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Risk analysis for mega commercial projects

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The American University in Cairo

School of Science and Engineering

Interdisciplinary Engineering Programs

RISK ANALYSIS FOR MEGA COMMERCIAL PROJECTS

by

Hesham Hamed Shaker Ibrahim

A thesis submitted in partial fulfillment of the requirements for the degree of:

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With specialization in:

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Under the supervision of:

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Professor, Construction Engineering Department

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I cannot find words to describe my happiness while writing the very last page of my research. In fact, this happiness is mixed with a feeling of gratitude towards many special people who are sent by God to help me in my life.

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ABSTRACT

Mega shopping mall projects have seen dramatic growth and great development in recent years in Egypt. In addition, many new Mega shopping mall projects are under construction and expecting to start working in the few coming years. In the absence of researches studying the Egyptian Mega shopping mall projects, this study tries to highlight the most critical risks that face the Mega shopping mall projects in Egypt and the associated most effective response methods currently employed in Egypt.

Through a comprehensive literature search and via a questionnaire survey, this research identifies the most critical risks that face the Mega shopping mall projects in Egypt and the associated most effective response methods currently employed in Egypt. The scope covers the analysis from different perspectives by including Owners/Developers, Designers, Consultants, Project Managers, and Contractors that have previous experience in large scale projects such as shopping mall projects. In this study, 30 construction project risks are classified into six main categories according to their type and 150 risk mitigation/elimination measures are introduced to overcome the impact of risks under each of these risk categories.

The results reveal that the main risk category that faces the Mega shopping mall projects in Egypt is the one including the financial risk factors. The most critical risk factor that faces the Mega shopping mall projects in Egypt is the financial ability of the client. This was similar to findings from the Egyptian construction industry by Orabi (2003), the Sudanese construction industry by Alwan (2006) and in Chinese construction industry by Tang et al. (2007). Other top critical comparable risks were concerned with changing needs, approvals and permits, and resources unavailability are identified in various countries and are top ranked terms of their impact on the Mega shopping mall projects.

Based on the examining study to clarify how a sample of contracts responded to the most critical risks in these kinds of specialized projects, it was concluded that using contractual measures was the key response method that was perceived by all different participants as the most effective method to eliminate/mitigate the effect of most of the risks considered in this research.

TABLE OF CONTENTS

7

8

LIST OF TABLES

13

LIST OF FIGURES

1.0 INTRODUCTION

1.1 INTRODUCTION

Risk can be defined from different perspectives. It practically refers to "an event or set of circumstances that, should it occur, will have an effect on the achievement of the project's objectives"(Simon, Hillson and Newland, 1997). Construction projects, due to their unique nature, involve quite a number of interacting activities that are full of risks, each of which may exert impacts, to some extent, upon the cost, time and quality. For a project to be successful, a sound risk management system is required. That system usually comprises identification, analysis and response (Burke, 2003) so that when the risks do eventuate they can be overcome. Thus, one of the main tasks of all the project participants, including employers, contractors, professional advisors and subcontractors, is to identify the discrete sources of risk, develop a risk management strategy as part of their risk management system (Flanagan and Norman, 1993) and also cultivate the capability of carrying out such.

Mega shopping mall projects have seen dramatic growth and great development in recent years in Egypt. For example, the "Gross Leasable Area" (GLA) within great Cairo is increased from 578,000 square meter in 2010 to reach around one million square meter in the first quarter of 2014, stated real estate investment and advisory firm *Jones Lang LaSalle* in its latest report ("Cairo real estate," 2014). In addition, many new Mega shopping mall projects are under construction and expecting to start working in the few coming years. That dramatic increase reflects the importance and the potential investment in these types of projects. Shopping mall projects have special characters such as: exclusive location, strong financial ability, unique design to be able to compete with the other, multi-tenant with different requirements, changing needs, high projects' cost, and tight time schedule, all these factors generate a new risk values and risk criticality and severity for other risks related to these projects. Therefore, in the absence of researches studying the Egyptian Mega shopping mall projects, the need for a detailed study that addresses the risk associated with such projects in Egypt is very important and very valuable.

The aim of this research is to try to highlight the most critical risks that face the Mega shopping mall projects in Egypt and the associated most effective response methods currently employed in Egypt. Though other researchers have talked the research topic before, it is considered to be innovative for three reasons. The first reason is its applicability to the Egyptian construction industry. The second reason is that it tries to extract detailed data from practitioners from the Egyptian construction industry in different roles concerning two aspects of risk management, namely: risk identification and risk response for Mega shopping mall projects; whereas other researchers who addressed the Egyptian construction industry either tackle only one of the aforementioned risk management activities, or did not mapping such type of projects in Egypt. The third reason is the time frame in which this research has been conducted during the first half of Year 2014 revealing the different roles perception of risks and their response methods after many variables and crises affected the industry mainly the Egyptian revolution and political upheaval stemming from the revolution in early 2011 and their consequences during last three years such as low levels of tourism and a depreciating pound that will continue to put pressure on Egypt economy growth.

1.2 THESIS COMPOSITION

1.2.1 PROBLEM STATEMENT

Egypt witnessed in the last decade, a major development in the field of establishing Mega shopping malls projects, where many of the projects started the business and many of them still under construction and also development in the size and quality of these projects. The great success of such type of shopping mall projects encourage new investors to start new investment in similar projects and also the existing developers to expand their investment in this field by increasing size and quality of such projects or establish a new projects.

Mega shopping mall projects have distinctive characteristics such as:

- High-cost projects
- Unique architectural design
- Prime location requirements
- Parking spaces problem

- Existing of many tenants, most of them have many different applications
- Advanced and variety of the project's components that can attract consumers
- Costly high quality finishing materials for internal spaces and external facades

Such special characteristics of these projects create special risks factors that can affect deeply on the project objectives and the probability of success such as:

- The inability of the Developer /Owner to finance or complete finance such costly projects
- Economic finance problems such as" fluctuation of the foreign currency exchange rate and difficulty of getting the foreign currency that needed for the most equipment and materials
- Frequent need for changes in such projects result of multiple tenants with different needs as well, which can lead to many problems to inability to achieve the project in the target cost and time period
- Using typical contracts that are not correspond to the nature of such projects and able to distribute risks equally and moderate to all parties

Therefore, it is important to have a sound risk management process that helps upgrading the construction industry in Egypt in general and shopping mall projects in particular, as well. Two of the most important aspects of a sound risk management process are risk identification and risk response. Different roles (Owners/Developers, Designers, Consultants, Project Managers, Contractors) working in the Egyptian construction industry are in need of a simple but efficient tool to help them properly identify the risks that they may encounter and the associated response methods to these risks. Thus, they can promptly deal with risks and can better assess their impact on construction projects.

1.2.2 RESEARCH OBJECTIVES

This study has five main objectives:

1. Identification and Ranking of the Related Risks
2. Identify the risk response methods (mitigation methods) related to the Mega shopping mall projects in the construction industry in Egypt and their effectiveness.

3. Compare the nature of construction risks encountered in Egypt construction industry to data collected from the literature review for the other national and international construction market.

4. Develop a spreadsheet file that summarizes the findings of this research, which could help different participants in different roles in their preparation of effective risk man agent process for new projects.

5. Examine how a sample of contracts responded to the most critical risks in these kinds of specialized projects (top ten critical ranked risks in this study) by analyzing-selected but important commercial shopping malls projects either finished or under construction in Egypt as case studies.

1.2.3 SCOPE OF WORK

The scope of this thesis includes the analysis of the most critical risk factors that faces participants in Mega shopping mall projects within the Egyptian construction industry. The scope covers the analysis from different perspectives by including Owners/Developers, Designers, Consultants, Project Managers, and Contractors that have previous experience in Mega projects such as shopping mall projects. In addition, case studies of real projects are included by analyzing the related contracts to clarify how a sample of contracts responded to the most critical risks in these kinds of specialized projects

1.2.4 METHODOLOGY

In order to acquire a comprehensive background in the aspects of this research, an extensive research was conducted into risk factors issues in the Egyptian construction using books, Magazines, the internet, journal articles, Master Thesis, and PhD dissertations. Performing literature review is done to examine the previous works related to the concepts of Risk Management to prepare a risk check list. Furthermore, this research will be supported by the use of questionnaire with key figures in such type of construction projects, which will allow for detailed exploration into subject. The results obtained from the questionnaires will be the main supporting data during this investigation. The methodology was conducted in the following steps:

- Literature review

- Questionnaire construction

- Questionnaire Management

- Data Processing

- Identification of risk criticality and mitigation measures

- Verification the results with the similar market studies (National / International)

- Validation against contracts' case studies

- Conclusion

1.2.5 CONTENTS AND ORGANIZATION

- **Introduction:** Chapter one presents a general introduction and background of the topic, including statement of the research problem, the objectives and methodology.

- **Literature review:** Chapter two summarize the literature review conducted during this thesis research, concerning risk and risk management issues well as shopping mall background and categories and examples for Egyptian shopping mall projects.

- **Methodology:** Chapter three introduce the detailed methodology adopted in this thesis.

- **Data Collection and Analysis:** Chapter four presents the analysis of the data collected from the survey and discuss the findings of this research and presents a summary spreadsheet file for these findings.

- **Contracts' Case studies:** Chapter five examine how the contracts responded to the most critical risks in these kinds of specialist projects (top ten critical ranked risks in this study) by analyzing number of important commercial shopping malls projects either finished or under construction in Egypt as case studies

- **Conclusion and recommendations:** Chapter six contains the conclusions of the research and recommendations for further research.

2.0 LITERATURE REVIEW

2.1 INTRODUCTION

The construction industry is associated with a high risk exposure and is therefore a field where risk management is crucial (Baker et at., 1998). During the last decade the demand for risk management in civil engineering and construction has increased as a consequence of more complex projects. The development within the construction sector will continue and consequently, the complexity of projects will increase. Hence the demand for increasingly sophisticated risk management will presumably also increase (Faber and Stewart, 2003).

Egypt witnessed in the last decade, a major development in the field of establishing Mega shopping malls projects, where many of the projects started the business and many of them still under construction. Mega shopping mall projects have distinctive two characteristics such as: First, large: large size, large green spaces, car parks, large scale construction and second, abundance: many industries, many shops, many functions (including shopping, restaurant, leisure, entertaining). Such special characteristics of these projects create special risks factors that can affect deeply on the project objectives and the probability of success.

The literature review has mainly covered two parts: the risk management process along with the effective mitigation process and Mega shopping mall projects: definitions, types, classifications, and examples in Egypt.

This chapter aims to provide a brief but comprehensive review of all concepts relevant to the work performed in this thesis. The first section (section 2.2) represent the comprehensive review for definition of risk. The study cover risk definitions and concepts and represent the importance for risk management as a tool to control and manage different risks.

Section 2.3 shows different approaches for risk management process with review for each process. Risk identification definitions and techniques explain the most important process in the risk management as shown in section 2.4. The different response techniques is explained to identify the risk response methods (mitigation methods) and their effectiveness as shown in section 2.7.

Section 2.9 represent eight distinct samples that represent similar studies to the one derived in this research.

The second part of this chapter is aimed at paving the road for clear understanding for the shopping mall projects in Egypt by explaining the different definitions for shopping malls and shopping centers as well. Shopping center definitions and basic configuration of shopping centers is examined to clarify the basis for shopping malls' classifications. Egyptian retail sector overview and the importance of shopping mall projects are presented in this section. Finally, examples for the existing Mega shopping mall projects and also Mega projects under construction is presented.

2.2 RISK

The outcome for the absence of agreement towards the definition of the term "risk"within standard institutions and the professional bodies is reflected in the presence of different definitions in the literature concerning risk and its management. For instance; risk is defined as "*the probability of occurrence of some uncertain, unpredictable and even undesirable event(s) that would change the prospects for the profitability on a given investment",* and in relation to construction; risk is described as *"an exposure to economic loss or gain arising from involvement in the construction process"*, and *"a consideration in the process of a construction project whose variation results in uncertainty in the final cost, duration and quality of the project"* (Kartam and Kartam, 2001).

Although, these previous expressed definitions of risk do not cover all and every definition available, yet they show that there are three different perspectives towards the term "risk": (1) risk is all negative (threat), (2) risk is defined neutrally (could be threat/opportunity), and (3) risk is explicitly described to include both negative and positive outcomes (threats and opportunities). Afify (2000) presents Chpman and Ward's (1987) definition of risk as "*the implication of the existence of the significant uncertainty about the level of project performance achievable"*, that means any factor that can affect project performance in a significant and uncertain way is a source of risk, and based on that project performance is measured against project objectives. Afify (2000) presented Dias and Ioannaou (1995), who conclude that there are two types of risk:

1. Pure risk where there is a possibility of financial loss but no possibility of financial gain.
2. Speculative risk that involves the possibility of both gains and loss

On the other hand, regardless of the continuing debate among risk management practitioners about the definition of risk; there exist several attempts from different professional bodies and standard institutions to propose a definition of risk that capture broad acceptance.

Moreover, the Risk Analysis and Management for Projects Guide (RAMP Guide) produced jointly by the Institute of Civil Engineers(ICE), the Faculty of Actuaries, and Institute of Actuaries define risk as "*a threat (or opportunity) which could affect adversely (or favorably) achievement of objectives"*. Similarly, the Guide to the Project Management Body of Knowledge (PMBok® Guide, 2004) created by the Project Management Institute (PMI®) defines risk as "*an uncertain event or condition that, if it occurs, has a positive or negativeeffect on a project's objectives*". For the purpose of this study; the study will give emphasis to the sources of risk that may have negative effect on the predefined project objectives; thus risk is seen as threats.

2.3 RISK MANAGEMENT PROCESS

2.3.1 A CONCEPT OF RISK MANAGEMENT

Risk management is one of the most critical project management practices to ensure a project is successfully completed, , Chapman, (1999) stated: *"Experience has shown that risk management must be of critical concern to project managers, as unmanaged or unmitigated risks are one of the primary causes of project failure."*
Edwards (2000) introduces Jones'(1995) definition of risk management " *Risk management can be defined as the use of a set of skills of an individual or a group of individuals to ensure that all risk events are identified, quantified, and handled for the project."* Risk management is not a synonym with insurance, nor does it embrace the management of all risks to which a business is exposed, in practice the truth lies somewhere in between of these two extremes. Cooper et al. (2005) explains that: The risk management process involves the systematic application of management policies, processes and procedures to the tasks of establishing the context, identifying, and analyzing, assessing, treating, monitoring and communicating risks.
Further, Flanagen and Norman (1993) suggest that risk management does not need to be complicated or require the collection of huge data; rather pure common-sense, judgment, analysis, intuition, analysis, experience, and willingness to operate in a disciplined manner. According to the Project Management Institution (1996), the objectives of project risk management is to increase

the probability and impact of positive events and decrease the probability and impact of events adverse to the project.

