are mostly related to the design of the projects and technical risks and therefore internal to the project. However, risks related to economic and political situation of Iran (external to the project) are influencing the projects more than other risks. Moreover, as discussed earlier in this chapter, even some of the risks related to management (M&T category) refer to the clients' management which can also be considered as external risks because the client is government.

The critical risks which are influencing the construction projects significantly in Iran revealed to be cash flow, lack of financial resources, inflation, price fluctuation, and late payment which in a sense all can be considered to be outcomes of instable economy. Although various data have been provided earlier about the economy of Iran in the Introduction and Methodology chapters, few more examples are presented in this chapter for further demonstration.

As stated in the Methodology chapter, official organizations announce dissimilar rates for the inflation and they have been also accused for providing incorrect figures. As reported by Mehr News; although the inflation rate had been announced to be 26.1% in November 2012 by Central Bank of Iran; by calculating individual indices provided by them and comparing them with the last year's indices, inflation rate would be 36% in November 2012 (*Khorasan*, 2012).

It can be realized how instable the economy of Iran is which certifies why economic and financial risks are influencing the construction projects more than all the other risks.

After identifying the internal and external risks and allocating them into five main categories defined above, the second section of the first question discusses the interaction between different risks.

- ***The nature and strength of interaction between various risks***

There is relationship among risks at different levels (Flangan and Norman, 1993; Thobani, 1999; Hastak and Shaked, 2000).

Existence of relationship between risks has been argued by different authors and their findings were also provided in the Literature Review chapter. Wang *et al*. (2004) have conducted a research about construction projects in developing countries and have stated how different levels of risk may influence each other. They have indicated the influences of country level risks on market and project level risks, and in turn the influences of market level on project level.

Flanagan and Norman (1993), in their book Risk Management and Construction, have also provided a hierarchy for the risk in construction project (figure 6.1) with the environment being at the top, followed by the market, the company and finally the project/individual.

They believe that risks in each level impact the levels below and emphasize on the intrinsic link between the company risks and the project risks since the outcomes of a risky project must be eventually borne by the company.

This relationship between different levels of risk explained above can be considered to be between different categories of risk as well because of the correlation of these levels with the categories provided for this thesis. Therefore, it is only the matter of classification and the focus is on the relationship between the risks in different ‘levels’ or ‘categories’.

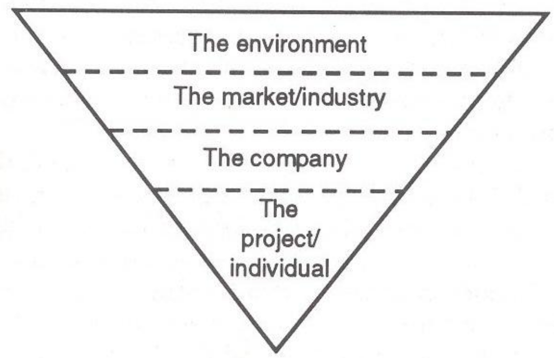


Figure 6.1 The risk hierarchy (Flanagan and Norman, 1993, p. 54)

The relationship between five main categories of risk in this thesis (P&G, M&T, E&F, C&S, N) and their sub-categories have been argued in the Interview Analysis chapter and is discussed more fully here with emphasizing on ‘Economy’ and its superior influences on other categories.

As Flanagan and Norman (1993) have stated “The performance of all companies is dependent on the economy. Changes in the money supply, interest rate, exchange rates, taxation, the prices of commodities, government spending and overseas economies affect all companies in varying degrees. This argument is valid in the construction industry.”

Primacy of economy was first declared by Karl Marx (1956), referring to the economic system as the substructure and the cultural system as the superstructure in any society. Therefore, according to Marx’ thoughts economy (base) determines other aspects of human’s society such as culture, politic, and history and this is sometimes called economic determinism.

Although Economic and Financial category has significant influences on other categories, the relationship cannot be assumed as one-way and obviously there is interaction (two-way effect) between them. As a result, these categories are influencing each other in different degrees and they can never be presumed as distinct categories; it is only the strength of this interaction which may differ between various categories. It is therefore clear that the sub-categories of one category not only may have influences on each other but also on sub-categories of other categories and examples are provided below.

One of the strongest interactions exists between Economic and Financial category (E&F) and Political and Governmental category (P&G) and their substantial interdependency cannot be underestimated. Figure 6.2 demonstrates an example of how instabilities of political and economic situations may influence each other; each of the four vertical sections of the diagram shows a specific period in the situation of the Iran (starting from Iranian revolution to present). Four sections from left to right are: Iran-Iraq War, Rafsanjani Government, Khatami Government, and Ahmadinejad Government. Vertical axis illustrates Iranian currency (in Toman) per US Dollar; although Rial is the official unit of Iranian currency, sometimes it may get expressed in Toman (one Toman equals 10 Rials). The Horizontal axis shows the years in Iranian calendar from 1979 to 2012 (the correspondence calendar can be found in Appendix H). Blue line demonstrates increases in Market rate and the red line shows the Central Bank of Iran Subsidized rate.

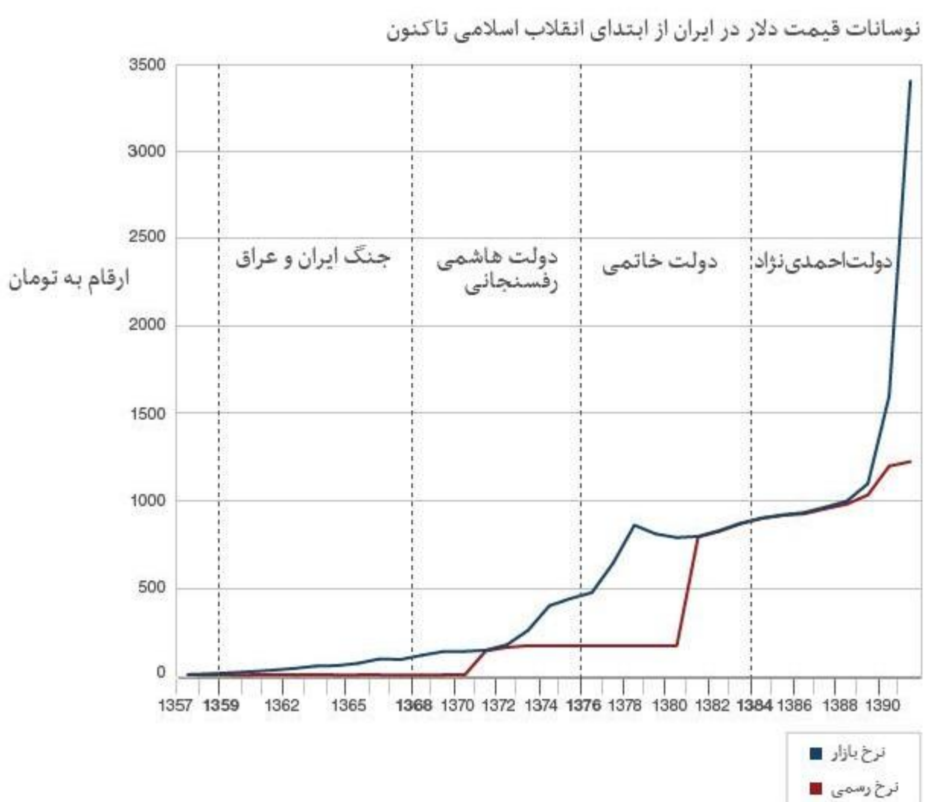


Figure 6.2 Fluctuations of Iranian currency per US Dollar - from Iranian revolution to present (BBC, 2012)

Consequently, instabilities of economy influence the budget of the country which covers the construction budget as well and this may have outcomes such as lack of financial resources for the construction projects. Moreover, the volatile economy results in relatively high inflation and in response to that the prices of construction materials increase.

Another point which needs to be emphasized on is that economy of each country is not isolated and is rather dependent on other countries to some extent. Example can be referred to the research undertaken by Grace (2010) explaining the construction boom of 2004-2008 which resulted in sharp increases in construction costs. He has stated that in 2006 (the peak of this boom), material costs increased to astronomical levels in United States i.e. steel 15%, cement 13%, asphalt 28% (according to the reports of Engineering News Record). However, the severe increase in demand caused by an Asian construction market was recognized as one of the principal reasons for these price increases in US.

Referring back to the Methodology chapter; as reported by Construction Companies Association Monthly Magazine in April 2012, the market indicates an 80% increase in the iron price and even 100% for some of the materials such as utility systems, pumps, and electronic equipment. If the increase in prices of construction materials in US mentioned above has been considered as an 'increase to astronomical levels', what would the increase of prices in Iran be called?

As discussed earlier, although the economy can be considered as the base for determining other aspects of the human society, each of the categories may influence other categories as well. Arguments were provided in the Interview Analysis chapter regarding the interaction of different risks and some of them are reviewed below.

Since the client is a governmental body for public projects, the political and governmental risks can influence the managerial risks intensely. The existing hierarchy of management levels in the ministries, the process by which they may get changed sometimes based on the individual opinion of upper levels, and also existence of connections strengthen this interaction between P&G and M&T risks. As explained in the previous chapter, two principal ministries namely Ministry of Housing and Urban Development and Ministry of Roads and Transportation were merged and established Ministry of Transportation and Housing in June 2011. After occurrences of subsequent issues in management of those two ministries and the influences on the projects being executed by them, the Iranian Majlis has proposed a plan for merging a third ministry with Ministry of Transportation and Housing in December 2012: The Ministry of Information and Communication Technology (ICT). If the plan gets accepted, similar to the previous combination of ministries, the apparent outcome would be omission of one of the ministers and subsequent changes in lower levels of management. Consequently, the projects this ministry and its associated governmental establishments are responsible for will be influenced due to the changes in management's positions and further changes in the structure and regulations of the ministry. However, the odd event which has happened is that before the plan gets accepted, and while there are still negotiations about the accuracy of this plan, the minister of Ministry of Information and Communication Technology has been dismissed. Such chaotic situations influence the organizations, their overall structures, management's positions, and the projects being undertaken by them.