2.3.2 STEPS OF RISK MANAGEMENT PROCESS

The Risk Management Process (RMP) is the basic principle of understanding and managing risks in a project. It consists of the main phases: identification, assessment and analysis, and response (Smith et al. 2006) as shown in Figure 2-1 and Figure 2-2. All steps in RMP should be included when dealing with risks, in order to efficiently implement the process in the project.
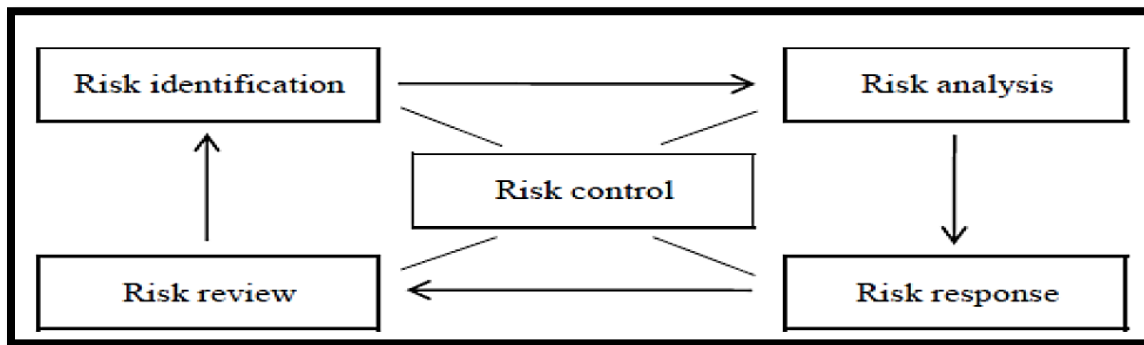
Figure 2-1, The process of managing risk (Smith et al. 2006)

There are many variations of RMP available in literature, but most commonly described frameworks consist of those steps mentioned previously. In some models there an additional step added, and the majority of sources identify it as risk monitoring or review.
While other works such as Flanagen and Norman (1993), and Baker et.al 1999, break it down to a five step process of risk management. The following figure demonstrates the systematic five-step method introduced by Baker et.al. (1999), adapted from British Slandered BS 8444(BSI, 1996):

- Risk identification
- Risk estimation
- Risk evaluation
- Risk response
- Risk monitoring
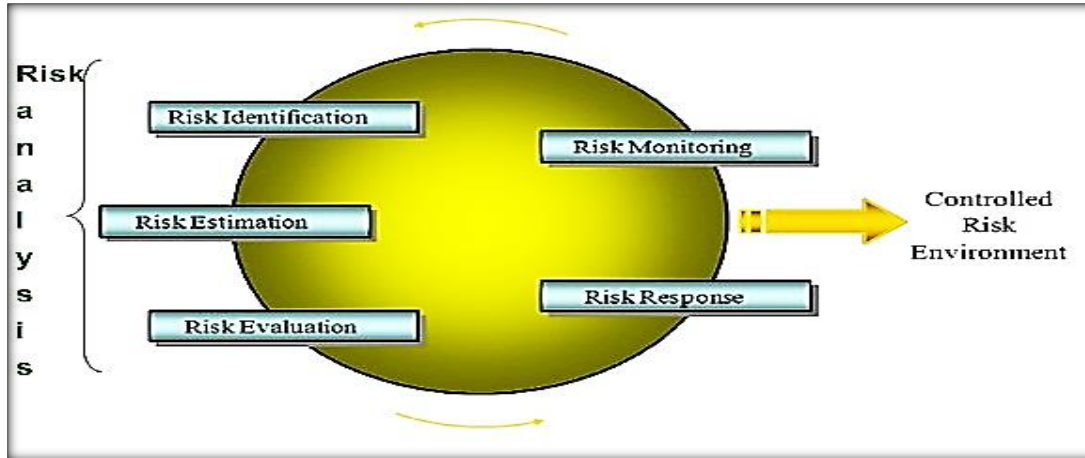
Figure 2-2, Risk management life cycle (Smith et al. 2006)

Risk identification and risk estimation can be considered as subtitles for Risk analysis with which risk evaluation can again be considered as subtitled to risk assessment, while risk response and risk monitoring collectively entitle risk control.

2.4 RISK IDENTIFICATION

The identification phase is stressed by many researchers. Winch (2002) claims that the first step in the RMP is usually informal and can be performed in various ways, depending on the organization and the project team. It means that the identification of risks relies mostly on past experience that should be used in upcoming projects. In order to find the potential risks, an allocation needs to be done. This can be decided and arranged by the organization. In this case, no method is better than another, since the only purpose is to establish the possible risks in a project. Chapman (2005) points out that since the risk management process builds heavily on the primary identification phase, the success of later risk management phases is directly comparable to the quality of the first identification phase. In fact, this is natural since if a risk is not identified it cannot be controlled, transferred or otherwise managed (Toakly and ling, 1991).

Kerzner (1998) defined risk identification as the process of examining a situation and identifying and classifying the areas of potential risk. Al-Bahar and Carndall (1990), defined it as the process of systematically and continuously, categorizing, and assessing the initial significance of risk associated with the construction project.

24

2.5 RISK ESTIMATION

The purpose of risk estimation is to understand and quantify the likelihood of a potential impact on the project outcome. According to British Standards BS 8444:1996 using either quantitative or qualitative analytical techniques, the risk that has already been identified must then be estimated. There has been extensive research that addressed estimating risk consequences and researchers have adopted, and in several cases introduced, several risk estimating techniques. These techniques are classified as either quantitative or qualitative techniques.

2.6 RISK EVALUATION

Risk evaluation is concerned with evaluating the impact of the risk that were previously identified and estimated. This involves two factors, firstly evaluating the probability or likelihood of a risk to occur and secondly estimating the impact or consequences of this risk in the event of its occurrence. The relationship between the two factors is presented by Orabi (2003) as, introduced by Krezner (1998), yielding the following equation:

Impact of risk = Likelihood of Risk * Consequence of Risk

2.7 RISK RESPONSE TECHNIQUES

This fourth step of the RMP indicates what action should be taken towards the identified risks. The response strategy and approach chosen depend on the kind of risks concerned (Winch, 2002). In addition, the risk needs a controller to supervise the development of the response, which will be agreed by the partners involved in this risk management process. (PMI, 2004).

Winch (2002) claims that the lower impact risk can be better managed. Most common strategies for risk response are: avoidance, reduction, transfer and retention (Potts, 2008). Beyond those types of responses, Winch (2002) describes that sometimes it is difficult to take a decision based on too little information. This may be avoided by waiting until the proper information is available in order to deal with the risk. This way of acting is called "Delay the decision" but this approach is not appropriate in all situations, especially when dealing with critical risks. Those need to be managed earlier in the process.

2.7.1 AVOIDANCE/ ELIMINATION

Risk elimination is sometimes referred to as risk avoidance. For the critical risks with negative impacts to the whole project, project's objectives should be reviewed. . In other words, if the risk has significant impact on the project, the best solution is to avoid it by changing the scope of the project or, worst scenario, cancel it. There are many potential risks that a project can be exposed to, and which can impact its success (Potts, 2008). So, early risk management is required in the early stages of a project instead of treated the damages after the occurrence of the risk (PMI, 2004).

The avoidance means that by looking at alternatives in the project, many risks can be eliminated. There are a number of ways through which risks can be avoided, e.g. placing conditions on the bid; tendering a very high bid; pre-contract negotiation as to which party takes certain risks; and not bidding on the high-risk portion of the contract (Carter and Doherty, 1974). If major changes are required in the project in order to avoid risks, Darnall and Preston (2010) suggest applying known and well developed strategies instead of new ones, even if the new ones may appear to be more cost efficient. In this way, the risks can be avoided and work can proceed smoothly because strategy is less stressful to the users.

2.7.2 RISK TRANSEFER

Potts (2008), states that the risk should be transferred to those who know how to manage it. If a risk can be managed by another actor who has a greater capability or capacity, the best option is to transfer it. The risk can be transferred to any of the project partners, for example, the client, contractor, subcontractor, designer etc., based on the risk character.

As a result this could lead to higher costs and additional work, usually called risk premium (Potts, 2008). It must be recognized that the risk is not eliminated; it is only transferred to the party that is best able to manage it (PMI, 2004). Shifting risks and the negative impacts they bring is also an option when the risks are outside the project management's control, for example political issues or labor strikes (Darnall and Preston, 2010). The situation may also consist of catastrophes that are rare and unpredictable in a certain environment. (Winch, 2002) Such risks that are beyond the management's control should be transferred through insurance policies. Afify (2000) presented,

risk transfer is the transfer of the risk to another organization with a comparative risk bearing advantage. This can take two main forms, contractual risk transfer and insurance.

2.7.3 RETENTION

When a risk cannot be transferred or avoided, the best solution is to retain the risk. In this case the risk must be controlled, in order to minimize the impact of its occurrence (Potts, 2008). Retention can also be an option when other solutions are uneconomical (Thomas, 2009). According to Flanagen and Norman (1993), the following factors must be considered in risk retention:

- The maximum probable loss
- The cost of insurance premium
- The likely cost of loss
- The likely cost of paying for the loss, if uninsured

2.7.4 REDUCTION / MITIGATION

By having an overview over the whole project it is easy to identify problems which are causing damage. In order to reduce the level of risk, the exposed areas should be changed (Potts, 2008). This is a way of minimizing the potential risks by mitigating their likelihood (Thomas, 2009). One way to reduce risks in a project is to add expenditures that can provide benefits in the long term. Some projects invest in guarantees or hire experts to manage high-risk activities. Those experts may find solutions that the project team has not considered (Darnall and Preston, 2010). Mitigation strategies can, according to Cooper *et al.* (2005), include:

- Contingency planning

- Quality assurance

- Separation or relocation of activities and resources

- Contract terms and conditions

- Crisis management and disaster recovery plans

Those risks which should be reduced can also be shared with parties that have more appropriate resources and knowledge about the consequences (Thomas, 2009). Sharing can also be an alternative, by cooperating with other parties. In this way, one project team can take advantage of another's resources and experience. It is a way to share responsibilities concerning risks in the project (Darnall and Preston, 2010).

2.8 RISK CONTROL AND MONITORING

According to Hillison (2001), presented by Orabi (2003), the final phase of the risk management process aims to monitor the statues of identified risks, identify new risks, ensure the proper implementation of agreed responses and review their effectiveness, as well as monitoring changes in overall project risk exposure as the project progresses. Risk review meetings may be held, including status reports from the project team on key risks and agreed responses, to assess the current status of the project. Meanwhile, Burchette and Tummala (1998) clarify that the risk control and monitoring phase will monitor the target measure of the selected project option and examine frequently whether any nonconformity would occur and any necessary corrective actions are possible in order to achieve the chosen project objectives. In additions, Burchett and Tummala (1998) suggested that the project manager or the appropriate project team member should report the progress and any significant variances to senior management and other personnel concerned.

2.9 SIMILAR STUDIES

Through the literature, researchers and authors addressed the subject of identifying the most significant risks associated with the construction industry and the effective corresponding response method. There are eight distinct samples that represent similar studies to the one derived in this research. Similarly to this study, the diversity of risk factors were discussed in these papers, their importance in several international construction markets, and the examination of the effects of their response methods, using a questionnaire survey as shown below:

The eight distinct samples that represent similar studies is described and listed chronologically as follows:

1. Baker et al. (1999) concentrated on the selection and use of the effective risk response techniques within the oil and gas industry and compares them with the use of those chosen by the construction industry. Results were concluded based on a comprehensive survey through one hundred companies working in these two sectors, concluding that risk reduction as a response method is the most commonly used. Risk reduction is the most commonly used by both sectors. Baker et al. (1999) proposed that the construction industry can benefit greatly from the more experienced oil and gas industry in managing technical risk.

2. Bing at al. (1999) established a study to examine the critical factors of risk in international construction joint ventures ICJV in East Asian countries and the most common and effective measures that are adopted by the industry participants for risk management, these are considered to be the most prevalent and influential. In the beginning, Bing et al. (1999) concluded a through literature review to point out the various factors that have an impact on the performance of ICJV. In this study, there is a research methodology which consists of questionnaire survey that divides into a case study and more than 300 international contractors. Table 1 Appendix A presents a list of gathered factors of risks, their mean and standard deviation of ICJV and shows the analysis of the collected data ranked 25 risks. . In Table 2 Appendix A there are 8 main groups indicating 33 effective mitigation measures. The most vital and important risk factors in ICJV are those connected to financial, project relationships, governmental policies, economic conditions, and subcontractors.

3. Smith and Bohn (1999) conducted an investigation into the use of contingency in smaller construction firms. Authors summed up the latest literature which is related to the classification of construction contract risk and mitigation measures. Eight major classifications are used by Smith and Bohn (1999) to organize the type of risks found from the literature, these are represented in the Tables from 3 to 10 Appendix A. Within 12 small and medium construction firms interviews were conducted with estimators and/or construction managers to figure out the current risk management practices. The risk factors that are figured out in the interviews were compared to the literature finding. The main conclusion drawn from the comparison that small to medium size contractors largely use contingency in those situations.

4. Wang et al.'s (2000) study of evaluation, management of foreign exchange and revenue risks in China's BOT projects. A) The study begins with searching for literature along with showing case studies to specify an initial list of important risks or critical risks related to BOT projects and mitigation measures for these risks. B) It identified unstructured interviews, discussions to filter the risks, measures that mentioned before. C) In order to evaluate the criticality of the risk and the effectiveness of their mitigation measures, a questionnaire survey was sent to project sponsors, developers, investors, contractors, and lenders. D) Case study showed further insight which is related to contract clauses and risk management frameworks for investing in China's future BOT infrastructure projects. About 50 risks in six categories associated with BOT power projects were indicated as shown in Table 11 Appendix A. Table 12 presents final list of critical risks, and their mitigation measures all gathered in the table. The foreign exchange rate and revenue risk, the financial closing risks, and tariff adjustment are all divided into two main groups: 1) Political and force majeure risk, 2) Foreign exchange and revenue risks. The main conclusions for Wang et al. (2000) study are as follows:

> Tariff adjustment; dispatch constraint; exchange rate and convertibility; and financial closing are the most critical risks. The first three factors were considered as very critical by international professionals. Financial closing was viewed critical by the financial professionals and very critical by the other respondents. The mitigation measures were evaluated by the respondents. Most of measures are viewed as effective or very effective and only a few of them are viewed as fairly effective.

5. Orabi (2003) established a study which is considered the closest research in this field. He used a comprehensive questionnaire survey to figure out the most remarkable risks that the contractors focus on in the Egyptian construction industry and the important risk mitigation measures related to it. 29 risks were divided among 6 major categories, they are divided according to the type. Also, there are 140 mitigation measures mentioned to overcome the effect and the impact of risks, under each of these six risk categories. Table 13 Appendix A represents the ranking of construction project risks according to their means. The main risk category that faced the construction industry in Egypt is the financial risk factors

between ranking 29 risks. Moreover, the study shows that the inappropriate project management practices currently working in the Egyptian construction industry, is considered to be one of the main risk factors facing contractors in the Egyptian construction field. Through this study, we conclude that in order to develop the outcome of the project and to save some of the total cost of the project in the long run by improving the education of project management in Egypt whether in universities or management agencies or training centers.

6. The second closest research conducted in this field similar to the one done in this study by Alwan (2006). It focuses on identifying risks and their effective mitigation measures for construction projects in a developing country as Sudan. Through a comprehensive literature and a questionnaire survey, including 29 construction risk items and 101 mitigation measures. The results as shown in Table 14 Appendix A that the most important and critical risk item that the Sudanese face in the construction industry is the capability of the client to finance the project. Another remarkable risks were linked to financial matters, various third parties' performance, volatile inflation, interest rates, and lack of proper materials. Furthermore, there are some powerful response methods that are used in the Sudanese construction industry as using contractual measures, raising awareness by giving training sessions for the project team, having reliable third parties, and maintaining good relationship with influential figures in the field. The main conclusions for this research illustrate relationships between contractors and the Government must be reinforced and improved in order to improve foreign investment in a country as Sudan, the rules and law should be applied, and inflation and interest rate must remain at a constant level.

7. This study, is conducted by El- Sayegh (2007), identifies and assesses the significant risks in the UAE construction industry and addresses their proper allocation. A comprehensive list of 42 risks was developed based on previous studies. Data were collected through a questionnaire distributed to construction experts. Out of 200 distributed questionnaires, 70 were returned (or collected). Sixty five out of 70 questionnaires were complete and used in the analysis. The relative importance index (RII) for each risk was calculated. An RII was calculated for the probability, impact and rating. The risk rating is calculated by

multiplying the probability and impact for each risk. The study reveals that economic risks such as inflation and sudden changes in prices, shortage in material and labor supply are significant. Other significant risks include owner risks such as unrealistic construction schedule, improper intervention and changes in design. Political, social and cultural risks are found to be insignificant. Local and international experts are in agreement as to the ranking of construction risks in the UAE. More risks are allocated to contractors or shared between contractors and owners with only two risks allocated directly to the owners. The results are presented in Table 15 and Table 16 Appendix A presents the top 10 risks in the UAE construction industry based on risk rating. According to risk rating values, the most significant risk is inflation and sudden changes in prices.

8. Tang et al. (2007) introduce study with title "Risk Management in the Chinese Construction Industry, this paper reports the findings of an empirical Chinese industry survey on the importance of project risks, application of risk management techniques, status of the risk management system, and the barriers to risk management, which were perceived by the main project participants. The risk management strategies adopted in the Three Gorges Project were also studied. Respondents were asked to list the importance of 32 possible risks identified in the literature, listed in the first section, on a scale of 1–5, where 1 represented negligible risk and 5 extreme risks. The study reveals that: Most project risks are commonly of concern to project participants; the industry has shifted from risk transfer to risk reduction; current risk management systems are inadequate to manage project risks; and lack of joint risk management mechanisms is the key barrier to adequate risk management. Table 17 Appendix A represents perception of respondents on importance of risks in the Chinese Construction Industry.

2.10 SHOPPING MALL PROJECTS

2.10.1 ITRODUCTION

Shopping mall projects already became a new popular investment spot now. Shopping mall investment had the characteristic of great invest, long time of return, high level of risk and high profit. So investors must carry on rational prediction and scientific evaluation to the risk of the project as investor's basis of investment decision before investing in, so as to ensure to obtain the participated investment return (Fei & De-huang, 2005).

Malls in the original meaning refers to the tracts for strolling. Most malls today are shopping malls, tracts to stroll while you shop and to shop while you stroll. Shopping malls make the world "*or a carefully walled-off, electronically monitored and closely guarded part of it safe*" for a semblance of strolling (Abaza 2001, 98; Bauman 1996, 27). The mall is a separate complex of shops, department stores, groceries stores, services, and entertainments, which simultaneously meet all kinds of needs and offer something new (Falk and Campbell 1997).

Malls are not only centers for shopping but highly organized social spaces for entertainment, interaction, and other types of consumer excitement (Frat and Venkalesh 1993; Pine and Gilmore 1999). Stores, food courts, restaurants, cinemas, children's play areas, interactive entertainment, social use areas, relaxation spaces, and promotional areas are now major components of any mall (Terblanche 1999).

2.10.2 COMMERCIAL REAL ESTATE AND LARGE-SCALE SHOPPING MALL

Commercial real estate primarily means the property for commercial purposes, including hotels, supermarkets; shops face the street, with commercial neighborhoods, commercial plaza, professional wholesale markets, shopping malls and other uses of real estate (Fei & De-huang, 2005). And shopping mall is a typical commercial real estate pattern. Shopping mall refers to an large integrated entertainment shopping center larger than 100,000 square meters, operated by the professional shopping center management groups, the compound degree of the trade being extreme complete (all trades, all kinds of business, and demonstrated highly specialized and highly integrated maturity structural characteristics), a lot of trades, a lot of shops, a lot of function, extremely wide and deep of portfolio (high-grade commodities must be available to ensure that

commodity varieties available (LIU & YANG, 2006). large department stores, supermarkets center carried out very wide portfolio of products from many different positioning width. commodity portfolio depth is extremely deep because of the numerous brand stores, professional theme shopping stores); positioning in the home (family / all-layer) : Family-style consumer-driven direction -- through the creation of large department stores and supermarkets and the large number of different types of retail businesses, such as home appliances, children and youth recreational facilities, cultural Square, restaurants to cover the old, middle-aged, young generation, and children all four different types of customers; with various types of sales for consumer demand, in addition to the various characteristics of shops to attract domestic and international tourists, to meet the full consumer-level one-stop shopping and one-stop enjoyment(cultural, entertainment, leisure, catering, exhibitions, services, tourism) . Mall had the following two characteristics: First, large: large size, large green spaces, car parks, large scale construction. Second, abundance: many industries, many shops, many functions (including shopping, restaurant, leisure, entertaining) (LIU & YANG, 2006).

2.10.3 EGYPTIAN RETAIL SECTOR OVERVIEW

The following figures, indicators and numbers that reflect the Egyptian retail sector overview and give a snapshot for Macroeconomic overview in Egypt. These data are found in many publications and reports concerning Egyptian retail sector such as:

1. Central Agency for Public Mobilization and Statistics CAPMAS' publications: STATICAL YEARBOOK issued in September 2014; Egypt in figures (March 2014).
2. General Authority for Investment & Free Zones published: Egypt for a bright future (GAFI, 2013)

The following figures represent the Egyptian retail sector as follows:

- It is expected that Egypt 's retail sales will grow from an expected EGP164.52bn (US$30.30bn) in 2011 to EGP262.26bn) by 2015, with long-term political stability the only question mark. Key factors as indicated in the report behind the forecast growth in Egypt's retail sales are an extremely large and youthful population, the emergence of a more affluent middle class, a vibrant tourism industry and the growing acceptance of modern retail concepts ("Egypt in figures," 2014).

- Egypt's substantial population makes it the largest market in the Arab world, with the population increasing from 82.5mn in 2011 to an estimate of 88.2mn by2015, and GDP per capita predicted to rise by 70% reaching USD 4.957 by 2015 ("Statistical yearbook," 2014).

- In 2005, 63.3% of the Egyptian population was described by the UN as economically active, with 36.3% in the 20-44 age range crucial for retail sales. In 2010, an estimated 65.1% of the population was active, while the proportion of those aged 20-44 is estimated to be 37.4% ("Statistical yearbook," 2014).

- Increasing urbanization is also contributing to growth in the retail sector. In 2005, 42.3% of the population was classified by the UN as urban, and this was estimated at 43.2% by 2010 ("Statistical yearbook," 2014).

- The country's retail market also benefits from high tourist spending, with official data showing that foreign tourist arrivals totaled 12.7mn in 2010, reversing the 2009 downturn and bringing in US$10.2bn in revenue. However, the anti-government protests that led to the resignation of Hosni Mubarak resulted in an estimated 210,000 tourists leaving Egypt at the end of January 2011, cutting revenues by US$178mn in one week. Cancelled holiday bookings for February deprived the country of another US$825mn in earnings ("Egypt in figures," 2014)

- Total tourist arrivals contracted by 80% in February, with the total number of arrivals in absolute terms falling to their lowest level since February 2008, several months after the terrorist attacks at Luxor ("Egypt in figures," 2014).

- Looking at previous data, it will take approximately a year for the sector to fully recover and this assumes that the underlying security environment remains stable. If the political situation stabilizes, it is expected that Egypt still has the potential to attract nearly 18mn visitors annually by the end of 2015 ("Egypt in figures," 2014)

- Retail sub-sectors that are predicted to show strong growth over 2015 with sales expected to grow by nearly 52% from US$0.50bn in 2011 to US$0.76bn by 2015(GAFI, 2013)

- Vehicle sales are forecast to grow by more than 200% from a predicted 330,309 units in 2011 to 999,746 by 2015. Car ownership in Egypt is estimated at around 23 cars per 1,000 people, which means the country has considerable room for growth (GAFI, 2013)

- With the Egyptian consumer electronics market one of the largest in the Middle East, sales are forecast to increase further from an expected US$3.40bn in 2011 to US$5.11bn in 2015, a rise of more than 50% (GAFI, 2013)

Summary, the Egyptian retail sector is growing rapidly over the next few years and the need for Mega shopping mall projects will be increased.

2.10.4 SHOPPING MALL PROJECTS' IMPORTANCE FOR THE EGYPTION ECONOMY

Importance of businesses of the Egyptian economy and the construction sector

The establishment of Mega shopping mall projects has a great importance to the Egyptian economy offering opportunities of new jobs and such investment promotes the Egyptian economy and increases investment, especially the foreign investment.

The following are some examples of new Mega scale new projects planned by Arab investors during the coming years, which reflect the importance of studying all the related risks to overcome them. Two examples are selected as follows:

- Al Masry Al Youm newspaper published in its issue of January 2014 under the title: "*Al Futtaim to implement EGP 16.5 billion investments in Egypt*" the following: *"Egypt is undergoing a transitional period, which necessitates investment in infrastructure and new projects"*, the Minister of Investment, Osama Saleh said during his official visit to the United Arab Emirates. The retail and leisure sector is a main stream of the Egyptian economy, Saleh added, highlighting Al Futtaim Group's trust and commitment in its future projects in Egypt. The Egyptian government is looking forward to working with the group in favor of the society and economy (Al Masry Al Youm, 2014). *"Egypt is a main expansion market for us, where we will carry out other investment projects in the future, including the expansion of Maadi City Center and the development of a new mall in Almaza"*, Iyad Malas, the Executive President of Majed Al Futtaim Holding Company said in an official statement issued by the company on Thursday. *"In general, we plan to invest EGP 16.5 billion in Egypt, creating 125,000 new direct and indirect jobs over the five coming years"*, he added (Al Masry Al Youm, 2014).

- Amwal Al Ghad English newspaper published in its issue of March 2014 under the title *"Dubai Retail Giant Majid Al-Futtaim to Expand Investments in Egypt"* the Egyptian Ministry of Foreign Trade, Industry and Investment said *"the leading Dubai retail developer Majid Al-Futtaim (MAF) will expand its investments in Egypt by around LE16.5 billion ($2.3 billion) over the next five years"* (Amwal Al Ghad English, 2014). According to the statement, the company intends to build four shopping malls in Cairo, Giza and Alexandria, a project worth EGP 11.3 billion ($1.6 billion) which will create roughly 38,000 job opportunities. The plan also includes establishing 32 hypermarkets in Egypt, worth EGP 5.2 billion ($0.7 billion) and providing 4,500 jobs (Amwal Al Ghad English, 2014).

2.10.5 EXAMPLES FOR SHOPPING MALLS PROJECTS IN EGYPT

Table 2-1, Summary for Egyptian shopping malls (JLL, 2014)

Ser.	Name	Type of Retail Center	GLA square meters
1	Cairo Festival City Mall	Super Regional Center	168,000
2	City Stars	Super Regional Center	150,000
3	Mall of Arabia	Super Regional Center	180,000
4	Maadi City Center	Regional	28,604
5	Alexandria City Mall	Regional	60,978
6	Dandy Mall	Regional	65,000
7	Golf City Mall	Regional	40,000
8	Sun City Mall	Regional	60,000
9	Katamia Downtown	Community	30,000
10	Porto Cairo Mall	Community	29,000
11	Park Avenue Mall	Community	18,000
Malls under construction			
12	Mall of Egypt	Super Regional Center	162,500
13	Madinaty Mega Mall	Super Regional Center	104,000
14	Mirage Mall New Cairo	Regional	43,000

Note: From "Cairo Real Estate Market Overview, 2014, JLL Reports. Jones Lang LaSalle.

3. RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter is aimed at introducing the methodology adopted to conduct this research. In order to acquire a comprehensive background in the aspects of this report, an extensive literature review was conducted into risk factors issues in the Egyptian construction industry using books, the internet, journal articles as well as my supervisor and other practitioners' guidance. The main input sources to this research are the data gathered from the literature and through a questionnaire survey administrated to a group of qualified practitioners in the Egyptian construction industry, which will allow for a detailed exploration in the subject. The data collected from experts of engineers, who have enough previous total experience in general and particularly previous experience in large scale shopping mall projects with different roles, through questionnaire survey then processed by the means of statistical analysis for the purpose of generalizing its findings, as much as possible, to the entire Egyptian construction industry rather than the targeted sample. Comprehensive study was conducted through direct interview with experts in the shopping mall field and through literature review to define the criteria of the target population, sample size, and sample procedures that matches with the target shopping mall projects in Egypt.

Validation and verification was held to the ranked critical list that obtained through the questionnaire. First, by comparing the nature of construction risks encountered in the Egyptian market to data extracted from literature for other national and international construction market. Second, study of actual shopping mall Project's Contracts Case Study in order to make sure that the top ten critical risk factors, which are obtained as a result of analysis for the research's questionnaire data, are addressed and taken into account shopping mall contracts.

Following, these findings will be an input to a simple spreadsheet file developed to aid all practitioners in the Egyptian construction industry in preparing effective risk management for their new projects. Figure 3.1 presents a schematic diagram of the methodology adopted in this research.
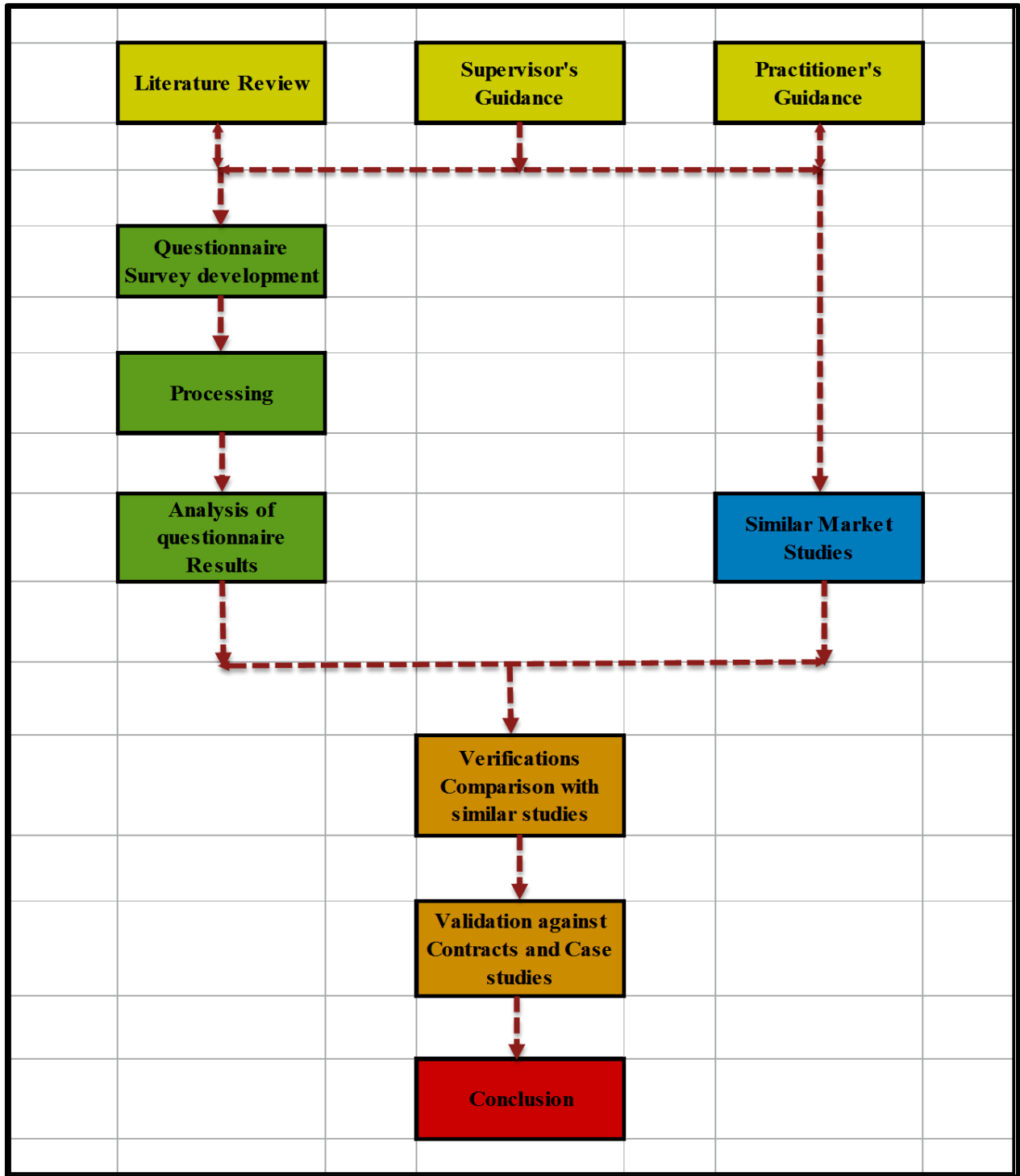
Figure 3-1, Schematic diagram of the research methodology

3.2 QUESTIONNAIRE CONSTRUCTION

3.2.1 MAIN PARTS OF THE QUESTIONNAIRE

Title

According to Dornnyei (2003), a questionnaire is like any other written document that requires a title that can identify the domain of the investigation, to provide the respondent with initial orientation and introduction to the topic. Walonik (2004) and Dornnyei (2003) suggests that one should avoid the use of titles such as "questionnaire" or "survey"; accordingly, the following title is chosen for this research questionnaire: "Assessment of the Most Critical Risks in the Commercial Construction Projects, Shopping Malls, in Egypt".