Expect from changes in management's positions (sub-category of P&G risks) which was mentioned by participants as a critical risk influencing their projects, the interaction between the political and governmental risks and the managerial risks can result in further risks: inexpert management (client), application of individual opinions, and regulations being replaced by connections (sub-categories of M&T risks). Due to the frequent changes in management's positions in governmental organizations, in many cases their expertise is less significant and may not be relevant to the responsibilities of the job they have been allocated to. This may then result in weakening of regulations and strengthening of individual opinions and connections.

This lack of expertise in management's positions of clients may influence the planning for the projects and result in unrealistic planning (sub-category of M&T risks). The planning which is not according to the available resources and required time may in turn lengthen the duration of the project – Delay (sub-category of P&G risks). Since time and cost are always related, increases in time would increase the costs (sub-category of E&F risks). Due to the instable economy of Iran, sharp increases in inflation rate and subsequent price escalations; this interrelation of time and cost becomes stronger. Therefore, as the time increases, the costs may increase intensely every single day.

Late payments of client (sub-category of E&F risks) can be considered as another factor lengthening the projects (sub-category of P&G risks) and then again delays result in extra cost (sub-category of E&F risks) due to the strong interaction of these risks.

Competition (sub-category of P&G risks) can be assumed to be another risk influencing the financial risks related to the construction projects (E&F risks). In some of the cases the reluctance of contractors for including contingency in the contract can be due to the competition. In a country such as Iran which is suffering from economic instabilities and financial risks are quite critical; minimizing the price of tender because of competition can strengthen the criticality of financial risks to a great extent.

Except from inexpert management in clients' organizations, analysis of the collected data revealed lack of project management and risk management expertise to some extent. This management risk may be resulted from cultural and social situation of Iran – especially the gaps in the culture regarding the concept of risk and its management.

Therefore, considering different categories of risk and their sub-categories, it can be perceived that they are deeply interrelated and due to the strong interactions between them each may influence other categories and also get influenced by them. More discussions about the relationship of risks are provided in the second question of the research where risk management is being argued.

6.2.2. How is the knowledge about construction risks utilized in managing risks in line with contingency theory?

Looking at the evaluation of the proposed mitigation strategies in questionnaires and also the responses provided in interviews for risk management process; it could be realized that three groups of participants have different perspectives. Their differing perspectives and perceptions of risk based on their knowledge and objectives in addition to the level of influences of risk on them consequently may result in different strategies adopted by them for managing risks.

As discussed in the first research question on page 220, Economic and Financial risks are the most critical category of risk for construction projects in Iran. As contractors are dealing with execution phase - associated with the majority of expenditure - E&F risks are more critical for them comparing to consultants and clients. Reasons for greater influences of E&F risks on contractors were stated by one of the contractors (CR2) on page 207 when he explained the difference in the nature of the job and responsibilities of contractors and consultants. However, except from the E&F risks, results of questionnaire and interview questions showed influences of other risks such as Political and Governmental on contractors more than other groups. Referring to question 8 of the interview on page 202, it can be seen that except from criticality of sub-categories of E&F risks on contractors which was mentioned by all of them, there are some other risks influencing them that may be caused by consultants (i.e. delays and changes in designs) or clients (i.e. issues with management). Dynamic and complicated features of construction projects require 'risk management' for dealing with the inherent risks of these projects. Risk management as an essential part of project management refers to identification and evaluation of risks in order to plan for implementation of risks responses. It is all about people making decisions according to the project's specifications and objectives. Decision-making as defined by Flanagan and Norman (1993, p. 31) is "a game of imperfect information involving the future, change, and human action and reaction." This process is not making right or wrong decisions, rather better or worse decisions are made. However as discussed in question 10 of interview on page 215, high criticality of the E&F risks on contractors (followed by consultants) and hence dealing with financial issues takes most of their time and therefore reduces required time for making decisions for other risks, coordinating and managing their companies, employees, and the work being executed. Moreover, serious lack of risk management knowledge in Iran (greatly resulted from cultural gaps) revealed from results of Risk Management statements in questionnaire on page 157 and also mentioned in questions 4 and 5 of interview on page 191, greatly influences the strategies undertaken by parties for managing the risks and decisions they make.

Risk can be considered as an element in all decision making processes and since it is involving the future, laws of probability can be assumed to be the heart of this concept because it allows prediction. As stated by Bernstein (1996, p.57) "the most powerful tool of risk management ever to be invented is the law of probability." Two schools of thought about the probability concept can be utilized in decision making process: objective probabilities and subjective probabilities. The former relates to probabilities based on repeated observations of an event whereas the latter represents the degree of belief in occurrence of an event by the decision-maker based on available information. Therefore, due to the uniqueness of construction projects subjective probabilities are likely to be utilized more in determining decisions, and experience can be considered as the strongest resource which is available to the decision-maker. Hence, organizational learning has been recommended for enabling people to learn from the past and make best use of their experience when managing projects. Considering the similarities between the risk management and contingency theory, adaptation in theory mostly happens through organizational learning which increases the decision-making potential through utilizing past experiences and applying them to current situations where possible.

However, organizational learning - as an essential concept in risk management and also contingency theory - is not being practiced in Iran very systematically. According to the responses to question 7 of the interview, due to the unsupportive culture and lack of risk management expertise the learning process may not be practiced efficiently. Some of the interviewees believed that the individuals may obtain experiences automatically via executing projects and so not all the companies had a well-organized process for evaluating the strengths and weaknesses of the projects for utilization in future projects. Moreover, high volatility and dissimilarities of situation for each project (compared to previous projects) was mentioned as another reason why organizational learning is not being practiced analytically since they consider effectiveness of past experiences relatively low for the very unique new projects. Furthermore, as mentioned by clients on page 199 lessons may be overlooked by top levels even when there is a learning process through evaluation of the pros and cons of each project.

Although organizational learning is effective for managing risks, it cannot be expected that the decisions made solely on the past (experience) forecast an uncertain future. Thus for a new project, except from the experience and available information related to previous similar projects to the one being undertaken, the actual risk identification and management would be based on specific information of the new project. Risk management (through utilizing the laws of probability) provides proactive decision making since it is usually associated with contingency plans (proactive) supporting the base plan. However, this does not mean that all the possible outcomes can be predicted via proactive planning or reactive planning is not necessary. Reactive planning is required and developing proactive plans results in relatively few crises to be realized while responding to risks via reactive risk management. Even though crisis management (as a subset of reactive planning process) is sometimes necessary, appropriate risk management decreases the need for crisis management to a great extent (Chapman and Ward, 1997). One part of risk management process is estimating contingency cost for covering any additional costs which may be resulted from occurrence of risks. Although precise estimation of the contingency cost is greatly dependent on the degree of expertise and accessibility of historical data, the most common approach for it is utilizing previous experiences with similar projects (Liu and Zhu, 2007). Since contingency theory is risk-based and aims at managing each situation depending on its specifications, contingency planning (proactive) and contingency cost (proactive) can be considered as required elements of the theory - similar to risk management. Likewise, while utilizing the theory, not all the aspects of any situation can be predicted precisely and subsequent reactive processes are therefore required after the situation materializes. Before continuing with risk management in Iran, one point needs to be explained about the concept of risk. Risk has been stated as ‘unforeseen event’ or ‘unpredictable event’ by various authors. Although there is much overlap between being ‘unforeseen’ and ‘unpredictable’ and these may be used interchangeably; there is slightly difference between them. Unforeseen can be referred to an event which is totally beyond what one can conceive (out of the blue) whereas unpredictable can be referred to an event which its level of predictability cannot be defined in a reasonable range (it can be foreseen). Managing the risks in Iran refers to unpredictable events because they can be foreseen and it is only their level of predictability which is decreasing in relation to the life time of the project.

In order to be able to plan proactively for the projects - contingency plan –according to the answers of questions 4 and 5 of interview on pages 193 and 194, many of the contractors and consultants investigate about project’s specifications, client and its financial viability before starting the project. It helps them obtain more specific information about the new project and its risks and plan according to the unique specifications of the project. Besides, according to question 6 of interview on page 197, the most frequently used technique for keeping the contingency plans on review was mentioned to be monthly review of project progress for updating the plans. However, referring back to the results of Politics and Government statements in questionnaire on page 161,examples and quotations from interviewees provided in previous chapter regarding political and governmental instabilities and subsequent risks such as unrealistic planning and budget allocation for projects on page177, changes in management positions on page 176, and Managerial and Technical risks such as intense changes in designs on page 185; it can be realized that due to the high volatility of the situation of the country, the ability of the parties for developing contingency plans (proactive) effectively is decreasing. Therefore, as mentioned in questions 4 and 5 of interview, managers may have to wait in many of the cases until the risk occurs and the impacts get determined and then decide on how they can manage it appropriately (reactive).

Contingency cost can be considered as one fair way for covering the risks which are likely to result in additional costs and also financial risks themselves which are mostly due to instabilities of economy and subsequent potential price fluctuations. Contractor is involved with estimation of contingency cost more than other parties since they are dealing with execution phase which can be assumed to be the phase associated with the majority of expenditure. Moreover, they have to bid for the new project and try to include this contingency cost in the price they calculate and offer in tendering phase. However, two main reasons are decreasing the effectiveness of contingency cost for mitigating the risks at the current situation of Iran.

Firstly, it is due to the high level of volatility and instability of economic and political situation of Iran which is resulting in quite unpredictable events, and therefore incapacitates the managers to predict and estimate the appropriate cost. Looking at the following recent examples, unpredictability can be perceived:

The diagram in the next page illustrates the exchange rate (US Dollar) fluctuations from 22th of July to 1st of October 2012. As reported by BBC (1 October 2012), Iranian currency has lost more than 15% of its value in ‘one’ day. Iran’s currency dropped to 34500 to the Dollar on 1 October 2012 while it was 29800 on 30 September 2012.

Figure 6.3 Exchange rate (US Dollar) fluctuations from 22 July to 1 October 2012(BBC, 2012)

Another example can be referred to the sudden changes in rules and regulations as sub-category of Political and Governmental risks (P&G). Looking at table 6.3, the differences between the Market rate and the Central Bank of Iran (CBI) Subsidized rate of currency over the last 12 years can be seen. Usually, CBI Subsidized rate would be provided by clients for the contractors for the expenditures related to exchange rate such as some of the materials. A new rule regarding cancellation of providing CBI Subsidized rate for many of the contracts, delays of client for providing it, or even problems regarding ambiguity of new rules would intensely influence the financial risks of the project. The reason is that the fluctuations of the CBI Subsidized rate is lower than the Market rate and therefore the contractor may not set aside a large contingency cost for it and hence the change for using the Market rate instead of it had not been predictable for them to cover it in the project costs. Considering the sharp increase in Dollar rate in autumn 2012 (1 Dollar = 35000 Rial on average), the difference will not be manageable for the contractor who was about to spend 12260 Rial for each Dollar when dealing with exchange rate.

Table 6.2 Market rate and CBI Subsidized rate of currency over the last 12 years (based on Khorasan, 2012)

Year	Central Bank of Iran subsidized rate – US Dollar	Market rate – US Dollar
2001	1750	8010
2002	7950	8020
2003	8280	8330
2004	8710	8750
2005	9020	9040
2006	9190	9230
2007	9280	9360
2008	9570	9670
2009	9830	9980
2010	10360	10440
2011	11000	13630
2012 (Spring)	12260	17590

As it is understood from two recent examples, the volatility of economic and political situation is fairly high in Iran and because they are not predictable cannot be sufficiently covered by contingency cost. Moreover, even if they could be predicted to some degree the required cost for mitigating them could not be included in the price offered by contractors for projects and this leads to the second reason mentioned above for reducing the effectiveness of contingency cost in Iran – competition. Due to the existence of high level of unsound competition, contractors have to bid for the projects with narrow margins. Therefore, they may not be able to cover the required cost for critical risks while estimating the contingency costs and subsequently minimize the price of tender (also shown in responses of statement 49 of Project Bidding on page 167). Even though they are aware of ignoring some of the risks, they prefer not to use contingency since they are worried about not getting the work because of contingency inclusion in their price – they want to keep their machinery and employees working. Another example being mentioned by many of the contractors in interviews which has decreased effectiveness of contingency cost can be referred back to adjustment tariff (changes in rules) on page 182; the criticality of E&F risks are not covered by clients for many projects anymore and hence contractors should allocate more contingency cost for covering them which would not be possible as it decreases their chance for winning the tender.

Although level of effectiveness of contingency cost is being reduced in Iran according to the above discussion, the managers are still utilizing other strategies for planning proactively for management of risks. According to the answers of questions 4 and 5 of interview on page 195, one of the strategies adopted by contractors for mitigating the financial risks is buying the materials as early as possible in order to be less influenced by price fluctuations.

Due to the uniqueness of projects, content of the General Conditions of the Contract would not be sufficient for executing all the projects. Therefore as analysis of responses to mitigation strategies provided in questionnaire demonstrates, adding/modifying clauses with agreement of all the parties to the Special Conditions of the Contract for each project is another strategy parties undertake for mitigating some of the risks associated with that specific project to some extent.

Regarding the instabilities of the political situation which have direct influences on managerial risks because of clients who are governmental bodies; analysis of responses to mitigation strategies provided in questionnaire and also answers to questions 4 and 5 on page 195 determine that the contractors and consultants try to work with the same client if possible for their different projects. Moreover, they maintain good relationship with their clients in order to manage application of clients' individual opinions on the execution of the project to a degree.

As the findings demonstrate, high instability of economic and political situation is causing the more critical risks for the construction projects. However, as the risk management strategies determine, the level of predictability of these risks is getting lower over the time period which is required for executing the project. Consequently, the ability of managers to develop contingency plans proactively is decreasing and many of the risks are managed reactively.

6.3. Countries with similar volatile situation to Iran

Construction projects are being executed in almost all the countries and they are associated with different risks, it is only the level of criticality of the risks which may vary from country to country. The risk management strategies undertaken in any of these countries may be effective in other countries depending on the existing situation. For instance, working with the same client was pointed out as an effective strategy for the contactors' risk identification and management in the research conducted by Hassanein and Afify (2007) in Egypt. As discussed earlier, working with the same client was also mentioned by managers in Iran (question 4 and 5 of interview on page 195) as an effective strategy for them in managing the risks. Thus, the strategies proposed here may also be effective in other countries depending on the similarity of the situation, the level of criticality of the risks and also the extent to which it is feasible to implement them. Example can be referred to Greece that is currently suffering from economic instabilities similar to Iran which subsequently influence the construction projects there as well.

Lack of knowledge about risk management which may increase the criticality of the risks is not only related to Iran. The studies conducted by Liu *et al*. (2007) in China and Cruz *et al*. (2006) in Spain have shown existence of similar issue in those counties. Organizational Learning (OL) can be considered to be an effective strategy for this risk in order to make more use of previous similar experiences (systematically) for improving risk management.

Moreover, offering regular seminars, workshops, and trainings as suggested in question 10 of interview on page 215 would be quite helpful in order to provide involved parties with more information about the importance and details of risk management as part of project management process. Although cultural gaps and lack of knowledge are associated with people's perception and understanding and therefore difficult to change, trainings can gradually help them figuring out the effects of risk management on their management process.

Regarding the high inflation and subsequent intense price fluctuations, buying the required materials as early as possible in the projects [mentioned in questions 4 and 5 of interview on page 196] can be assumed as an effective strategy in order to be less influenced by the escalations.

Consistency of the contract type with the type of project is an important issue in construction projects. Different categories of actors (parties) are involved in any construction project and they have to cooperate and communicate appropriately in order to execute the project. Since there may be misalignments between these groups, EPC contract type may help mitigating some of the risks because of fewer numbers of parties being involved and succeeding improvements in communications, cooperation and decision makings [suggested in question 8 of interview on page 202]. Furthermore, hiring in-house consultant can also be suggested as a strategy for improving the coordination between various parties.

While these strategies may be effective for mitigating different risks associated with construction projects, the volatility of the situation of a country may increase to a level where the predictability of the risks becomes very difficult. Therefore, similar strategies as suggested by some of the interviewees [question 9 of interview on page 213] in Iran may get considered:

- Executing projects which have shorter durations – however, this strategy may not be very effective in cases of sharp increase in inflation and prices over a short period such as the examples provided earlier
- Retreating from public sector projects and executing private projects
- Stop working for a while and waiting for the situation to become more stable and predictable

As discussed in contingency theory, situation and the contextual variables for each project can be considered to be unique. However, there are still similarities between various situations and that is the reason why management strategies in one country may be effective (in varying degrees) in another country with similar situation though unique to some extent. Having discussed the risk mitigation strategies being utilized in Iran, an argument is provided in the next section to evaluate the theory in general and in the context of construction projects.

6.4. Evaluation of contingency theory

Based on the discussion above about other countries with similar situations, it can be realized that although each situation may have its unique contextual variables there are still similarities between situations. This is the same when considering various projects in one country; even though they are unique (as a requirement to name them 'project') they have similarities in different aspects. This is how organizational learning - one of the main concepts of risk management and contingency theory - can be effective; utilizing the past experiences from similar situations and apply them to the current situation. Therefore, the criticism of contingency theory by Hahn (2007) about negating the value of prior knowledge can be rejected. He has said that since the logic of this theory is uniqueness of each situation, it means that intuition and judgment are only tools available for management, hence value of previous knowledge is denied.

The criticism is contradictory in itself, how can the management be practiced by 'judgment' without prior knowledge and experience? Moreover, the theory is not ignoring the similarities between different situations; it is just emphasizing on the uniqueness of each in order to justify why the decisions may differ in each situation. If each project is totally different, learning cannot be taken from one project to another. Therefore, it is based on the experience, knowledge, and available information about the new project that one can make decisions on developing appropriate and effective strategies for managing the project and its risks.

Referring to the last sentence of the above paragraph, a word such as 'appropriate' has been critiqued and authors such as Galbraith (1973) and Schoonhoven (1981) have criticized the theory on the ground that it has lack of clarity due to the ambiguity of such theoretical statements. They have mentioned an example from Thompson - a contingency theorist - (1967) where he has suggested that a particular structure should be 'appropriate for' a given environment. This lack of clarity has been further criticized by other contingency theorists; asserting that people may perceive various meanings while studying this theory because of these ambiguities.