Instructions

There are two types of instructions utilized in this research questionnaire:

- **General instruction**

An opening welcome states the respondent about the purpose of the questionnaire and the data that will be measured. It included thanking the respondent for volunteering his/her valuable time and effort to fill in the questionnaire.

- **Specific instructions**

These instructions precede the questionnaire itself to demonstrate how respondents should respond and answer the questionnaire, the five-points numerical scale is used to evaluate the questions along with clear explanation for each numerical category stands for.

3.2.2 QUESTIONNAIRE CONTENT

Questionnaire content is specified after conducting an extensive review of the relevant literature review and consulting qualified and competent practitioners working in the field of construction. In order to simplify the purpose of assessment of the most critical risks in the commercial construction projects risks from the perspective of all construction's participants, from the various methods for classifying risks, it was decided to classify risks

according to their type as suggested by several practitioners. Hence, six main risk categories, according to literature, were set:

1. Construction and design risks

2. Financial and economic risks

3. Political/ Government risks

4. Client-generated risks

5. Subcontractors-generated risks

6. Miscellaneous risks.

Extensive literature review concentrating particularly on shopping mall projects and the associated risks and frequent consulting of qualified and competent practitioners with a good and previous experience in the shopping mall projects in Egypt were then conducted to specify the different risks that should be included under each of the above-mentioned categories.

These risk categories and their sub-risks were mostly developed from studies conducted by Smith (2002), Han and Diekmana (2001) , Wang et al. (2000), Bing et al. (1999), Smith and Bohn (1999), and Edwards (1995). In addition, the recommendation of the experts is to link between the risk of the former studies that were examined before, especially in the Egyptian market, and to check its impact and the extent of relative importance, especially after the recent events experienced by the country of revolutions and unrest. Thus the closest research conducted in this field similar to the one done in this study is by Orabi (2003), who via a comprehensive questionnaire survey identified the most critical and significant risks that face contracting working in the Egyptian construction industry and their associated effective risk mitigation measures. Based on all the above, a list of 30 risks were chosen for the research's questionnaire as shown in Table 3-1 and copy of the complete questionnaire survey is attached in Appendix B.

Table 3-1, Risk factors included in the questionnaire survey

Ser.	Risk Code	Risk Group	Risk Factor
1	A1	1-CONSTRUCTION AND DESIGN RISKS	Improper Design
2	A2		Constructability
3	A3		Improper Project Management
4	A4		Site Safety
5	A5		Low Construction Productivity
6	A6		Defective Work
7	A7		Resources Unavailability
8	A8		Defective Material
9	B1	2-FINNCIAL AND ECONOMIC RISKS	Foreign Exchange and Convertibility
10	B2		Cash Shortage
11	B3		Inflation and Interest Rates
12	B4		Competition
13	C1	3-POLITICAL/ GOVERNMENT RISKS	Political Instability
14	C2		Change in Laws
15	C3		Corruption
16	C4		Approvals and Permits
17	C5		Expropriation
18	D1	4- CLIENT-GENERATED RISKS	Financial Ability
19	D2		Changing Needs
20	D3		Claims
21	D4		Possession of site
22	E1	5-SUBCONTRACTORS-GENERATED RISKS	Technical qualifications
23	E2		Financial Ability
24	E3		Variation of Bids
25	F1	6-MISCELLANEOUS RISKS	Differing Site Conditions
26	F2		Physical Damages
27	F3		Force Majeure
28	F4		Partnership
29	F5		Environmental Protection
30	F6		Legal Risks

Once more, an extensive literature review was conducted and interviews were held with experts in the field of construction industry to define, as much as possible, the response techniques that can be employed in the Egyptian construction industry especially in the shopping mall projects. The findings concluded that there were 150 response methods from all the four response techniques: 1) elimination; 2) transfer; 3) reduction; 4) retention. Table 3-2 display the number of response methods for each category of risks from each response technique. These 150 mitigation measures were mostly developed from studies conducted by Orabi (2003), Han and Diekmana (2001) , Wang et al. (2000), Bing et al. (1999), Smith and Bohn (1999), Edwards (1995) and Smith (2002).

Table 3-2, Number of response methods per each risk category

Ser.	Group Code	Group Description	Eliminate	Transfer	Reduction	Retention	Total
1	A	Construction and Design Risks	6	7	20	10	43
2	B	Financial and economic Risks	5	0	18	0	23
3	C	Political / Government Risks	5	3	18	3	29
4	D	Client- Generated Risks	5	0	6	6	17
5	E	Subcontractors- Generated Risks	1	3	10	0	14
6	F	Miscellaneous	5	3	14	2	24
		TOTAL	27	16	86	21	150

The classification of the 150 mitigation measures , as shown in Table 3- 3, is done according to the concept of the four mitigation techniques and as advised by the experts working in such field using the following mitigation techniques: Elimination technique coding with (E), Transfer technique coding with (T), Reduction technique coding with (D), and Retention technique coding with (R).

Table 3-3, Classifications of the 150 mitigation measures according to the four mitigation technique

ACTION CODE	MITIGATION CODE	ACTION CODE	MITIGATION CODE	ACTION CODE	MITIGATION CODE	ACTION CODE	MITIGATION CODE
D	A11	D	A84	E	C36	D	E32
T	A12	R	A85	D	C37	T	E33
D	A13	D	B11	D	C41	D	E34
E	A14	D	B12	E	C42	D	F11
T	A15	D	B13	D	C43	T	F12
E	A16	E	B14	D	C44	E	F13
E	A21	D	B21	D	C45	R	F14
R	A22	E	B22	D	C46	T	F21
R	A23	D	B23	E	C47	D	F22
D	A24	D	B24	D	C51	D	F23
T	A25	D	B25	T	C52	D	F24
E	A26	D	B26	D	C53	T	F31
D	A31	E	B31	D	C54	D	F32
D	A32	D	B32	D	D11	E	F33
R	A33	D	B33	D	D12	D	F34
T	A34	D	B34	R	D13	D	F41
D	A35	D	B35	R	D14	D	F42
T	A41	D	B36	D	D21	D	F43
R	A42	D	B37	R	D22	D	F44
R	A43	D	B38	R	D23	D	F51
D	A44	E	B41	D	D24	R	F52
D	A45	D	B42	D	D31	E	F53
D	A51	D	B43	E	D32	E	F54
R	A52	D	B44	E	D33	D	F61
D	A53	E	B45	R	D34	E	F62
D	A54	R	C11	R	D35	D	F63
R	A55	D	C12	E	D41	D	F64
D	A61	T	C13	E	D42		
R	A62	D	C14	D	D43		
D	A63	D	C15	E	D44	Eliminate	E
T	A64	D	C16	D	E11		
D	A71	D	C21	D	E12	Transfer	T
E	A72	T	C22	D	E13		
E	A73	E	C23	D	E14	Reduction	D
D	A74	D	C24	T	E21		
D	A75	R	C25	D	E22	Retention	R
T	A76	D	C31	T	E23		
D	A77	D	C32	E	E24		
D	A81	D	C33	D	E25		
R	A82	R	C34	D	E26		
D	A83	E	C35	D	E31		

Finally, the survey is completed with its four main sections:

- The first section is inquiry of the general background about the respondent (Name, Designation, Education back ground, Professional, Number of years of work experience, Role, Position, Company's name, Nationality and Company Ownership, Projects on which the participant has the most experience can be categorized as and contact details), as well as asking participant's permission for authorization of disclosure of his/her personal information for the sole purpose of this research.

- The second section that was divided into six sections for the various risk group and then divided into 30 subsections, discusses the probability of a defined risk to occur. A scale of likelihoods from 1 (not likely) to 5 (extremely likely) was provided.

- The third section that was divided into six sections for the various risk group and then divided into 30 subsections, discusses the degree of impact of a defined risk to occur. A scale of significance from 1 (not significant) to 5 (extremely significant) was provided.

- The fourth section, which suggests various possible mitigation measures, was divided into six subsections, each for one of the six categories. The six subsections together include 30 blocks each containing the response methods associated with the 30 risks. The 30 blocks collectively included 150 close-ended questions using a 5- point Likert scale. The scale points ranged from 1 (not effective) to 5 (extremely effective). Optional blank spaces were provided for the respondents, to list other key response methods that were not listed in the questionnaire in Appendix B.

3.3 QUESTIONNAIRE ADMINISTRATION

This subsection discusses the selection of an appropriate sample, the various types or methods of questionnaire administration, and the strategies that can be employed to promote positive questionnaire attitude and involvement on the part of the respondents.

3.3.1 SAMPLE SELECTION

When selecting a representative study sample for a target population three factors should be addressed:

- Definition of the target population
- Sampling procedures
- Sample size

Definition of the target population

According to Dornyei (2003) "the population is the group of people whom the survey is about". In other words, the target population of a study consists of all the people to whom the survey's findings are to be applied or generalized.

According to the objectives of this research that were formerly mentioned in chapter one, this research attempts to assess the most critical risks in Mega shopping malls projects that faces the Egyptian construction industry from the perspective of experts with different roles. Also, studying the most effective response methods currently employed by the main participants working in Egypt to eliminate and/or mitigate their effects.

Therefore, the members of the target population are the first category of different roles: Owners/Developers, Project Managers, Designers, Consultants, and Contractors working and/or involved in Mega shopping mall projects in Egypt. Accordingly, the target population includes:

- A large scale domestic Contractor that is recorded under class "one" of building and complementary work categories according to the Egyptian Federation for Construction & Building Contractors.
- An international or multinational Contractor that is currently working in Egypt whether solely or under a partnership with another domestic or international Contractor.
- Consultants and Designers firms with multi displace class "A" according to Egyptian Engineers Syndicate.
- National or international Project Management firms that working in Egyptian construction industry and have previous large scale shopping malls projects in Egypt.

- Reputable Owners/Developers have large shopping mall projects working now in Egypt or who are currently building such large projects.

A comprehensive research to define the average number of Mega shopping mall projects existing or under construction in Egypt was conducted through direct interview with different experts and competent practitioners in different roles working in similar Mega shopping mall projects in Egypt and by studying many reports concerning Retail and Real Estate in Egypt such as:

- General Authority for Investment: several Periodic Publications and Non Periodic Publication such as
    - Invest In Egypt "Retail" (issued in 06 November 2014)
    - Invest In Egypt "Real Estate" (issued in 10 November,2014)
    - Egypt for a Brighter Future (December 2013)
- American Chamber of Commerce, Business Monthly Magazine.
- Jones Lang LaSalle periodical publications such as:
    - Cairo, the Strongest Performing City in the World
    - Cairo Real Estate Market Overview - Q1, Q2, Q3 &Q4 2013

As result, the estimated number of Mega shopping mall projects either existing or working or still under construction is around 20-40 projects.

Based on the above, the size of the target population according to the aforementioned criteria for different roles is approximately equal: 40 projects * 5 different roles = 200 companies in different roles.

Sampling procedures

According to Dornyei (2003) the sample is a subset of the population which is representative of the whole population. In other words the sample is the group of people whom researchers actually examine. By adopting appropriate sample procedures to select a smaller number of people to be questioned the study can save a considerable amount of time, cost, and effort and can still come up with accurate results. Sampling procedures have been designed to ensure representative of the whole population. The issue of representativeness is critical, because

the strength of the study's conclusions can draw from the results obtained from a selected group depends on how accurately the particular sample represents the large population.

Dornyei (2003) presented a number of sampling procedures upon which an appropriate survey sample can be selected:

Snowball sampling: A chain reaction, whereby the researcher identifies a few people with previous defined criteria of the particular study then is asked to identify further member of the population.

Random sampling: Involved selecting members of the population to be included in the sample on a completely random basis.

Convenience or opportunity sampling: Where an important criterion of sample selection is the convenience for the researcher: members of the target population will be selected for the purpose of the study if they meet certain practical criteria.

In this research a combination of Convenience and Snowball sampling are used for sample selection procedures.

First, a certain criteria are set for the selection of the sample members as follows:

- A qualified engineer is currently working or has been working with qualified and reputable firm in different roles according to the criteria set before for such companies and firms (Owners/Developers Companies, Designers/Consultants Firms, Project Managers Firms, Contractors Companies)
- Suitable participant will have a good previous experience with a total experience of least ten years, and preferable who has a previous experience in such Mega shopping mall projects in Egypt (less than ten years of experience can be accepted in case he has a good experience in similar large scale shopping mall projects in Egypt).
- Working in an area related to risk and risk management.
- Capable of identifying others who could also comply with the same criteria.

Second, employing the snowball sampling procedure, individuals selected according to the aforementioned criteria are asked to identify others who should also comply with the same criteria.

Sample size

Determine of the right sample size is very important; whereas, in order to perform statistical analysis and obtain appropriate statistical significance, a minimum sample size should be achieved. Many researchers and statisticians have addressed this point and introduced different methods for specifying the appropriate sample size. Two methods are used to estimate the ample size as follows:

First method: Dornyei (2003) presented the following guidelines to aid researchers in specifying the minimum sample size:
- A range of 1% - 10% of the population is usually mentioned as the magic sampling fraction depends on how careful the selection has been.
- From a statistical point of view, to obtain a normal distribution of the samples, theoreticians have agreed that a minimum sample size of 25-30 samples should be obtained.
- Subgroup within the samples that might be expected to have differently from the rest of population are another important factor to be considered.
- Finally, it is suggested to leave a decent margin to provide for unforeseen or unplanned circumstances when the final sample size is set.

As indicated by Dornyei (2003) the magic sample friction 10% of the population. Target population as indicated above is equal 40 projects * 5 different roles = 200 companies in different roles. So, sample size at least 20 companies in different roles. Assuming an average of two replies from each company means that the number of qualified replies should be around 40 responses which satisfy the minimum requirement of pure statistical.