Even though these critiques can be assumed as true; while discussing these and other critiques related to philosophical concepts and linguistics studies, attention should be drawn to two points:

- Usually when the statements such as ‘appropriate’ or ‘consistent’ are used in scientific themes and theories, they can become more precise and meaningful based on the pattern of the sentence and their application in the sentence. For further clarification, it is good to consider the opinions pointed out in philosophical areas and linguistic studies concerning the concept of words. Ludwig Wittgenstein in his book - Philosophical Investigations (1953) has argued that the function a word performs in the language constitutes its meaning, so the meaning of a word can be perceived according to its use in the language. Therefore, the ambiguity of a word is not inherent but rather depending on its use in a context it may result in unclear understandings.

- Regarding the further critiques about different people analyzing various meanings from one word; it should be noted that discussing the Hermeneutics studies, these critiques are indicated in the philosophical and linguistic areas. Hermeneutics refers to the diverse interpretations of people from words and texts (Mallery *et al.*, 1986). This discussion may happen not only for the mentioned words (i.e. appropriate) but also for the complete research where different people may analyze the whole concept of the research differently. Although this criticism can be presumed as true; considering the *context* of any research, its statements would be interpreted fairly similar by its readers.

Therefore, it should be stated that such theoretical statements - in the structure of the text and context of the research - transfer the clarity and meaning of the words to a great extent and would have the same interpretations (meaning) for majority of the people studying it. For this reason, when contingency theory suggests that the management strategies should be appropriate for the situation, by defining the situation it can be realized how the appropriateness would be. Considering the contingency theory in the context of construction projects; by identifying the contextual variables of the situation the theory is being applied to, the appropriateness of management strategies for the situation can be understood to a great extent.

Looking at the contextual variables of Iran, criticality of them and the degree to which they are getting less and less predictable (not unforeseen) in relation to the life time of the project; and referring to the argument provided earlier in this chapter (for question 2) about the contingency theory, risk management and their relationship; it can be seen from the case study that: as the degree of predictability of the risks within the life time of the project is decreasing, the ability for the proactive contingency planning is also decreasing and many of the risks should be managed by reactive planning. Moreover, since the level of volatility is sharply growing, necessity for crisis management as a subset of reactive planning process is also growing. More detailed evaluation of the theory is discussed in the next chapter – Conclusion and Recommendations.

6.5. Conclusion

This chapter answered the research questions, proposed guidelines which may be effective for other countries with similar situation and continued with discussing the results in relation to contingency theory.

Next chapter, Conclusion and Recommendations, provides an overall summary of the thesis and the conclusions based on the results of data analysis. It then discusses the contributions to knowledge and finally explains the limitations of the study leading to presentation of suggestions on how future research in this area can be continued.

7 - Conclusion and Recommendations

In this final chapter, an overall summary of the findings of the thesis is provided. It starts with a brief explanation about the process of conducting the thesis and continues with conclusions based on the results of data analysis (collected via questionnaire and interview). It is then followed with discussing the contributions to knowledge referring to implications of findings of this thesis for contingency theory. Finally, limitations of the research are argued and suggestions are provided for further research in this area and how investigations on this topic can be continued.

This thesis aimed at investigating risk management in construction projects. Since the environment has an important influence on how any project is managed, it was advantageous that research be situated geographically and temporally within a specific environment. Considering the unstable social, economic, and political conditions in Iran today in comparison with many other countries, it was found to be a suitable case to be evaluated in this thesis for analysing the influences of environment on construction project risk management in-depth.

The theoretical framework for this thesis, as a structure for supporting the research work, was chosen to be contingency theory in order to explain why the problem under study exists and to serve as a basis for conducting the research. To investigate how the risks associated with the construction projects can be managed properly depending on the environment; questionnaires and interviews were chosen as data collection methods and three key categories of actors involved in construction projects were chosen as participants: client, consultant, and contractor. The selected projects for the thesis were public projects (governmental projects) in which the client is a governmental body. Criticality of construction risks along with effectiveness of proposed mitigation strategies were evaluated using 100 questionnaires being distributed to three groups of participants. Out of 76 valid responses received, interviews were conducted with 24 of them in order to extract the knowledge and understand how these groups mitigate the identified risks.

7.1. Summary of findings

Utilizing contextual data about Iran, findings about risk management in construction projects have been verified through a systematic investigation (using questionnaire and interview). High percentage of highly experienced participants can be considered quite significant, providing further support to the credibility of the information obtained. Although in-depth discussions have been provided in Chapters 4, 5, and 6 and a number of points have been made; the main conclusions are reiterated here before discussing the contributions to knowledge.

The researcher proposed five main categories of risk for the construction projects (each being either internal or external to the project) as follows:

1. Political and Governmental (P&G) = External (E)
2. Managerial and Technical (M&T) = Internal (I)
3. Economic and Financial (E&F) = External (E)
4. Cultural and Social (C&S) = Internal (I)
5. Natural (N) = External (E)

Through evaluating the opinion of all the participants about the risks, it could be ascertained that the level of criticality for the construction projects' risks in Iran is more than intermediate.

The three most critical risks which are influencing construction projects significantly (from various sections of questionnaire and interview questions) revealed to be one of the following risks: cash flow, lack of financial resources, inflation, price fluctuations, and late payment which in a sense all can be considered to be outcomes of instable economy – E&F category of risk.

The hierarchy of risk categories' criticality (after E&F category) is followed by Managerial and Technical risks and then the Political and Governmental risks. However, as discussed in previous chapters since many of the managerial risks refer to the client (who is a governmental body); Managerial and Technical risks can be considered both as internal and external to the project. Therefore, evaluations establish the greater influences of external risks on construction projects than the internal ones. Moreover, lower criticality of sub-categories of Cultural and Social risks and Natural ones was illustrated.

As different categories of actors differ in types of personality, objectives, job responsibilities, and the extent to which they cope directly with the risks, their evaluation of risks was also different from each other. The clients had evaluated the risks rather more critical than contractors followed by consultants as the group considering the risks relatively less critical than the two other groups. However considering the high criticality of Economic and Financial risks; as the contractor is seeking financial benefits and is dealing with the execution phase (as a phase associating with major expenditure), the influences of these risks on contractors are much more than other groups. The difference between the viewpoints of three groups of participants was also demonstrated when comparing the results of Chi-squared test for the risks. The difference was mostly between the opinions of the clients for evaluating the risks as more critical and the consultants for evaluating them as less critical compared to others. This difference in opinions was observed much more in the Political and Governmental risks than other categories of risk. It therefore shows the higher influences of Political and Governmental risks on clients compared to the consultants.

Due to the existence of interaction between different categories of risk - especially great influences of economic risks on other categories - this high level of economic instability increases the criticality of other risks as well. Lack of knowledge and expertise about risk management has been added to the high level of volatility of economic and political situation and as a result construction projects are facing serious difficulties recently.

In the Discussion chapter, it was pointed out that the results of the case study about the risks and their management strategies have implications for contingency theory.

Since the situation in Iran is very volatile and various aspects of it are changing frequently, application of previous experiences on new projects for proactive planning is losing its value and effectiveness because of the dissimilarities between situations in which different projects are being executed. However, utilizing the experiences would still have influences while risks are being managed reactively.

In order to be able to plan proactively for the projects - contingency plan, many of the contractors and consultants investigate about project’s specifications, client and its financial viability before starting the project. It helps them obtain more specific information about the new project and its risks and plan according to the unique specifications of the project.

Besides, the most frequently used technique for keeping the contingency plans on review was mentioned to be monthly review of project progress for updating the plans. Regarding the instabilities of the political situation which have direct influences on managerial risks because of clients who are governmental bodies; contractors and consultants evaluate maintaining a good relationship with client as an effective strategy for managing client's application of individual opinions on the execution of the project to a degree.

However, high level of instabilities of the situation decreases the level of predictability of risks within the life time of the project, and in turn the ability for the proactive contingency planning would be decreased. Consequently, effectiveness of contingency cost is also being decreased because not only the level of predictability is low but also unsound competition is putting contractors under pressure for including adequate contingency cost in price of tender.

As the critical risks are becoming less and less predictable, the apparent outcome would be the growth in reactive planning for managing the risks. Moreover, as the examples provided in previous chapters demonstrate the volatility of situation (especially economic), the need for crisis management would also grow. The instability of situation and subsequent difficulties in its management is reaching to a level where retreating from governmental projects or even not executing any type of project for a while (until the situation becomes more predictable) have been suggested by contractors. It shows that the current situation has put the contractors in a position where they prefer giving up on financial benefits (if any) in order not to be added in the list of companies which have been bankrupted over the last few years.

7.2. Contribution to knowledge

According to the above discussion and referring to the evaluation of the contingency theory argued in previous chapter, contributions to knowledge are provided: modifying the contingency theory from a conceptual theory to a more tangible and meaningful theory.

Managing any situation requires managing its risks as well and besides, contingency theory brings into focus the concept of risk. Therefore, while utilizing the theory for managing any specific situation there will be the risks which can be reasonably predicted and the ones that cannot. It is evident that managing both of these types of risks is implied in the theory and hence this blend of proactive and reactive management should be explicit in the theory. This mixture of proactive and reactive management in the theory can be assumed as a moving scale which is subject to change depending on the situation (changes in the ratio of proactive and reactive strategies). While the risks are more predictable, the proactive percentage may be more in this scale and less reactive percentage would be left for the risks which have a lower level of predictability. Considering the situation of Iran; the extent to which the predictability of risks within the life time of a project is decreasing results in changes in this moving scale and eventually the proactive starts to shrink and reactive starts to grow. As a result, ability to have proactive contingency plans decreases and many of the risks should get managed purely reactive.

To be able to manage any situation proactively, contingency plans are required. Contingency plan has not been mentioned explicitly in the theory but it follows logically that these plans are implied as part of the theory. Therefore, utilization of contingency plan in the contingency theory requires to be made explicit.

Except from the mixture of proactive and reactive management, and also utilization of contingency plan which need to be made more explicit in the theory, there can be other modifications in order to make the theory more specific. Using contingency theory for managing situations and risks (making decisions), has been stated to be unique for each particular situation. Therefore, the '*situation'* should be defined in order to refer to a more specific concept. Definition of the situation, comprising its contextual variables such as environment, culture, cost, and size can reveal more clarity when discussing the theory. For instance, when arguing contingency theory in context of construction projects in this thesis, the situation can be more specific by pointing out its contextual variables i.e. risk management of construction projects which are public and therefore having a governmental organization as their client and they are located in Iran with the economic and political instabilities at the moment. However, this does not mean that by defining the contextual variables, one specific management strategy could be proposed for all the projects which were evaluated in this thesis, but rather more similarities would be clarified (for practicing the similarities among the dissimilarities). Although these projects can be more similar to each other comparing to public construction projects in another country, still each project is different from the other to some extent. Therefore, definition of the situation is required to be more specific, including the overall context (i.e. construction projects), the contextual variables and the risks. This will then help to provide some generalizations for these projects; for example it can be stated that while utilizing the theory for managing these projects, the reactive management percentage of the moving scale may be more than the proactive management percentage (for many projects) according to the critical risks and their level of predictability – it can still differ for various projects.

This eventually may lead to a more specific and detailed theory for any situation and hence instead of saying ‘it *all* depends’, it can be stated that ‘it depends on this and that’, i.e. Utilizing contingency theory for managing risk of construction projects in Iran depends on economic conditions of the country more than other variables.

7.3. Limitations of this research

Any research may include some limitations due to different reasons specially the limited time frame for conducting this kind of study.

The design of this research could cover other types of design than the ones chosen to make the research more comprehensive. It could have adopted a comparative design in order to compare Iran with another country regarding risks of construction projects and their management strategies. Also, It could have adopted a longitudinal design for Iran in order to evaluate the economic trend of the country (over the years) to investigate how recent economic issues may have influenced the risk management strategies compared to previous years. However, adopting these designs for further investigations would extend the research beyond the specified time frame. Moreover, taking into account this research’s questions, the adopted designs appropriately fulfil the objectives of this research since risks associated with construction projects of a distinct environment were about to be investigated. Therefore, other designs suggested above – although beneficial for extending the research – were not best suited to the focus of this study and might have detracted from reaching the present conclusions.

Using the current designs, research could still go further if duration of study was longer. The methodology could equally be well applied to private construction projects in Iran; the results would be probably different (from public projects) and therefore could be compared to the current results to find out the similarities/differences; a distinct example regarding the differences between public and private projects can be referred to financial resources of a project (one the critical risks influencing public sector construction projects in Iran at the moment) that can be provided much easier for a private project since the resources belong to individuals and private companies whereas it may be provided with delay for public projects or sometimes not even provided in case the budget of the country faces issues. Furthermore, the research could also investigate the specific risks associated with various types of public construction projects.

Structure of the questionnaire could be improved for two questions; there was a table in the first page asking the participants to rank the risks they mention and a question at the end asking them to rank the groups of risks. Both sections had the same problem while analyzing them, most of the participants had ranked the risks and their groups with repeated numbers which led to incomplete answers that were not suitable for analysis. If more explanation was provided for participants about how the questions should be answered, there would be no ambiguity for them and therefore while analyzing, researcher did not have to select fewer numbers of answers (only the correct ones) for the first table or exclude the last question completely. However, although this was an important defect it did not have a large impact on the results achieved from the questionnaires.

Since this research was focusing on public sector construction projects, clients were governmental establishments and therefore it was quite difficult to access the top-level managers in these organizations. Acceptable number of questionnaires was returned from clients and data were analyzed. However, only two clients attended for interviews; although useful information was achieved from their answers to the interview questions, in parts where they had different opinions, having more clients (for interviews) could be effective for further clarification on specific answers.

This research was conducted in Iran and questionnaires were translated into Persian language and likewise interviews were conducted in Persian. The fact that these were in Persian (researcher and participants' native language) have given richer expression of the issues whereas if it was carried out in English it would have been stilted and less informative. However, using two languages in a research may result in limitations such as the extra time that the translation process requires. Moreover, neither documents (contextual data) nor the content of interviews could be added in appendices since the thesis had to be in English and hence only some parts were translated and added to the content of thesis when there was a discussion on them. Additionally, available software could not be utilized for analyzing content of interviews since they do not cover Persian language.

Collecting the data for a research from another country than the one the researcher's university and supervisor are is problematic in itself since at some points the number of supervisory meetings reduces which may restrict the progress of the research. Therefore, for this research only a limited time was scheduled to be spent in Iran for data collection since the researcher would need her supervisor's guidance for analysis. The extra time required for translation process had to be included in this duration and therefore collecting the questionnaire was stopped when the number of valid responses reached to 76% since the analysis had to be started and besides slots had to be allocated to the participants interested in interview before leaving the country. Likewise, due to lack of time interviews could not be conducted with 4 of the interested participants since the data had to be analyzed and then the results had to be translated back to English.

Considering the results of the research, although findings about contingency theory can be generalized; suggested management strategies and guidelines may not be applicable in countries with very different situation than Iran. However; the methodology has the potential to be replicated in any other country (with distinct environment) and may/may not lead to different results.

Having considered the limitations related to different aspects of this research, suggestions can be provided for future research in order to improve the knowledge in this area.

7.4. Future research

Managing risk of construction projects is a complicated area as it deals with two complex concepts: project, and risk. Although investigations have been done before on this area by various researchers and this thesis also aimed at studying it more; there are still rooms available for further research. Some suggestions are provided below for future research to focus on:

- Investigation on risk management of private construction projects in Iran
- Comparison between private and public construction projects in Iran and their risk management
- Investigation on risk management of construction projects in Iran focusing on the project types (i.e. building, road, utility) to identify specific risks which may be associated with any of them
- Investigation on both aspects of the risk (positive: opportunity and negative: threat) while studying risk management of construction projects in Iran
- Investigation on risk management of construction projects in Iran utilizing other risk management theories
- Identification of influences of experience on risk management of construction projects in Iran
- Identification of risks and risk management strategies for construction projects which any of the three categories of actors who are Iranian may have executed in other countries than Iran

Further research can also be investigated in other countries in order to provide the opportunity for carrying out comparative studies – between Iran and other countries – and to identify how the specific contribution of this research can be built upon:

- Replication of the methodology of this study (utilizing similar questionnaire and interview questions) in other countries to find out any similarities/difference in results
- Investigation on how contingency plans - as part of contingency theory – are utilized in risk management of construction projects in other countries
- Investigation on how contingency cost is estimated while managing risk of construction projects in other countries
- Investigation on how the scale of proactive/reactive management strategies (while utilizing contingency theory for risk management) may differ in other countries depending on their situation

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Appendices

A: Invitation to participant

B: Participant information sheet

C: Consent form

D: Questionnaire

E: Risks mentioned by participants for the first table of questionnaire

F: Chi-squared test result

G: Interview questions

H: Correspondence of Iranian and Gregorian calendar

A. Invitation to participant

Invitation to participate in a research project

Royal Docks Business School

University of East London

Docklands

E16 2 RD

“Date”

Dear “Name”,

The purpose of this letter is to invite you to participate in a postgraduate research study. The participant information sheet enclosed provides details of the purpose of the study, which you need to consider before deciding whether you would be willing to take part.

You are Not obliged to take part in this study. If you do agree to participate, you remain free to withdraw from the study at any time and may do so without any disadvantage to yourself and without any obligation to give a reason.

If you decide that you would like to participate in the study once you have considered the information provided, please complete and return the enclosed consent form and the questionnaire provided.

Participants will be provided with summary of the results on request. Please do not hesitate to contact me if you would like to discuss the information provided or ask any questions before agreeing to part in the study.

Many thanks for taking the time to read this information.

Yours sincerely,

Mana Ghahramanzadeh

PhD Student / Email: mana_ghahremanzadeh@hotmail.com

B. Participant information sheet

Participant information sheet

Royal Docks Business School

University of East London

Docklands

E16 2RD

University research ethics committee

If you have any queries regarding the conduct of the programme in which you are being asked to participate, please contact the Secretary of the University Research Ethics Committee, Ms Debbie Dada, Admissions and Ethics Officer, Graduate School, University of East London, Docklands Campus, London E16 2RD (Tel 020 8223 2976, Email: d.dada@uel.ac.uk)

The Principal Investigator

Mana Ghahraman Zadeh

Royal Docks Business School

University of East London

Docklands Campus

E16 2 RD

E-mail: mana_ghahremanzadeh@hotmail.com

Consent to participate in a research study

The purpose of this letter is to provide you with the information that you need to consider in deciding whether to participate in this study.

Project title

Managing risk of construction projects: a case study of Iran

Project description

This research is intended to investigate the interactive influences of risk factors in construction projects in Iran; distinguishing the specific characteristics of environment in Iran from the general knowledge available about construction projects' risks and risk management and exploring how these unique factors influencing the projects in Iran can be managed appropriately.

Therefore, some specific risk factors which may influence Iran more than other countries, that no solution has been presented for them in the literature, will be used to understand what is the chains of logic the managers in Iran utilize for mitigating those risks. Some general guidelines will be proposed which may be effective for Iran and countries suffering from similar risks, that helps managers and contractors manage the construction projects according to the situation and mitigate the risks as much as possible.