Second method to define the sample size by using sample size equation introduced by Cochran (1977), as follows:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where:

- **_n_:** sample size

- **_Z_:** is determined by the acceptable likelihood of error (the value is set to 1.96, representing a level (likelihood) of error of 5%)

- **_p_:** percentage picking a choice, expressed as decimal (.5 used for sample size needed)
- **_d_:** width of confidence interval, expressed as decimal (.15 is used for sample size needed)

By using this formula that provide us with the minimum sample size needed the result is approximately 42 participants.

For this research, 65 questionnaires were sent to different role companies and expert engineers based on the previous sampling procedures (snowball sampling procedure) and as indicated in the participants detail in appendix C. Successful 44 respondents were received within the pre-defined receiving period and were considered an accepted sample size for our research.

3.3.2 ADMINISTRATION METHODS

Administration method has a significant reflection on the format and to some level also on the content of the questionnaire; therefore, the different types or methods of questionnaire administration need to be explained carefully. Webb (2000) and Dornyei (2003) introduce a number of media by which the questions are to be presented to the respondents: mail, telephone, and face–to-face, via the medium of computer screen, the e-mail, or facsimile. It was concluded that questionnaires through phones calls have to be short and composed of simple and ease language. On the other hand, conducting questionnaire through mails, face–to-face, via computers, e-mail, or facsimile enables the use of long and complex questionnaire.

Dornyei (2003) highlighted that email surveys entail embedding the questionnaire in, or attaching it to, an email message. The former involves including a questionnaire in the main body

of the email text, with the recipients marking their answers in the space provided and then replying to the sender. In the second method that required the recipients to download the instrument, answer the questions, and then send the completed form back as an attachment.

In this research two of the above mentioned methods are employed, namely face to face and email questionnaire administration methods. Actually, almost all the questionnaire of this research are being delivered to the respondents by email and a period of time is set to give the respondent a chance to fill it in before the respondent send it. In some cases and if the respondent is known to the researcher, the questionnaire could be picks up by hand. In fact, the face-to-face administration method has been chosen since it increases the chances for the questionnaires to be returned and allows the researcher to create relationship with the respondent, to explain the purpose of the enquiry, and to encourage cooperation (Dornyei, 2003). Moreover, this relationship with the respondent gives the researcher an excellent opportunity to correct and complete the respondent reply.

3.3.3 CONFIDENTIALITY AND ETHICAL ISSUES

Researchers who are wishing to adopt questionnaires as a data collecting instrument must insure that the data collected is not abused and should be aware of and observe certain basis research ethical principles. It is possible to grantee the confidentiality of the respondent, by not revealing any of the given information by the respondent to anyone. The following steps have been compiled by Dornyei (2003) through discussions by Oppenheim (1992) and Sudman and Bradburn (2003):

- No respondents should be harmed through participating in the research.
- The respondents should receive a sufficient amount of initial questionnaire information to participate with their own point of view.
- The respondents right to privacy should at all-time be respected and maintained

The researcher is morally, professionally and legally obliged to maintain the same level of confidentiality that was initially promised to the respondent, during as well as after the research is conducted.

In this research, all of the aforementioned points were carefully and strictly preserved. Moreover, respondents are also asked for their authorization for disclosing their personal information for the sole purpose of this research which reflects respecting the privacy of the respondents.

3.4 PROCESSING DATA

Processing the data that has been already collected in the administration of the questionnaire will be the subject of discussion. This task starts with coding questionnaire data, which is followed by entering data into a computer file, processing questions and data analysis, and finally summarizing and reporting data.

3.4.1 CODING QUESTIONNAIRE DATA

The fact that almost all the questions in the survey are closed-ended questions makes it much easier to code them and therefore soothes the progress of data analysis. The open-ended questions in this survey were restricted to the optional part of the respondent's general information and contact details (Name, Position and Experience, Company name and Company's Nationality), as well as the sections marked "others" in the survey. However, due to anonymity and confidentiality matters it has been decided not to code this section but instead include all the participating respondents who do not wish to disclose their personal information in a table (see Appendix C). As for the section of "others" most of respondents did not fill out these boxes with their own personal additional information, this includes additional suggestions by the respondents in each of the relevant section. The following is the coding frame set for the three various sections within the survey, namely the" Probability of Risk", "Impact of Risk" and "Effectiveness of Mitigation Measures". Table numbers 3-4 through 3-8 show the coding frame for all items in this research questionnaire.

For the mitigation measures, a histogram is produced for each question containing the answers of all 44 respondents. This will illustrate the most effective and least effective mitigation measure for each risk component. Besides, there was no missing data in the survey; consequently Code 9 for missing data can be neglected in this research. A comprehensive description of the dataset, which was entered using Microsoft® Excel, is shown in Appendix A.

Table 3-4, Coding frame for back ground information

6. Education back ground:	Coding	7. Professional:	Coding
€ Bachelor degree	1	€ Architect	1
€ Master degree	2	€ Mechanical engineer	2
€ Doctoral Degree	3	€ Electrical engineer	3
€ Other (Kindly Specify)	9	€ Civil engineer	4
		€ Construction engineer	5
		€ Other (Kindly Specify)	9
8. Number of years of work experience:	Coding	9. Role	Coding
€ Less than 5 years	1	€ Owner	1
€ 5-10 years	2	€ Designer	2
€ 10-15 years	3	€ Consultant	3
€ 15-20 years	4	€ Project Manager	4
€ More than 20 years	5	€ Contractor	5
		€ Sub- contractor	6
		€ Other (Kindly specify)	9
10. Position:	Coding	13. Company Ownership:	Coding
€ Executives	1	€ Public Sector	1
€ Project Managers	2	€ Private Sector	2
€ Department Heads	3	€ Corporation	3
€ Architect/ Engineer	4	€ Others (Kindly specify)	9
€ Other (Kindly specify)	9		
14. Projects on which you have the most experience can be categorized as:	Coding	15-Please select the most contract type	Coding
€ Residential	1	€ Lump Sum	1
€ Commercial Projects	2	€ Cost plus	2
€ Institutional Projects	3	€ Turnkey	3
€ Industrial	4	€ Design & Construct Contract	4
€ Infrastructure Projects	5	€ Project management contract	5
		€ Unit Price	6
		€ Partnership & Alliance	7
		€ Others (Kindly Specify)	9

Table 3-5, Coding frame for the probability of risk

Risk Probability	Code
Not Likely	1
Slightly Likely	2
Likely	3
Very Likely	4
Extremely Likely	5
Missing Data	9

Table 3-6, Coding frame for the impact of risk

Risk Important	Code
Not Significant	1
Slightly Significant	2
Significant	3
Very Significant	4
Extremely Significant	5
Missing Data	9

The total risk (severity of risk) is found by multiplying the probability of a defined risk to occur with the impact it may cause. It can express in a mathematical equation as follows:

Risk (total risk/ severity of risk) = Probability of its occurrence * Impact of its occurrence

R= P*I

However, to calculate the total risk R, the probability of a risk to occur had to be adjusted to a number from 0.2 to 1.0 The total risk will come out as a number from a minimum of 0.20 (not likely to occur but might have extremely significant impact if it actually did) up to 1.00 (extremely likely to occur as well as might have extreme significant impact if it actually did)

Table 3-7, Coding frame for probability of risk

Risk Probability	Code	Probability
Not Likely	1	0.20
Slightly Likely	2	0.40
Likely	3	0.60
Very Likely	4	0.80
Extremely Likely	5	1.00
Missing Data	9	9

Table 3-8, Coding frame for the effectiveness of mitigation measures

Risk Effectiveness (Mitigation)	Code
Not Effective	1
Slightly Effective	2
Effective	3
Very Effective	4
Extremely Effective	5
Missing Data	9

3.4.2 DATA ENTRY

The next step in processing the questionnaire data after compiling the code frames is to record the questionnaire data onto the computer file. Concentration in this task is essential since mistyped figures will be a contamination to the dataset (Dornyei, 2003). Moreover, either working together with someone while data entry is conducted, taking turns in dictating and typing, or having someone go over the files after entering the data will also minimize or totally eliminate mistyping this process. In this research the data was input with the aid of friends who read out the respondents answers as the researcher filled them into excel sheet. The software packages used for processing and analyzing the questionnaire data are Microsoft® Excel and the Statistical Package for the Social Science (SPSS) A complete and final printout of the compiled data, including a description of all respondents' details and answers, is listed in Appendix A.

3.5 PROCESSING QUESTIONNASIRE AND DATA ANALYSIS

Processing the close-ended questions, which are the main type of questions used in this research, involves a number of successive steps, data cleaning, reducing number of variables, examining internal consistency reliability, and statistical analysis.

Data cleaning

This section involves "cleaning" the data files previously entered, which most likely will contain errors that can be classified into two main groups. The first type of commonly made mistakes is the results of human error occurring throughout the data entry process whereas the second type of mistakes is generated by the respondent while filling out the survey, e.g. if by mistake, the respondent answers a blank question instead of the intended questions above, Dornyei (2003). Consequently, the incorrect data entry can be re-entered into a second data file for the computer to check and compare so adjustment can be made. As previously mentioned, there was always two people entering the questionnaire data, so if any mistakes were done, it was corrected by the other person who double checked the data entry.

Handling Missing Data

Missing data are trouble to the research since it is hard to satisfy if these data are important. In other word, it is hard to identify if the respondent has left this question unanswered intentionally, or by mistake. Meanwhile, from a statistical point of view, missing data can invalidate complete questionnaires. Since it is common to have a few missing values in every questionnaire, two actions are taken to deal with missing data in this research:

- By mail to the respondent highlighting the missing items and asking for any clarification or any ambiguity may exist in the missing questions.
- Direct interview was held with the respondent, if it is possible, to complete and clarify any missing items.
- In the blanks left for the respondent for any additions, most of the questionnaire returned back without any additional feedback, notes or new risk items; these data are left empty as they are. Moreover, even if some respondents filled in some of these questions, their scores

will be excluded from the statistical analysis. By these means all missing data were completed and rectified.

Reducing number of variable

It is essential to reduce, to manageable proportions, the number of variables measured by the questionnaire. This is achieved by summing up in multi-item scales all the parallel items that focus on one area. Thus, the following multi-item scales are created for this research questionnaire:

[A] Construction and Design risks
[B] Financial and Economic Risks
[C] Political / Government Risks
[D] Client – Generated risks
[E] Subcontractors – Generated Risks
[F] Miscellaneous Risks
[A11] through [F64] Response Methods for each risk

Moreover, response methods are grouped according to the response technique they follow: retention, reduction, elimination, and transfer. In additions, cases are grouped according to role type: owner group, designers group, consultants group, project managers group and contractors group.

Examining internal consistency reliability

In order to ensure that the questionnaire is free from errors of design, it should have appropriate and well-documented internal consistency reliability. This attribute refers to the homogeneity of the items making up the various muli-item scales within the questionnaire. In order to meet this requirement, the questionnaire is design to satisfy two conditions:

- Instead of single items, multi-item scales are used whenever it is possible.
- Ensuring that the multi-item scales work in a homogenous manner, that is, they correlate with each other and with the total scale score.

Internal consistency reliability is measured by the Cronbach Alpha coefficient (Dornyei, 2003) which is obtained easily with the SPSS software package. It ranges between zero and one, and

since it represents a correlation coefficient, the higher the coefficient is, the more consistency there is between the items. In this research, it is aimed at achieving internal consistency reliability (Cronbach Alpha) coefficient of at least 0.7 per each section of the questionnaire survey examined for internal consistency reliability; whereas, Nunnally (1978) stated that in the early stages of research on predictor tests or hypothesized measures of construct, one saves time and energy by working with instruments that have an only modest reliability for which a purpose reliability of 0.70 or higher will suit.

Statistical analysis

"When an individual uses descriptive statistical, he talks about the data he has; but when he talks about inferential statistical, he talks about data he does not have." (Dornyei, 2003)

The standard method of analyzing quantitative questionnaire data is by means of submitting them to various statistical procedures. These procedures are categorized under two broad categories: descriptive statistics and inferential statistics.

Descriptive Statistics, are used to summarize the data collected and present them in smaller space and easier to read and interpret format. The set forth descriptive statistics procedures are performed on the different multi-item scales and each single item of this research questionnaire:

Mean- (the average)
Range-(the highest value minus the lowest value)
Mode- (the number occurring most frequently)
Median- (the middle of the a set of numbers)
Standard Deviation- (shows the relationship to the Mean)
Skewness- (measures the deviation of the distribution)

Further, ranking the following according to their mean in a descending order as follows:

- The probability of occurrence of defined risks
- The impact of occurrence of defined risks
- The multiplication of the two aforementioned variables, R = P*I
- The various risks respective mitigation measures

Additionally, some of the risks have the same mean value; in this case the standard deviation should be the deciding factor when ranking the various construction risks. The standard deviation is a statistic that tell us how tightly all the various results are clustered around the mean in a set of data. The standard deviation will be small when the results are tightly bunched together and the bell shaped curve is steep. On the other hand, when the slandered deviation is large, the results are spread apart and the bell curve is relatively flat. For that reason the smaller the values of the standard deviation, the higher the risk was ranked.

Inferential statistics, are used to measure the statistical significance of the results obtained from the descriptive statistics and if they are powerful enough to indicate a more generalization phenomenon. In other words, inferential statistics are used to enable the researcher to generalize the results obtained from the statistical analysis performed on the sample data over the whole population. The inferential statistics procedure used in this research is the analysis of variance (AVOVA) which is performed to specify the variance of the results obtained between different roles, i.e. Owners group, Designers group, Consultants group, Project Managers group and Contractors group. The significance tests are conducted at a 5% level of significance using an F distribution.

3.6 Validation and verification of the results

After getting the critical risk ranking by multiply probability of each risk by the probability of occurrence of this risk as indicated in the survey results, validation and verification process have been held in two stages as follows:

- **Data Validation:** The data validation is performed through the comparison of the critical ranked risks obtained through the survey results to the ranked risks obtained from the literature review in Egypt, Chania, United Arab Emirates, Sudan, East Asian countries.
- **Study of Actual Shopping Mall Project's Contracts Case Study**: In order to make sure that the top ten critical risk factors, which are obtained as a result of analysis for the research's questionnaire data, are addressed and taken into account shopping mall contracts, a validation is performed between the top ten risk factors and actual shopping mall projects 'contracts clauses. Three projects were selected for this study, all of them are considered as a large shopping mall project.

4.0 DATA COLLECTION AND ANALYSIS

4.1 INTRODUCTION

• This chapter presents the analysis performed on the collected data. Identification and Ranking of the Related Risks will be answered in this chapter. In the beginning, the data sample is described and its characteristics are presented. The sample description includes describing the characteristics of the participants' data including: education back ground, professional, and number of years of work experience, role, and position. Next the questionnaire survey design is examined for the internal consistency reliability. Following, descriptive and inferential statistics are performed on the data collected through the questionnaire to analysis the probability, impact as well as the total risk. Subsequently, the same descriptive and inferential statistics are performed on the data collected through the questionnaire to obtain ranked checklist of the response methods associated with each of the aforementioned risks according to their effectiveness, which is the fourth objective of this research. Next the results are being incorporated in an easy-to-use spreadsheet file as a summary to the research findings and which could be a helpful tool for all partners in shopping mall construction projects in Egypt in their planning of an effective risk management process, which is the fifth objective of this research. Finally, the sixth objective of this research is being attempted by comparing the results of this research to similar results extracted from literature to measure up the norms of the Egyptian construction industry to those of international construction industry.