Participants will take part in filling the questionnaires and also in interviews.

By using questionnaires (filled by contractors, clients and consultants), risks which influence construction projects in Iran will be identified and ranked.

Once the problem is recognized through using questionnaires, in-depth interviews will be conducted with contractors, clients and consultants in order to find out how they manage the projects according to the situation. Information from the interviewees will be very useful in the analysis of this research work.

The interview might take approximately one hour. The research work is purely for academic purpose and information from you will be confidential. Brief quotations from the interview may be used in my thesis but will not be attributed to you individually and your anonymity will thus be maintained. The questions are open ended and the guideline questions (that will be explored during the interview) are:

- What is the nature of the projects you are doing and their sizes?

- What do you consider as “risk” in construction projects?
- What are your broad organizational processes and policy documents regardless of type of the project?
- What processes does the organization have for managing/mitigating risks?
- How do you develop the contingency plans? In which phase?
- What mechanisms are there for keeping the contingency plans on the review?
- Who is responsible for evaluation of the effectiveness of the contingency plans?
- At the end of the project, how is the learning process of what has happened during the project?

Confidentiality of the data

The information obtained as part of this project will be treated in confidence and will not be made available to anyone else. The interviews will be recorded and stored in a voice recorder, the recordings and any notes or transcripts that you provide will be coded to safeguard your anonymity. Questionnaire results and analysis of interviews will be written up in research thesis and journal papers but they will be anonymised so that individual participants cannot be identified. All data will be stored securely and accessed solely by the researcher. The interviews will be coded with a number instead of a name. Should a participant withdraw their contribution, individual data units can be identified and that data removed from the research process. The link will be kept only on the paper transcripts of the interviews and will be stored in the researcher’s home office. Once the project has been completed, all data collected will be destroyed. You are free to ask for your data to be withdrawn from the study and to be destroyed at any time.

Location

You can choose whether you would prefer to take part in the interview in researcher’s office, or whether you would prefer to make alternative arrangements.

Disclaimer

You are not obliged to take part in this study, and are free to withdraw at any time during the tasks. Should you choose to withdraw from the study you may do so without disadvantage to yourself and without obligation to give a reason.

Thank you for your anticipated cooperation.

Yours Faithfully,

Mana Ghahramanzadeh

C. Consent form

Consent to participate in a research programme involving the use of human participants

Title of the programme: Managing risk of construction projects: a case study of Iran

I have read the information letter relating to the above programme of research in which I have been asked to participate and have been given a copy to keep. The nature and purposes of the research have been explained to me, and I have had the opportunity to discuss the details and ask questions about this information. I understand what is being proposed and the procedures in which I will be involved have been explained to me.

I understand that my involvement in this study, and particular data from this research, will remain strictly confidential. Only the researchers involved in the study will have access to the data. It has been explained to me what will happen to the data once the research programme has been completed.

I hereby fully and freely consent to participate in the study which has been fully explained to me.

Having given this consent I understand that I have the right to withdraw from the programme at any time without disadvantage to myself and without being obliged to give any reason.

Participant's name:

Participant's signature…………………

Investigator's name: Mana Ghahramanzadeh

Investigator's signature……………….

Date…………………

D. Questionnaire

Questionnaire

Mana Ghahramanzadeh

University of East London

Every construction project involves risks. From your experience, please list here the most important risks and rank your list of risks, where the most important risk =1.

List of Risks	Rank

Construction Risk

The **Criticality** of a risk refers to the extent the risk affects the success of managers in carrying out a construction project. Please rate the criticality of each risk by circling a suitable figure:

(**Scale**: 1 = Not critical at all, 2 = Slightly critical, 3 = Somewhat critical, 4 = Critical, 5 = Very critical).

Please also list other key risks in the blank rows provided and rate their criticality.

ID	Risk	Criticality Low High
1	**Approval and Permit:** Delay or refusal of project approval and permit by government	1 2 3 4 5
2	**Change in Law**: Government's inconsistent application of new regulations and laws	1 2 3 4 5
3	**Justice Enforcement**: Lack of enforcement of legal judgment	1 2 3 4 5
4	**Government Influence on Disputes**: Unnecessary and unjust influence by government on court proceedings regarding project disputes	1 2 3 4 5
5	**Corruption**: Corrupt government officials demand bribes or unjust rewards	1 2 3 4 5
6	**Expropriation**: Due to political, social or economic pressures, government takes over the facility run by the firm without giving reasonable compensation	1 2 3 4 5
7	**Political Instability**: Frequent changes in government; agitation for change of government or disputes between political parties or different organs of the state	1 2 3 4 5
8	**Cultural Differences**: Differences in work culture, education, and values between project partners	1 2 3 4 5
9	**Human Resource**: Facing difficulties in hiring and keeping suitable and valuable employees	1 2 3 4 5
10	**Cash Flow**: Information on lucidity of partner's accounts, financial soundness, foreign exchange liquidity	1 2 3 4 5
11	**Foreign Exchange and Convertibility**: Fluctuation in currency exchange rate and/or difficulty of converting currencies	1 2 3 4 5

ID	Risk	Criticality Low High
12	**Inflation and Interest Rate**: Unanticipated inflation and interest rate	1 2 3 4 5
13	**Cost Overrun**: Unavailability of sufficient cash flow, inadequate measurement and pricing of Bill Of Quantities, ill planned schedule	1 2 3 4 5
14	**Inadequate Design**: Unanticipated design changes and errors in design/drawings	1 2 3 4 5
15	**Low Construction Productivity**: Obsolete technology and practices by partners; or low labour productivity of local workforce	1 2 3 4 5
16	**Site Safety**: High rate of accidents during construction or operation phases	1 2 3 4 5
17	**Late Payment**: Client pay the contractors much later than is specified in the contract	1 2 3 4 5
18	**Inadequate Quality Control**: Partner tolerance of defects and inferior quality	1 2 3 4 5
19	**Inadequate Project Management**: Inadequate project planning, budgeting; inadequate project organization structure; or incompetence of local project team	1 2 3 4 5
20	**Environmental Protection**: Stringent regulation which will have an impact on construction firms' poor attention to environmental issues	1 2 3 4 5
21	**Public Image**: Victim of prejudice from public due to different living standards, values, culture, and social system.	1 2 3 4 5
22	**Intellectual Property Protection**: Former employees, partners and/or third parties steal company's intellectual property, commercial secrets or patent details	1 2 3 4 5
23	**Force Majeure**: The circumstances that are out of the control of partners, such as flood, fires, storms, epidemic diseases, war, hostilities and embargo	1 2 3 4 5
24	**Market Demand**: Inadequate forecast about market demand	1 2 3 4 5
25	**Competition**: Competition from other investors/developers/contractors	1 2 3 4 5

Effectiveness of Risk Mitigation Measures

The **Effectiveness** of a mitigation measure for a risk refers to the extent the measure will enable managers to mitigate the risk. Please rate the effectiveness of each mitigation measure for a risk by circling a suitable figure:

(Scale: 1 = Not effective at all, 2 = Slightly effective, 3 = Somehow effective, 4 = Effective, 5 = Very effective).

Please also list other key mitigation measure in the blank row provided and rate its effectiveness.