4.2 SAMPLE DESCRIPTION AND CHRACTERISTICS

According to subsection 3.3.1 of this thesis, the target population that have been addressed by the questionnaire of this research are the Egyptian construction industry's experts such as Owners/Employers, Designers, Consultants, Project Managers, Contractors, Subcontractors, etc., and preferably of his previous experience in the field of Mega shopping mall projects. In this research a combination of Convenience and Snowball sampling are used for sample selection procedures.

For this research, 65 questionnaires were sent to different role companies and expert engineers based on the previous sampling procedures and as indicated in the participants detail in appendix A. Only 44 respondents successfully completed the survey on time. Besides, due to anonymity and confidentiality issues, the respondents contact information has carefully been left out. Appendix D shows additional sample description and characteristics Tables and Figures.

Educational back-ground

Figure 4-1 indicates the percentages of participants' education back-ground. Most of the participants have bachelor degree with percentage equal 70 % that reflect the majority of the participants have the same level of education. Master degrees represent 21% and doctoral degree represent 9% that means the sample covers different types of education back ground.
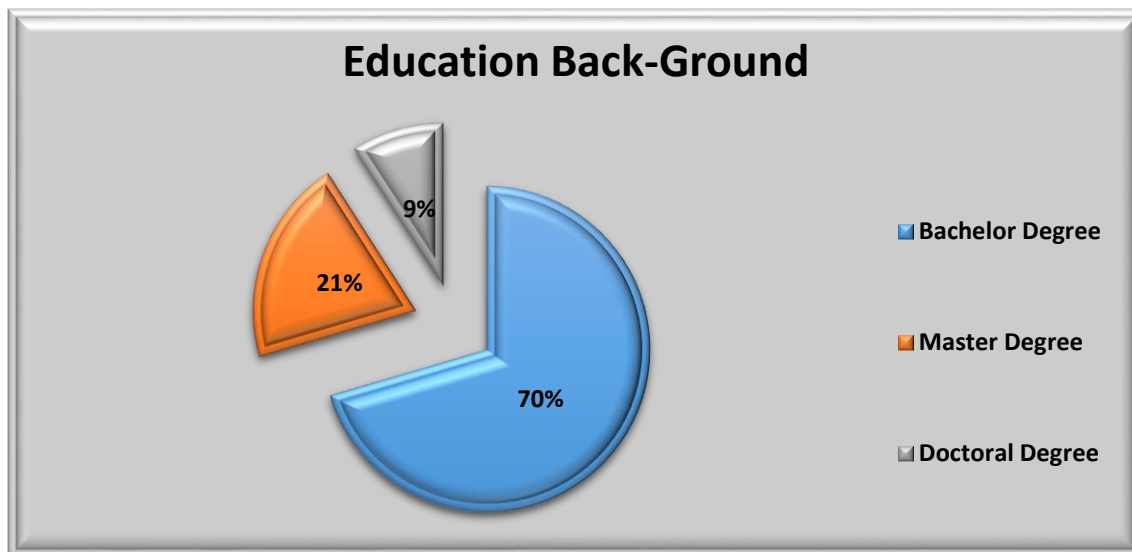
Figure 4-1, Shows percentages of education back-ground

Professional

Figure 4-2, shows the percentage of the participants' profession. Civil Engineers represent 40% from the total participants, Architects represent 32% and Mechanical Engineers and Construction Engineers represent 14%. These figures represent that the survey covered the most of participants' professional in the Egyptian construction industry.
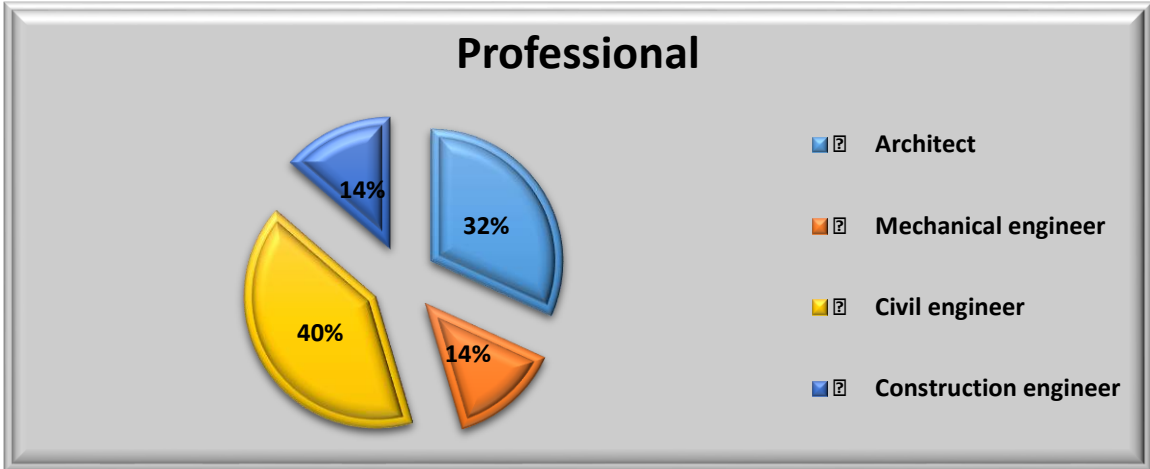
Figure 4-2, The percentage of the participants' professional

Number of years of work experience

The number of years of experience of the respondents to the questionnaire should indicate important information as to the number of construction project risks they have been exposed to and how they are aware of the associated response methods. According to Figure 4-3 that shows a bar chart for the number of replies per each experience interval. About 43% (19 participants) of the respondents have more than 20 years of experience, which indicate that the input data of the research is adequately reliable in terms of experience of the respondents.

	€ Less than 5 years	€ 5-10 years	€ 10-15 years	€ 15-20 years	€ More than 20 years
Number	2	3	10	10	19
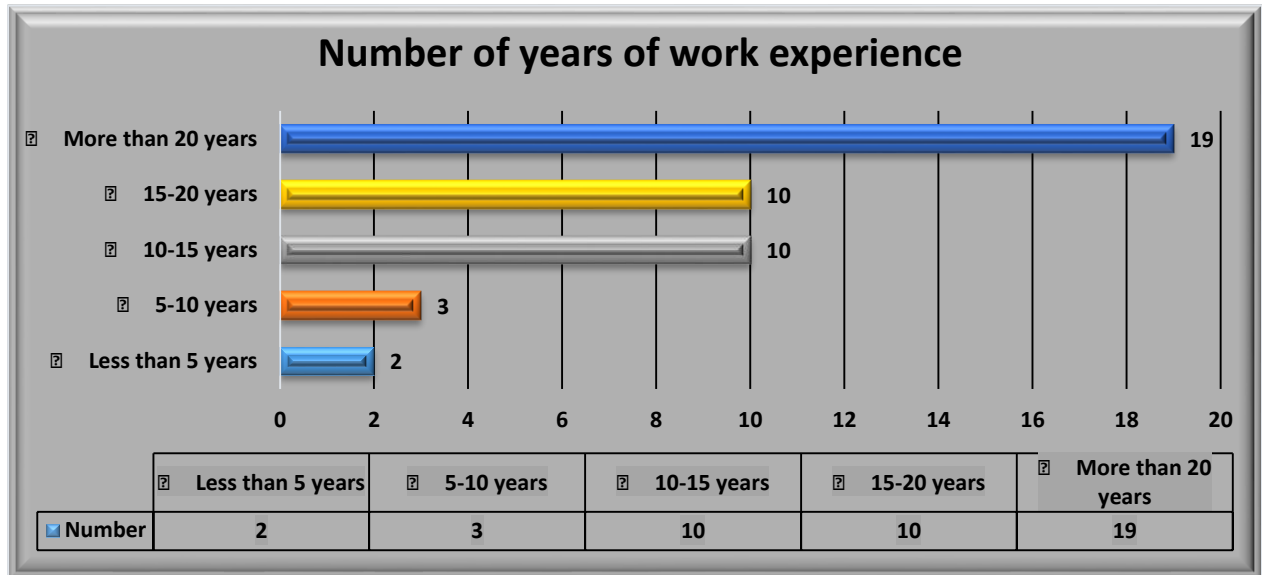
Figure 4-3, The number of years of work experience

As shown above in the Figure 4-3, around 23% (10 participants) of the respondents have from 15-20 years of experience, almost 23% (10 participants) of the respondents have from 10-15 years of experience, only 7% (3 participants) of the respondents have from 5-10 years of experience and finally 4% (2 participants) of the respondents have less than 5 years of experience. These percentages indicate that the input data of the research is adequately reliable in terms of roles of the respondents. In addition, the only two participants who have less than 5 years of experience are still working in Mega shopping mall projects so as highlighted before in chapter three their responses will be considered in our analysis.

Participants' roles

In general the construction industry characterized by the multiplicity of different involved participants such as Owners, Consultant and Contractor etc. and every partner has his own vision that may have some differences from the other party. As noted before this research is aimed to examine the risks as a general within all participants in the Egyptian construction industry, so the survey is target all different groups of participants. According to Figure 4-4, which shows the percentage of the participants' roles, about 23% (10 participants) of the respondents are representing Owners group. As shown below in the pie chart, around 14% (6 participants) of the respondents are representing Designers group, almost 18% (8 participants) of the respondents are representing Consultants group, 20% (9 participants) of the respondents are representing Project Managers group and finally 25% (11 participants) of the respondents are representing Contractors group. These percentages indicate that the input data of the research is adequately reliable in terms of roles of the respondents.
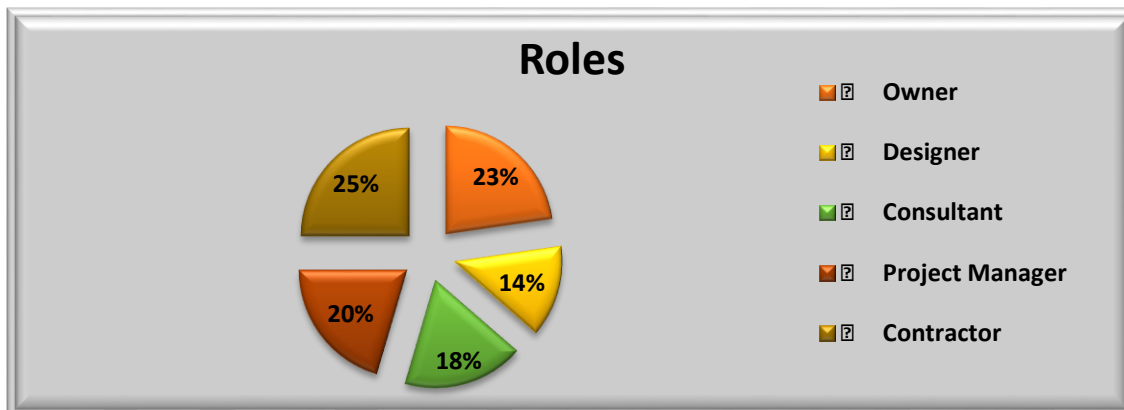
Figure 4-4, Shows the percentage of the participants' roles

Respondent position

According to Figure 4-5, shows the percentage of the participants' positions, about 32% (14 participants) of the respondents are representing Executive group. As shown below in the pie chart, around 29% (13 participants) of the respondents are representing Project Managers group, almost 23% (10 participants) of the respondents are representing Department Heads group, and finally 16% (7 participants) of the respondents are representing Architect/ Engineers group. This percentage indicates that the input data of the research is adequately reliable in terms of positions of the respondents.
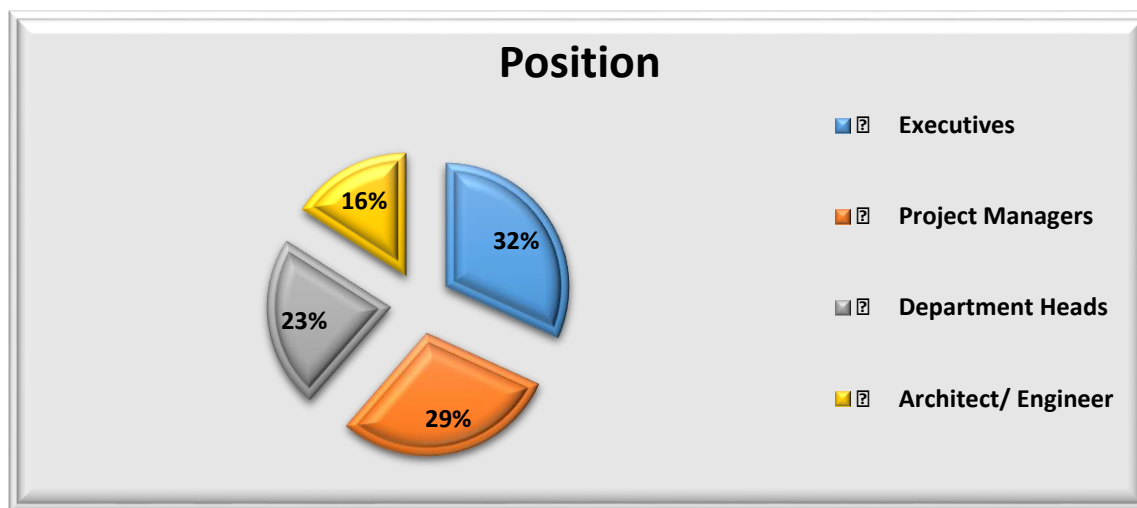
Figure 4-5, The percentage of the participants' positions

Participants' type of experience

Within the total survey sample (44 respondents), most of them have several types of experience. According to Figure 4-6 that shows the percentage of the participants' type of experience, about 89% (39 participants) of the respondents have a residential experience.
As shown above in the pie chart, around 84% (37 participants) of the respondents have commercial projects' experience, almost 41% (18 participants) of the respondents have institutional projects experience, 39% (17 participants) of the respondents have industrial experience, and finally 36% (16 participants) of the respondents have infrastructure projects experience.

% Participants' type of experience

	Residential	Commercial Projects	Institutional Projects	Industrial	Infrastructure Projects
Percentage %	89%	84%	41%	39%	36%
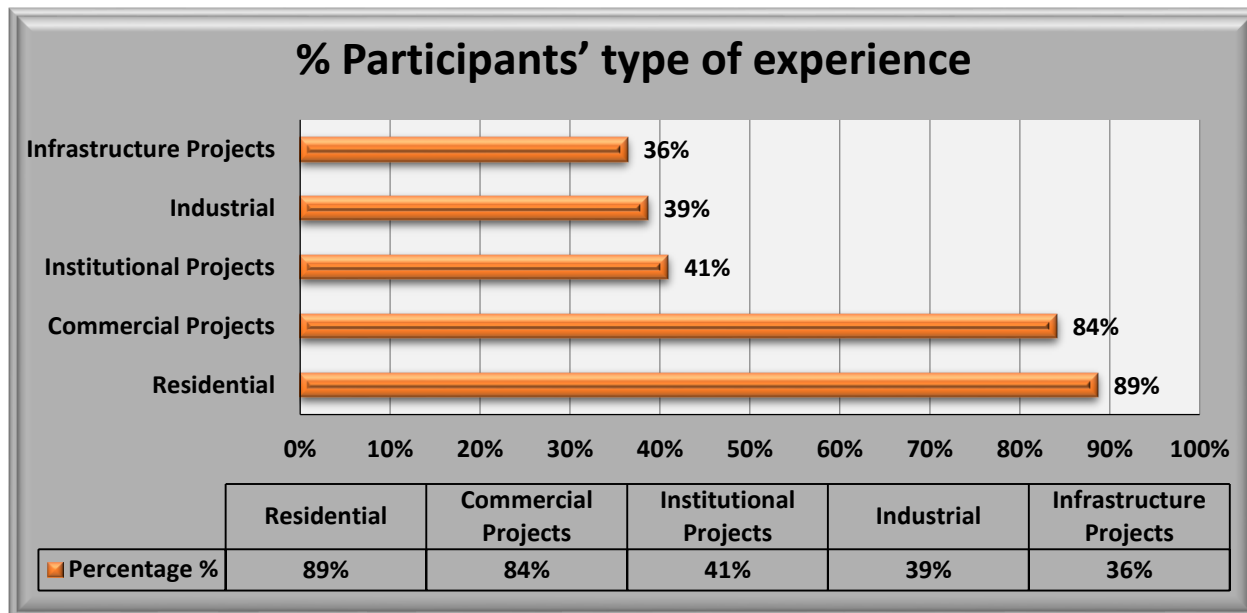
 Figure 4-6, The percentage of the participants' type of experience

Based on the percentages shown above, selected sample represents the target population and most of the sample participants have previous experience in the Commercial projects (84%). In other word, these percentages indicate that the input data of the research is adequately reliable in terms of the type of experience.