Mitigation Measures for Risk 1 : Approval and Permit	**Effectiveness**
Prepare and submit all necessary documents and feasibility study report in a timely manner to government departments	1 2 3 4 5
Maintain good relationship with government and higher officials	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 2: Change in Law / 3: Justice Enforcement	**Effectiveness**
Obtain government guarantee to adjust tariff	1 2 3 4 5
Include clauses for delays and additional payments in contract, which occur due to new rules or change in law	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 4: Government Influence on Disputes	**Effectiveness**
Provide dispute settlement clauses in the contract	1 2 3 4 5
Maintain good relations with concerned government officials and concerned authorities	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 5: Corruption	Effectiveness
Set aside a budget for unavoidable expenses	1 2 3 4 5
Cultural and commercial awareness training to management and key personal who may have to deal with corrupt officials	1 2 3 4 5
Try to work directly with the business connections, i.e. do not hire a broker or middleman	1 2 3 4 5
Obtain all necessary approvals in timely manner to minimize chance for corrupt individual to obstruct work	1 2 3 4 5
Maintain good relations with relevant government officials and relevant authorities	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 6: Expropriation	Effectiveness
Develop contingency plans and obtain insurance for expropriation possibility	1 2 3 4 5
Include clauses in contract where client is obliged to give reason or getting approval from relevant parties and authorities in time of expropriation	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 7: Political Instability	Effectiveness
Develop own contingency plans for possible political instability, such as plan for emergency evacuation	1 2 3 4 5
Seek incorporation of termination or delay clauses in contract	1 2 3 4 5
Be informed of political developments by using information sources like risk assessment companies	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 8: Cultural Differences	Effectiveness
Undertake comprehensive negotiations and agreement with government and partners	1 2 3 4 5
Devise unambiguous and agreed risk sharing code at the time of contract	1 2 3 4 5
Try to have as large an equity share as possible	1 2 3 4 5
Provide dispute settlement clauses in the contract	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 9: Human Resource	Effectiveness
Sign formal employment contract with all staff	1 2 3 4 5
Offer training to new and existing staff	1 2 3 4 5
Offer better remuneration/incentive packages to staff	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 10: Cash Flow	Effectiveness
Examine the target company’s financial viability, technical and management competence and connections with government	1 2 3 4 5
Have clear contractual terms and conditions, agree on one accounting standard and define clear authority and responsibility in contract	1 2 3 4 5
Define clearly the merging scope of assets, employees, shares, organization, and strategies when merging with a partner	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 11: Foreign Exchange and Convertibility	Effectiveness
Obtain government guarantees of exchange rate and convertibility, e.g. fixed rate for long period or less fluctuation.	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 12: Inflation and Interest Rate	Effectiveness
Obtain payment and performance bonds from banks	1 2 3 4 5
Adopt alternatives to contract payment, e.g. land development rights, resource swap	1 2 3 4 5
Specify extension or compensation clauses in contract for payment	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 13: Cost Overrun	Effectiveness
Measure and price Bills of Quantities properly during bidding phase	1 2 3 4 5
Develop a clear and appropriate plan and control schedule and cost	1 2 3 4 5
Secure standby cash flow in advance	1 2 3 4 5
Incorporate escalation clauses for interest, inflation rates and delays in contract	1 2 3 4 5
Obtain payment and performance bonds from banks	1 2 3 4 5
Specify extension or compensation clauses in contract for payment	1 2 3 4 5
Enter into fixed rate loan contract with lending banks	1 2 3 4 5
Sign fixed or pre-determined prices with material and accessory facilities suppliers	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 14: Inadequate Design	Effectiveness
Introduce adjustment clauses in contract to review plan and constructability	1 2 3 4 5
Arrange and undertake comprehensive site investigation before construction phase	1 2 3 4 5
Specify construction extension clause in contract	1 2 3 4 5
Organize for appraisal/vetting of drawings and design criteria by at least one independent engineering / architect consultant	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 15: Low Construction Productivity	Effectiveness
Adopt proper quality control procedures	1 2 3 4 5
Adopt proper safety control program	1 2 3 4 5
Incorporate weather impacts into project schedule	1 2 3 4 5
Review plans jointly with partners to determine changes	1 2 3 4 5
Apply innovative production concepts/philosophies like Lean Construction, Just In Time and Total Quality Management, to decrease variability and rework during construction	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 16: Site Safety	Effectiveness
Get Third Party Insurance for compensation to general public and staff	1 2 3 4 5
Adopt proper safety control program, management system, supervision, incentives and preventive measures	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 17: Late Payment	Effectiveness
Examine the financial resources liability / employers' financial viability	1 2 3 4 5
Inquiring employer's reputation in payment	1 2 3 4 5
Review the contract properly to allocate extra budget in bidding phase	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 18: Inadequate Quality Control	Effectiveness
Adopt proper quality control procedures, supervision and incentives	1 2 3 4 5
Adopt proper incentives for personnel and staff for improving the quality	1 2 3 4 5
Review plans jointly with partners to determine changes	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 19: Inadequate Project Management	Effectiveness
Hire competent project management team	1 2 3 4 5
Clear definition of each staff's scope of work	1 2 3 4 5
Conflict resolution clause in contract and specify construction extension clause in contract if client causes the delay	1 2 3 4 5
Provide clauses on schedule delay and additional payment if caused by client	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 20: Environmental Protection	Effectiveness
Adopt strict pollution control measures	1 2 3 4 5
Include disclaimer in contract for present pollution level	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 21: Public Image	Effectiveness
Comply with civil laws and standards, social and cultural values	1 2 3 4 5
Maintain good reputation and image to the public	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 22: Intellectual Property Protection	Effectiveness
Exploit legislation to get protection against unauthorized use of confidential information	1 2 3 4 5
Confirm whether a good intellectual property protection scheme is in place for the key intellectual property like trademark, patent or copyright law	1 2 3 4 5
Insist on having trustworthy people on key places	1 2 3 4 5
Intellectual property rights training to all key employees by sending them to seminars	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 23: Force Majeure	Effectiveness
A party which fails to meet his contractual obligation due to force majeure must notify the other one within a reasonable time	1 2 3 4 5
Obtain government guarantee to adjust tariff or extend concession period	1 2 3 4 5
Insure all of the insurable force majeure risks	1 2 3 4 5
Obtain government's guarantee to provide financial help when needed	1 2 3 4 5
Include delay clauses for contingency plan in contract	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 24: Market Demand	Effectiveness
Employ reputable third party consultant to forecast market demand	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

Mitigation Measures for Risk 25: Competition	Effectiveness
Conduct market study and obtain exact information of competitive projects	1 2 3 4 5
	1 2 3 4 5
	1 2 3 4 5

To what extent you agree with the following arguments:

Please select your agreement choice by putting a “x” in the table for each argument:

Do you agree with the following arguments?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Do Not Know
Managers’ proficiency in risk management plays an important role in project management activities						
Iranian contractors urgently need risk management knowledge and expertise in managing construction projects						
Risk management can effectively protect the contractors’ interest						
Risk management will be involved in considerable extra cost of management expense and time						
Construction insurance can protect contractors’ interest effectively						
In Iran, insurance companies are familiar with the background of construction projects						
Construction insurance against risk is expensive due to high premiums in Iran						
The services of claim from insurance companies in Iran are standard						
Insurance claims are difficult and wordings are complicated, therefore contractors have to turn to an intermediary (e.g. agents, brokers, loss adjusters)						
Contractors can retain the premium and manage the risks by themselves effectively						
A contract of works in Iran should contain strict and clearly defined insurance terms						
Insurance companies in Iran could not provide risk management service effectively even at extra charge						
Underwriters should give contractors premium discount in consideration of construction companies’ good risk management practice						

Do you agree with the following arguments?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Do Not Know
There are significant fluctuations in the progress payment exchange rate of the projects in Iran						
There are significant fluctuations in the inflation rate of Iran						
Immature economic and banking systems adversely affect projects						
Financial condition of the client is not well known						
Political instability results in financial problems						
Political instability results in planning problems						
Political instability results in day-to-day changes in policy						
Frequent changes in Laws and orders in Iran influence the construction projects negatively						
There are problems in the import and export regulations of Iran						
Occurrence of long delays resulted from bureaucracy						
There is a considerable problem of bribery and corruption in Iran						
The system of communication about the nature of risks within the organization is effective						
The system of communication about the risk mitigation strategies within the organization is effective						
The system of communication about any project changes within the organization is effective						
There is a communication gap between the contractor and the client						
There is a communication gap between the contractor and the consultant						
The manager hasn’t got enough experience in project management						
Similar work experience of the contractor is not sufficient						

Do you agree with the following arguments?	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Do Not Know
There are problems in availability of construction plant and spare parts						
There are problems in the availability of subcontractors						
There are problems in the availability materials						
There have been frequent occurrences of strikes in the construction market						
There are problems in the availability of Labour / Foreman						
Labour rates are high in Iran						
Efficiency / Productivity of local labour is low						
Adverse weather conditions prevail in the area where project is carried out						
Natural disasters are frequently observed in the geographical area where the project is implemented						
Construction site is not very secure						
It is almost impossible to stock materials on the site						
Drawings and the Contract are not in sufficient detail						
Applying the clauses of the contract is not such easy						
In the contract agreement, the function and the responsibility of the client and the contractor is not clearly stated in sufficient detail						
Contractual clauses about the claims and arbitration are not seem to be fair from the contractors perspective						
There is not enough information about the ground conditions						
Due to lack of time for preparation of the tender, the contractor has not worked in detail for the project bid						
Due to competition factor in preparation of the tender, the contractor has not considered all the costs related to risks						
It is almost impossible to finish the constructions works on time						

Personal Information

ID:
Name:
Company:
Address:
Tel:
Fax:
E-mail:

Job title: **Client (Employer) :** Manager ☐ Client's representative ☐ Technical manager ☐ Other (Please specify): ……	**Contractor:** Chief director ☐ Project manager ☐ Site manager ☐ Technical manager ☐ Other (Please specify): ……	**Consultant :** Chief director ☐ Project manager ☐ Designer ☐ Superintendent ☐ Measurer (Structural) ☐ Measurer (Mechanical) ☐ Measurer (Electrical) ☐ Other (Please specify): ……

Gender: Female ☐ Male ☐
Approximate years of experience in Construction Industry: 5 years or less ☐ 6-10 years ☐ 11-19 years ☐ 20-29 years ☐ 30 years or more ☐
Average number of company employees (Last 5 years): 1-50 ☐ 51-100 ☐ 101-500 ☐ 501-1000 ☐ More than 1000 ☐
Average annual turnover (Last 5 years): Under £ 5m ☐ £ 5m – 10m ☐ £ 10m-15m ☐ £ 15m-20m ☐ More than £ 20m ☐
Have you ever worked on a Construction project in other countries except Iran? Yes ☐ No ☐ If Yes (Please Specify): …………..

Company information

- How many expert risk managers your organization has?

  No risk manager ☐ 1 ☐ 1-4 Risk manager ☐ 5 or more ☐

- In your organization, is there sufficient interaction between expert risk management team and non-expert employees?

  No Interaction at all 1☐ 2 ☐ 3 ☐ 4☐ 5☐ Very strong interaction

- Are you satisfied with the prevailing risk management strategy of your company?

  Not satisfied at all 1☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ Very satisfied

- From your experience or perspective, how would you rate the Risk Groups (A to H) with respect to severity? (Least Severe = 1 and Most Severe = 8)

A. Political/Government Level Risks	[ ]	E. Sociological and Environmental Risks	[ ]
B. Risks associated with partners	[ ]	F. Managerial Risks	[ ]
C. Force Majeure	[ ]	G. Project Finance and Cash Flow Risks	[ ]
D. Construction and Design Risks	[ ]	H. Macro/Market Level Risks	[ ]

I am very grateful for your considerate cooperation, thank you very much for your time and effort.