4.3 EXAMINING INTERNAL CONSISTENCY RELIABILITY

In order to make sure that the questionnaire is free from errors of design, it should have well-documented internal consistency reliability. Reliability is concerned with the ability of an instrument to measure consistently. Internal consistency reliability is measured by the Cronbach Alpha coefficient (Dornyei, 2003). Alpha was developed by Lee Cronbach in 1951 to provide a measure of the internal consistency of a test or scale; it is expressed as a number between 0 and 1. Internal consistency describes the extent to which all the items in a test measure the same concept or construct. Science it represents a correlation coefficient, the higher the coefficient is, the more consistency there is between the items. If the items in a test are correlated to each other, the value of alpha is increased. However, a high coefficient alpha does not always mean a high degree of internal consistency. This is because alpha is also affected by the length of the test. If the test length is too short, the value of alpha is reduced (Nunnaly, Bernstein & , 1994).

As indicated in section 3 of this thesis it is aimed to achieve an internal consistency reliability (Cronbach Alpha) coefficient at least 0.70 per each section of the questionnaire survey examined for internal consistency reliability. Nunnally (1978) stated that in the early stages of research on predictor tests or hypothesized measures of construct, one saves time and energy by working with instruments that have an only modest reliability, for which a purpose reliability of 0.7 or higher will suffice. Employing the SPSS (Release 22) software package on the dataset collected via the questionnaire survey, Cronbach Alpha internal reliability coefficient was computed for a number of sections and values exceeded reliability of 0.70 as shown in Table 4-1. Appendix G shows Cronbach Alpha internal reliability coefficient's tables.

Table 4-1, Cronbach Alpha reliability coefficient for different sections

Section Examined	Cronbach Alpha Coefficient
Construction Project Risks Probability	0.856
Construction Project Risks Total Risk	0.854
Construction Project Risks Impact	0.882
Risk response methods effectiveness (Mitigation)	0.955
Role 1	0.818
Role 2	0.825
Role 3	0.927
Role 4	0.804
Role 5	0.929

4.4 RANKING OF THE PROBABILITY OF CONSTRUCTION RISKS

One of the main goals of this research is to identify the probability of occurrence of defined risks related to the Egyptian construction industry through analyzing the data collected via the questionnaire survey. As noted in section 3 the questionnaire survey is composed of six subsections, which collectively includes 30 different construction project risks: (1) construction and design risks; (2) financial and economic risks; (3) political / governmental risks; (4) client-generated risks; (5) subcontractors-generated risks; (6) miscellaneous risks. The following table lists all the probabilities of risk values according to their means as well as revealing their median, mode, standard deviation, skewness and range.

Table 4-2, Ranking of the Probability of occurrence of construction project risks according to their Means and Standard Deviations

Overall Probab. Rank	Risk Code	Mean	Mode	Median	Min	Max	Range	Standard Deviation	Skewness
1	A1	0.773	0.800	0.800	0.400	1.000	0.600	0.157	-0.317
2	D2	0.764	0.800	0.800	0.400	1.000	0.600	0.143	-0.089
3	D1	0.750	0.800	0.800	0.400	1.000	0.600	0.171	-0.149
4	C4	0.732	0.800	0.800	0.400	1.000	0.600	0.120	-0.315
5	B2	0.727	0.800	0.800	0.400	1.000	0.600	0.176	-0.219
6	A3	0.723	0.600	0.700	0.400	1.000	0.600	0.172	0.184
7	B1	0.718	0.800	0.800	0.400	1.000	0.600	0.187	-0.264
8	D3	0.718	0.600	0.700	0.200	1.000	0.800	0.201	-0.183
9	A5	0.714	0.800	0.800	0.400	1.000	0.600	0.150	-0.394
10	A7	0.695	0.600	0.600	0.200	1.000	0.800	0.202	-0.268
11	C1	0.691	0.600	0.600	0.200	1.000	0.800	0.207	-0.126
12	B3	0.686	0.600	0.600	0.400	1.000	0.600	0.156	-0.060
13	F6	0.686	0.800	0.800	0.200	1.000	0.800	0.183	-0.422
14	A6	0.673	0.600	0.600	0.400	1.000	0.600	0.129	0.518
15	A4	0.655	0.800	0.800	0.200	1.000	0.800	0.239	-0.297
16	C3	0.645	0.600	0.600	0.400	1.000	0.600	0.233	-0.104
17	F1	0.641	0.600	0.600	0.200	1.000	0.800	0.174	-0.199
18	C2	0.632	0.800	0.700	0.200	1.000	0.800	0.213	-0.433
19	E1	0.627	0.600	0.600	0.400	1.000	0.600	0.139	0.219
20	E2	0.614	0.600	0.600	0.400	1.000	0.600	0.144	0.263
21	A8	0.614	0.600	0.600	0.200	1.000	0.800	0.178	0.060
22	D4	0.605	0.600	0.600	0.200	1.000	0.800	0.188	0.282
23	F2	0.595	0.600	0.600	0.200	1.000	0.800	0.178	0.044
24	F3	0.595	0.400	0.600	0.200	1.000	0.800	0.211	0.161
25	E3	0.577	0.600	0.600	0.200	1.000	0.800	0.201	0.229
26	B4	0.573	0.600	0.600	0.200	1.000	0.800	0.216	-0.162
27	A2	0.559	0.600	0.600	0.200	1.000	0.800	0.179	0.030
28	F4	0.514	0.600	0.600	0.200	1.000	0.800	0.183	0.244
29	F5	0.477	0.400	0.400	0.200	1.000	0.800	0.214	0.852
30	C5	0.405	0.200	0.400	0.200	1.000	0.800	0.224	1.029

Additionally, some of these risks have the same mean value, and therefore the value of the standard deviation will then be the deciding factor for the particular risk's ranking. As shown in Table 4-2 which listed the ranked probability risks based on the mean of each risk, the highest mean score is "Improper Design" code "A1" with score 0.773 and the lowest one is "Expropriation" code "C5"with score 0.405. Out of the total 30 risks examined, 15 risks, from different risk groups, have a probability mean equal or more than 0.65 (0.65 is almost the average of the 30 risk's probability means); their distribution among the six risk groups is as shown in Table 4-3.

Table 4-3, Breakdown of most probability risks (more than 0.65) within risk group

Risk Category	Risk Symbol	Number of Risks in group	Risks with Criticality Mean >0.65	%
Construction and Design Risks	A	8	6	75.00%
Financial and Economic Risks	B	4	3	75.00%
Political / Governmental Risks	C	5	2	40.00%
Client-Generated Risks	D	4	3	75.00%
Subcontractors-Generated Risks	E	3	0	0.00%
Miscellaneous Risks	F	6	1	17.00%
Total		30	15	50%

The three risk groups A,B&D have the same highest percentage values of risks with means equal or more than 0.65 as follows: (1) Construction and Design Risks group that contains 6 risk factors out of 8, with percentage 75%, with mean equal or greater than 0.65 that reflects the importance of this group that related to a very critical and sensitive group belongs to the design issues and construction process that always have a lot of risk factors; (2) Financial and Economic Risks that contains 3 risk factors out of 4 ,with percentage 75%,with mean equal or greater than 0.65 because this group is related to financial and economic risks that can affect deeply in expensive and high quality projects such as our concern shopping mall projects; and (3) Client-Generated Risks group is remarkably critical group. It has 3 risk factors out of four, with percentage 75%, with mean equal or greater than 0.65 that reflect the importance of this group that

related to the Employment/Owner risks factors that can affect directly in such big commercial projects. In conclusion, the three groups have totally 12 out of the 15 most critical risks with percentage around 80% that mean these groups considered the most criticality groups in the Egyptian construction industry.

Table 4-4 represent the distribution of the top ten risks within the different groups. Group A is the highest number of risks within the top ten ranked probability risks with four risks. Group A "Construction and Design Risks" group includes risks that considers the most probability risks for most construction projects in Egypt. The second group is group "D "that related to the Owner and that matches with the existing practice in the Egyptian market. Financial and Economic Risks group B has two risks within the top ten probability risks. Financial problems and Economic problems are expected risks in the devolving countries like Egypt. Due to the unrest in Egypt since Egyptian revolution January 25, 2011 some risks become important to identify and mitigate like Political /Government Risks. Risk C4 with title "Approval and Permits" has been found within the top ten risks as a result for a lot of problems that faces construction industry in Egypt to get approvals and different permits due to a lot of problems related to the governmental procedures. Two groups have not any risks existing within the top ten probability risks group E and group F.

Table 4-4, Shows the list of the top ten probability risks and their distribution within the different groups

Serial	Group Code	Group Description	Number of Risks	List
1	A	Construction and Design Risks	4	A1,A3,A5,A7
2	B	Financial and Economic Risks	2	B2,B1
3	C	Political / Government Risks	1	C4
4	D	Client- Generated Risks	3	D2, D1, D3
5	E	Subcontractors-Generated Risks	0	0
6	F	Miscellaneous	0	0
		Total	10	

4.4.1 Comparison between the probabilities of occurrence of construction project risks overall risks and the five roles

To investigate the probability of occurrence between different roles participated in this study , Tables from 1 to 6, Appendix B, showing statistical analysis within each role named as follows: Role one represents the Owner groups that represent 23% of the total participants, Role two is the Designer group that represent 14% of the participants, Role three is the Consultant group representing 18% of the total participants, Role four Project Manager group that they represent 20% of the total participants and finally the fifth role group that represent the Contractors with 25% existing within the survey group. In addition to a summary comparison table for all results ranking the probability of occurrence between different roles and also with the overall participants is shown in the Appendix J.

Within the top ten ranked risks there are only three common risks were found between the overall ranking and with the different roles as shown in Table 4-5. The three common risks are A1, D1 and D2. Risk A1 with title "Improper Design" and with overall mean score 0.773 reflect that this risk is highly occurrence in the construction industry in Egypt and especially in the shopping malls projects.

Table 4-5, Comparison between the top ten risks probabilities according to their means and overall probability and the five roles

Overall Ranking		Role 1 Ranking		Role 2 Ranking		Role 3 Ranking		Role 4 Ranking		Role 5 Ranking	
Risk Code	Overall Mean	Risk Code	Mean	Risk Code	Mean	Risk Code	Mean	Risk Code	Mean	Risk Code	Mean
A1	0.77	A1	0.80	D1	0.87	A1	0.83	B2	0.80	C4	0.75
D2	0.76	D1	0.78	C4	0.80	A3	0.80	A1	0.80	D2	0.75
D1	0.75	D2	0.76	A5	0.77	D2	0.80	B1	0.80	D3	0.75
C4	0.73	B1	0.76	C2	0.77	D3	0.78	D2	0.78	A7	0.73
B2	0.73	B2	0.74	A1	0.77	A7	0.78	A6	0.76	C1	0.73
A3	0.72	C4	0.72	F6	0.77	A5	0.75	D1	0.73	D1	0.71
B1	0.72	A5	0.72	A3	0.77	B3	0.73	C1	0.73	A1	0.69
D3	0.72	F6	0.72	A4	0.77	C4	0.73	A3	0.73	B2	0.69
A5	0.71	A3	0.70	D2	0.73	D1	0.70	B3	0.71	A4	0.69
A7	0.70	B3	0.70	A6	0.73	C1	0.70	D3	0.71	A5	0.67

Moreover, "Improper Design Risk" is the highest ranking among owners with mean 0.800 and consultants with mean 0.825 that reflect the importance of a proper design for the owner to achieve his goals and also for the consultancies to be able to consult the project. The second ranked one is risk D2 with title "Changing Needs" and with overall score 0.764 and the highest mean score was found within Consultant role with mean value 0.800. Changing needs risk in shopping mall projects is related to the type of such projects that contains a multi tenants with different scales and different activities that lead the Owner to request a lot of changes to adapt these requirements. The third common risk is D1 with title "Financial Ability" with overall mean score is 0.75 and with the highest mean score within Designers role with score 0.867 that considered the highest probability mean within different roles. Financial ability for the Owner is a very important risk in such unique projects.

Table 4-6, Distribution of the top ten probability risks factors within different groups and roles

Group Description		Overall	Role 1	Role 2	Role 3	Role 4	Role 5
Construction and Design Risks	No.	4	3	5	4	3	4
	List	A1,A3, A5, A7	A1, A5, A3	A5, A1, A3, A4, A6	A1, A3, A7, A5	A1, A6, A3	A7, A1,A4, A5
Financial and Economic Risks	No.	2	3	0	1	3	1
	List	B2,B1	B1, B2, B3	0	B3	B2, B1, B3	B2
Political / Government Risks	No.	1	1	2	2	1	2
	List	C4	C4	C4, C2	C4, C1	C1	C4, C1
Client-Generated Risks	No.	3	2	2	3	3	3
	List	D2, D1, DE	D1, D2	D1, D2	D2, D3, D1	D2, D1, D3	D2, D3, D1
Subcontractors-Generated Risks	No.	0	0	0	0	0	0
	List	0	0	0	0	0	0
Miscellaneous	No.	0	1	1	0	0	0
	List	0	F6	F6	0	0	0
Total		10	10	10	10	10	10

Table 4-6 that represents the distribution of the top ten probability risk factors within different roles and different groups reflects a slight difference in the risks probabilities within different roles. All five roles agreed that Construction and Design Risks are the most probability in the shopping mall projects in Egypt. Role 2 (Designer Group) select five risk factors to be within the top ten factors, three roles select four risk factors from eight to be within the top ten factors. Owner group and project manager group select only three risk factors from this group that can be explained by examining the second group where the Owner and the project Manager select financial risk factors more than any other group. Selecting three risk factors out of five risk factors in Financial and Economic Risks group by the Owner and Project Manager is matching with the duties for each of them in the construction process. Role 2 (Designer) does not consider Financial and Economic Risks as be within the top ten probability risk. The number of risk factors in two groups (Political / Government Risks group and Client- Generated Risks) within the different roles almost equal and matching with the overall results. Any of Subcontractors-Generated Risks are not considered to be within the top ten ranked probability risks. Within the Miscellaneous risk group that contain different type of risks only risk factor F6 " Legal Risk" is selected by the Owner and the designer to be with the top ten probability risk factors. Legal risk factors are very important issue for the most of Owners / Employers because any Owner/Employer wants to complete his project with minimum or without any legal problems can disturb his business.