Are you willing to participate in Interview? Yes☐ No ☐

E: Risks mentioned by participants for the first table of questionnaire

P&G	P&G	M&T	M&T	E&F
Political / Governmental Level	Rules and Contract	Managerial	Construction & Design	Project Finance & Cash Flow
Existing immorality in administrative system	Unfair "General Conditions of the Contract" - advantageous to client	Lack of knowledge for project cost estimation (Client)	Ambiguity of design and construction details	Lack of credibility (Client)
Changes in management positions	Lack of justice enforcement in contract clauses	Inadequate quality control	Incomplete maps for construction	Budget shortage for construction projects
Time increase (Late delivery of the project)	Changes in rules	Unrealistic planning	Inadequate Design	Cash flow (Client's inconsistency of payment)
Bureaucracy		Inadequate project management	Old methods and procedures of construction	Lack of Return on Investment
Corruption		Site accidents		Inflation
Political instability		Changes in client's requirement		Instable economy
Sanctions		Cost overrun		Exchange rate fluctuation
Unsound competition in biddings		Inadequate time management		
E&F	E&F	E&F	C&S	C&S
Price Fluctuation	Materials & Facilities	Late Payment	Sociological and Environmental (Cultural)	Human Resource
Intense increase of prices	Rare materials	Clients' late payment to contractor	Lack of support from client and consultant for the contractor for improvement of work	Inexpert human resource
	Unavailability of materials		Lack of team working culture	Sub-contractors' late delivery of their work
	Inappropriate quality of materials		Communication issues between parties	Lack of human resource
N				
Force Majeure				
Bad weather				

F: Chi-squared test results

Distribution of responses for the risks that their *p*-value >= 0.05 is as follows:

4 - Government Influence on Disputes (Intermediate): $\chi^2 = 6.98$ df = 4 $p = 0.053$

Government Influence on Disputes	Client	Contractor	Consultant
Not Critical	9%	29%	50%
Intermediate	55%	37%	33%
Critical	36%	34%	17%
Total	100%	100%	100%

8 - Cultural Differences (Not Critical): $\chi^2 = 5.22$ df = 4 $p = 0.095$

Cultural Differences	Client	Contractor	Consultant
Not Critical	45%	49%	75%
Intermediate	36%	29%	13%
Critical	18%	22%	13%
Total	100%	100%	100%

9 - Human Resource (Intermediate): $\chi^2 = 5.61$ df = 4 $p = 0.084$

Human Resource	Client	Contractor	Consultant
Not Critical	9%	39%	25%
Intermediate	27%	29%	38%
Critical	64%	32%	38%
Total	100%	100%	100%

10 - Cash Flow (Critical): $\chi^2 = 5.86$ df = 4 $p = 0.077$

Cash Flow	Client	Contractor	Consultant
Not Critical	0%	15%	0%
Intermediate	18%	15%	13%
Critical	82%	71%	88%
Total	100%	100%	100%

12 - Inflation and Interest Rate (Critical): $\chi^2 = 4.56$ df = 4 $p = 0.116$

Inflation & Interest Rate	Client	Contractor	Consultant
Not Critical	0%	10%	4%
Intermediate	0%	17%	21%
Critical	100%	73%	75%
Total	100%	100%	100%

13 - Cost Overrun (Critical): $\chi^2 = 7.08$ df = 4 $p = 0.051$

Cost Overrun	Client	Contractor	Consultant
Not Critical	0%	12%	13%
Intermediate	0%	29%	29%
Critical	100%	59%	58%
Total	100%	100%	100%

14 - Inadequate Design (Critical): $\chi^2 = 5.30$ df = 4 $p = 0.093$

Inadequate Design	Client	Contractor	Consultant
Not Critical	0%	24%	33%
Intermediate	27%	29%	21%
Critical	73%	46%	46%
Total	100%	100%	100%

15 - Low Construction Productivity (Intermediate): $\chi^2 = 0.58$ df = 4 $p = 0.109$

Low Construction Productivity	Client	Contractor	Consultant
Not Critical	27%	32%	33%
Intermediate	27%	34%	29%
Critical	45%	34%	38%
Total	100%	100%	100%

16 - Site Safety (Intermediate): $\chi^2 = 4.43$ df = 4 $p = 0.120$

Site Safety	Client	Contractor	Consultant
Not Critical	27%	39%	50%
Intermediate	18%	32%	29%
Critical	55%	29%	21%
Total	100%	100%	100%

17 - Late Payment (Critical): $\chi^2 = 1.63$ df = 4 $p = 0.180$

Late Payment	Client	Contractor	Consultant
Not Critical	18%	15%	17%
Intermediate	9%	7%	17%
Critical	73%	78%	67%
Total	100%	100%	100%

19 - Inadequate Project Management (Critical): $\chi^2 = 4.01$ df = 4 $p = 0.134$

Inadequate Project Management	Client	Contractor	Consultant
Not Critical	36%	22%	13%
Intermediate	9%	29%	25%
Critical	55%	49%	63%
Total	100%	100%	100%

20 - Environmental Protection (Not Critical): $\chi^2 = 2.87$ df = 4 $p = 0.170$

Environmental Protection	Client	Contractor	Consultant
Not Critical	64%	76%	88%
Intermediate	18%	12%	4%
Critical	18%	12%	8%
Total	100%	100%	100%

21 - Public Image (Not Critical): $\chi^2 = 4.54$ df = 4 $p = 0.117$

Public Image	Client	Contractor	Consultant
Not Critical	36%	54%	71%
Intermediate	18%	20%	13%
Critical	45%	27%	17%
Total	100%	100%	100%

22 - Intellectual Property Protection (Not Critical): $\chi^2 = 3.82$ df = 4 $p = 0.141$

Intellectual Property Protection	Client	Contractor	Consultant
Not Critical	55%	59%	79%
Intermediate	27%	29%	17%
Critical	18%	12%	4%
Total	100%	100%	100%

24 - Market Demand (Intermediate): $\chi^2 = 2.79$ df = 4 $p = 0.172$

Market Demand	Client	Contractor	Consultant
Not Critical	27%	41%	25%
Intermediate	27%	32%	38%
Critical	45%	27%	38%
Total	100%	100%	100%

25 - Competition (Intermediate): $\chi^2 = 1.71$ df = 4 $p = 0.181$

Competition	Client	Contractor	Consultant
Not Critical	27%	34%	29%
Intermediate	27%	39%	33%
Critical	45%	27%	38%
Total	100%	100%	100%

G. Interview questions

1. What is the nature of the projects you are doing and their sizes?
2. What do you consider as “risk” in construction projects?
3. Regardless of the type of the project, what are your broad organizational processes and policy documents which may create risk?
4. What processes does the organization have for managing/mitigating risks?
5. How do you develop the contingency plans? In which phase?
6. What mechanisms are there for keeping the contingency plans on the review? And who is responsible for evaluation of the effectiveness of the contingency plans?
7. At the end of the project, is there any learning process of what has happened during the project? How?
8. How is your relationship with contractor/consultant/client? Do they also mitigate the risks or all the existing risks will be shifted under your responsibilities?
9. In your questionnaire, you have ranked … and … as the most important risks; what is your opinion about effective mitigation strategies for them?
10. Please feel free to provide me with your opinion about any existing issue in construction industry in Iran which was not mentioned in this interview.

H: Correspondence of Iranian and Gregorian calendar

Correspondence of Iranian and Gregorian Calendars[1]

Month		1386		1387		1388		1389		1390	
		2007		2008		2009		2010		2011	
Farvardin	1	March	21	March	20	March	21	March	21	March	21
	31	April	20	April	19	April	20	April	20	April	20
Ordibehesht	1	April	21	April	20	April	21	April	21	April	21
	31	May	21	May	20	May	21	May	21	May	21
Khordad	1	May	22	May	21	May	22	May	22	May	22
	31	June	21	June	20	June	21	June	21	June	21
Tir	1	June	22	June	21	June	22	June	22	June	22
	31	July	22	July	21	July	22	July	22	July	22
Mordad	1	July	23	July	22	July	23	July	23	July	23
	31	Aug	22	Aug	21	Aug	22	Aug	22	Aug	22
Shahrivar	1	Aug	23	Aug	22	Aug	23	Aug	23	Aug	23
	31	Sept	22	Sept	21	Sept	22	Sept	22	Sept	22
Mehr	1	Sept	23	Sept	22	Sept	23	Sept	23	Sept	23
	30	Oct	22	Oct	21	Oct	22	Oct	22	Oct	22
Aban	1	Oct	23	Oct	22	Oct	23	Oct	23	Oct	23
	30	Nov	21	Nov	20	Nov	21	Nov	21	Nov	21
Azar	1	Nov	22	Nov	21	Nov	22	Nov	22	Nov	22
	30	Dec	21	Dec	20	Dec	21	Dec	21	Dec	21
Dey	1	Dec	22	Dec	21	Dec	22	Dec	22	Dec	22
		2008		2009		2010		2011		2012	
	30	Jan	20	Jan	19	Jan	20	Jan	20	Jan	20
Bahman	1	Jan	21	Jan	20	Jan	21	Jan	21	Jan	21
	30	Feb	19	Feb	18	Feb	19	Feb	19	Feb	19
Esfand	1	Feb	20	Feb	19	Feb	20	Feb	20	Feb	20
	29/30	March	19	March	20	March	20	March	20	March	19

[1] There are 31 days in each of the first six months of the Iranian calendar, 30 days in each of the next 5 months and 29 days in the last month, except in leap year when it has 30 days.