4.5 RANKING OF THE IMPACT OF CONSTRUCTION RISKS

In addition to define the probability of the most risks that can threat the shopping mall projects in the Egyptian construction industry, identifying the impact of occurrence of defined risks related to the Mega shopping mall projects and their perceived criticality in the Egyptian construction industry through analyzing the data collected via the questionnaire survey, is the second objective of this research. As noted in section 3 the questionnaire survey is composed of six subsections, which collectively includes 30 different construction project risks: (1) construction and design risks; (2) financial and economic risks; (3) political / governmental risks; (4) client-generated risks; (5) subcontractors-generated risks; (6) miscellaneous risks. The following table lists all the impact of risk values according to their means as well as revealing their median, mode, standard deviation, skewness and range. Additionally, some of these risks have the same mean value, and therefore the value of the standard deviation will then be the deciding factor for the particular risk's ranking.

Table 4-7, Ranking of the Impact of occurrence of construction project risks according to their Means and Standard Deviations

Rank	Risk Code	Mean	Mode	Median	Min	Max	Range	Standard Deviation	Skewness
1	D1	4.682	5	5	3	5	2	0.555	-1.55
2	B2	4.364	5	5	2	5	3	0.855	-0.989
3	A1	4.182	5	4	2	5	3	0.805	-0.602
4	A3	4.159	4	4	2	5	3	0.796	-0.833
5	C4	4.159	5	4	2	5	3	0.878	-0.718
6	D2	4.136	4	4	2	5	3	0.757	-0.547
7	F3	4.136	4	4	2	5	3	0.842	-0.719
8	D3	4.114	4	4	2	5	3	0.647	-0.616
9	F6	3.977	4	4	2	5	3	0.839	-0.419
10	F1	3.955	4	4	2	5	3	0.767	-0.224
11	B1	3.932	4	4	2	5	3	0.914	-0.578
12	C1	3.932	4	4	1	5	4	0.939	-0.688
13	A7	3.886	4	4	1	5	4	1.049	-0.953
14	A4	3.841	5	4	1	5	4	1.147	-0.771
15	A5	3.727	4	4	3	5	2	0.686	0.411
16	B3	3.727	4	4	2	5	3	0.75	0.169
17	D4	3.659	4	4	2	5	3	0.851	-0.392
18	E1	3.636	4	4	3	5	2	0.606	0.384
19	C2	3.568	4	4	1	5	4	1.053	-0.705
20	A8	3.523	4	4	2	5	3	0.839	-0.303
21	A6	3.432	3	3	2	5	3	0.751	0.072
22	F4	3.432	3	3	1	5	4	0.889	0.206
23	F2	3.432	4	4	1	5	4	1.156	-0.628
24	E2	3.364	3	3	2	5	3	0.979	0.094
25	C5	3.318	4	4	1	5	4	1.345	-0.368
26	A2	3.186	3	3	1	5	4	1.017	-0.246
27	B4	3.182	3	3	1	5	4	1.154	0.175
28	E3	3.159	3	3	1	5	4	0.928	-0.491
29	C3	3.159	3	3	1	5	4	1.065	0.019
30	F5	2.818	2	3	1	5	4	0.936	0.202

As shown in Table 4-7 which listed the ranked impact risks based on the mean of each risk, risk D1 with title "Financial Ability" has the most impact score 4.682 that reflect very important issue related to the type of shopping mall projects that require a good and stable financial ability from the client to complete such expensive projects. The lowest one is risk F5 with title "Environmental Protection" with score 2.818 that reflect poor attention to environmental issues. As Table 4-8 may indicates the most impact risk factors according to risk group. Out of the total 30 risks examined, 16 risks, from different risk groups, have an impact mean equal or more than 3.7 (3.7 is the average of the 30 risk's impact means); their distribution among the six risk groups is as shown in Table 4-15 with percentage equal 53%.

Table 4-8, Breakdown of most impact risks according to risk group

Risk Category	Risk Symbol	Number of Risks in group	Risks with Criticality Mean >3.7	%
Construction and Design Risks	A	8	5	63.00%
Financial and Economic Risks	B	4	3	75.00%
Political / Governmental Risks	C	5	2	40.00%
Client-Generated Risks	D	4	3	75.00%
Subcontractors-Generated Risks	E	3	0	0.00%
Miscellaneous Risks	F	6	3	50.00%
Total		30	16	53%

Five groups out of six: A, B, C, D & F have the risks with impact means equal or more than 3.7. Two of them have high impact risk factors with percentage 75% as follows: (1) Financial and Economic Risks group B that contains 3 risk factors out of 4 with impact mean equal or greater than 3.7 that reflect the importance of this group that related to financial and economic risks that can affect deeply in expensive and high quality projects such as our concern shopping mall projects; and (2) Client-Generated Risks group D is remarkably as a high critical ,it has 3 risk factors out of four with impact mean equal or greater than 3.7 that reflect the importance of this group that related to the Employer/Owner risks that can affect directly in such sensitive shopping

mall projects. The third group is the Construction and Design Risks group that contains 5 risk factors out of 8, with percentage 63%, with impact mean equal or greater than 3.7 that reflect the importance of this group that related to a very critical and sensitive group that belong to the design issues and construction process that always have a lot of risk factors. In conclusion, the four groups have totally 11 out of the 16 most critical risks with percentage around 69% that mean these groups considered the most criticality groups in the Egyptian construction industry. As representing in Table 4-9 the distribution of the top ten of the most impact risk factors based on the mean value , groups D & F have more impact risk factors than the other four risk groups whereas, they exclusively include 6 out of ten of the most impact risk factors.

Table 4-9, Shows the list of the top ten impact risks and their distribution within the different groups

Serial	Group Code	Group Description	Number of Risks	Risk Code
1	A	**Construction and Design Risks**	2	**A1 , A3**
2	B	**Financial and economic Risks**	1	**B2**
3	C	**Political / Government Risks**	1	**C4**
4	D	**Client- Generated Risks**	3	**D1, D2, D3**
5	E	**Subcontractors-Generated Risks**	0	**0**
6	F	**Miscellaneous**	3	**F1 , F3, F6**
		Total	**10**	

Group D includes risk factors related to "Client-Generated Risks" group including very critical and impact risks as follows: D1 related to "Client financial Ability", D2 related to "Changing Needs" and D3 related to "Claims" issues. The three risks have great impact in the most construction projects in Egypt and in particular on the shopping mall projects. The second group is group F that related to the "Miscellaneous" risk factors. The three risk factors within group F are as follows: F1 related to deferring site conditions, F3 related to force majeure and F6 related to legal risks. Both "Financial and economic Risks" group and "Political/Government Risks group have only one risk factor in each group. Risk B2 named "Cash Shortage" with impact mean value equal 4.364 has severe impact on the Mega projects as shopping mall projects. Also, risk C4

with title "Approvals and Permits" with impact mean equal 4.159 has a great impact in the shopping mall projects and leads to a lot of problems to all the participants. Subcontractors-generated risk group, has not any risk existing within the top ten impact risks.

In the following subsection each of the risk groups is addressed individually.

4.5.1 Comparison between the Impact of construction project risks within different five roles

Table 1 in the Appendix K is a summary comparison of all results shown above, ranking the impact of all selected construction risks between different roles and also with the overall participants. Within the top ten ranked risks as shown in Table 4-10 there are only four common risks were found in the overall ranking and within the different roles. The four common risks are A3, D1, D2 and B2. Risk A3 with title "Improper Project Management" and with overall mean score 4.159 reflect that this risk has an effective impact in the construction industry in Egypt and especially in the shopping malls projects.

Table 4-10, Comparison between the top ten risk impact according to their means, overall impact and the five roles

Overall ranking		Role 1		Role 2		Role 3		Role 4		Role 5	
Risk Code	Mean	Risk Code	Impact Mean	Risk Code	Impact Mean	Risk Code	Impact Mean	Risk Code	Impact Mean	Risk Code	Impact Mean
D1	4.68	D1	4.90	A4	4.83	D1	4.38	D1	4.89	D1	4.55
B2	4.36	B2	4.60	C4	4.67	F3	4.25	B2	4.75	D3	4.27
A1	4.18	D2	4.44	D1	4.67	A1	4.25	A1	4.44	C1	4.18
A3	4.16	F6	4.40	B2	4.60	B2	4.25	A3	4.33	F3	4.18
C4	4.16	F1	4.30	A3	4.50	A3	4.13	D2	4.33	B2	4.09
D2	4.14	F3	4.30	A1	4.50	A7	4.13	B1	4.22	C4	4.00
F3	4.14	A1	4.20	C2	4.33	D2	4.13	C4	4.22	F1	3.91
D3	4.11	D3	4.20	F2	4.33	C5	4.13	B3	4.00	F6	3.91
F6	3.98	A3	4.20	A7	4.33	B3	4.00	F3	4.00	D2	3.82
F1	3.96	D4	4.10	D2	4.17	C1	4.00	A7	4.00	A3	3.82

Within group D there are two common risks within all roles and overall risks D1 and D2, one of them D1 is ranked the most impact risk with overall with mean score 4.68 with title" Financial Ability" for the owner. Financial ability of the owner risk has a very important impact in the shopping mall projects that need strong and stable financial ability. The second risk in group D is risk D2 with title changing needs and with overall score 4.14. Changing needs risk in shopping mall projects is related to the type of such projects that contains a multi tenants with different scales and different activities that push the owner to request a lot of changes to adapt these requirements. The fourth common risk is B2 with title" Cash Shortage" and overall mean score 4.364. Cash shortage means unavailability of sufficient in-house cash flow or of funds from owner to be able to complete the project on time and within budget that considered very sensitive and important for shopping mall projects.

Table 4-11 represent the distribution of the top ten impact risk factors within different roles type in comparison with the overall participant results. Role 2 "Designer Group" select Construction and Design Risk factors are the most risk factors that have impact on the shopping mall projects. Selecting four risk factors out of ten by the designers that include risk A1 "Improper Design", reflect the Designer's perception to the importance of the proper design for shopping mall projects. Role 5 Contractors select only one risk factor A3 "Improper Project Management "from this group that reflect the importance of the proper project management to the Mega projects like shopping mall projects.

Project Managers group select three risk factors out of ten from "Financial and Economic Risks" group that reflect the importance of this factor for any construction management especially in large scale projects like shopping mall projects. Designers group do not consider "Political / Government Risks" have a critical impact in such projects. Owners selected four risk factors from group D that related to their understanding of this group for the criticality of this risk group. Subcontractors-Generated Risks are not existing in the top ten impact risks as a result for the absent of any subcontractor in the survey group to reflect their opinion. The same three risk factors are selected from "Miscellaneous" group within three roles that reflect the importance of these three risks named as follows: F1 "Differing Site Conditions", F3 " Force Majeure" , F6 "Legal Risks".

Table 4-11, Distribution of the top ten impact risks factors within different groups and roles

Group Description		Overall	Role 1	Role 2	Role 3	Role 4	Role 5
Construction and Design Risks	No.	2	2	4	3	3	1
	List	A1,A3	A1, A3	A4, A3, A7, A1	A1, A3, A7	A1, A3, A7	A3
Financial and Economic Risks	No.	1	1	1	2	3	1
	List	B2	B2	B2	B2, B3	B2, B1, B3	B2
Political / Government Risks	No.	1	0	2	2	1	2
	List	C4	0	C4, C2	C5, C1	C4	C4, C1
Client-Generated Risks	No.	3	4	2	2	2	3
	List	D2, D1, D3	D1, D2,D3, D4	D1, D2	D1, D2	D2, D1	D2, D3, D1
Subcontractors-Generated Risks	No.	0	0	0	0	0	0
	List	0	0	0	0	0	0
Miscellaneous	No.	3	3	1	0	1	3
	List	F3, F6, F1	F6,F1, F3	F3	0	F3	F3, F1, F6
Total		10	10	10	10	10	10

4.6 CONSTRUCTION RISKS CRITICALITY

One of the main goals of this research is to achieve a checklist of the most critical risks that face the Egyptian construction industry through analyzing the data collected via the questionnaire survey. The questionnaire survey is composed of six subsections, which collectively includes 30 different construction project risks: (1) construction and design risks; (2) financial and economic risks; (3) political / governmental risks; (4) client-generated risks; (5) subcontractors-generated risks; (6) miscellaneous risks.

The total risk (severity/ criticality of risk) is found by multiplying the probability of a defined risk to occur with the impact it may cause. It can express in a mathematical equation as follows:

Risk (total risk/ severity/criticality of risk) = Probability of its occurrence * Impact of its occurrence. R= P*I

Table 4-12, ranking of the severity of risks according to their means and standard deviations

Rank	Risk Code	Mean	Mode	Median	Min	Max	Range	Standard Deviation	Skewness
1	D1	3.523	4.000	3.200	1.600	5.000	3.400	0.954	0.017
2	A1	3.300	3.200	3.200	1.200	5.000	3.800	1.104	0.009
3	B2	3.268	4.000	3.600	0.800	5.000	4.200	1.202	-0.222
4	D2	3.200	3.200	3.200	0.800	5.000	4.200	0.948	0.161
5	C4	3.082	4.000	3.200	1.200	5.000	3.800	0.942	-0.096
6	A3	3.068	2.400	3.000	0.800	5.000	4.200	1.064	0.133
7	D3	3.005	2.400	3.100	1.000	5.000	4.000	1.120	0.263
8	B1	2.936	3.200	3.200	0.800	5.000	4.200	1.236	0.144
9	C1	2.855	3.200	2.700	0.200	5.000	4.800	1.313	0.260
10	A7	2.850	5.000	2.700	0.200	5.000	4.800	1.300	0.204
11	F6	2.800	3.200	2.700	0.600	5.000	4.400	1.078	0.069
12	A5	2.700	2.400	2.400	1.200	5.000	3.800	0.896	0.616
13	A4	2.691	4.000	3.000	0.200	5.000	4.800	1.423	0.003
14	B3	2.650	3.200	2.400	0.800	5.000	4.200	1.052	0.486
15	F1	2.609	2.400	2.400	0.400	5.000	4.600	1.019	0.280
16	F3	2.518	4.000	2.200	0.600	5.000	4.400	1.132	0.254
17	C2	2.418	3.200	2.400	0.200	5.000	4.800	1.209	-0.069
18	A6	2.364	1.800	2.400	0.800	5.000	4.200	0.869	0.345
19	E1	2.309	2.400	2.400	1.200	5.000	3.800	0.751	0.932
20	D4	2.282	1.600	2.100	0.800	5.000	4.200	1.082	0.868
21	A8	2.232	3.200	1.800	0.600	5.000	4.400	1.021	0.748
22	F2	2.150	2.400	2.400	0.200	5.000	4.800	1.134	0.403
23	C3	2.132	1.800	1.800	0.000	5.000	5.000	1.257	0.814
24	E2	2.123	1.800	1.800	0.800	5.000	4.200	0.945	0.782
25	B4	2.005	1.800	1.800	0.200	5.000	4.800	1.270	0.593
26	E3	1.936	1.800	1.800	0.200	5.000	4.800	1.041	0.674
27	A2	1.877	2.400	1.800	0.000	4.000	4.000	1.009	0.174
28	F4	1.773	1.800	1.800	0.200	5.000	4.800	0.815	1.324
29	C5	1.491	0.200	1.200	0.200	5.000	4.800	1.203	1.270
30	F5	1.432	0.800	1.200	0.200	4.000	3.800	0.934	1.042

The above Table 4-12 lists ranking for all the severity of risks according to their means as well as revealing their median, mode, standard deviation, skewness and range. Additionally, some of these risks have the same mean value, and therefore the value of the standard deviation will then be the deciding factor for the particular risk's ranking. The risk factor D1 with title "Financial Ability" has the most critical score 3.52 that reflect very important issue related to the type of shopping mall projects that require strong financial ability from the client to complete such expensive projects.
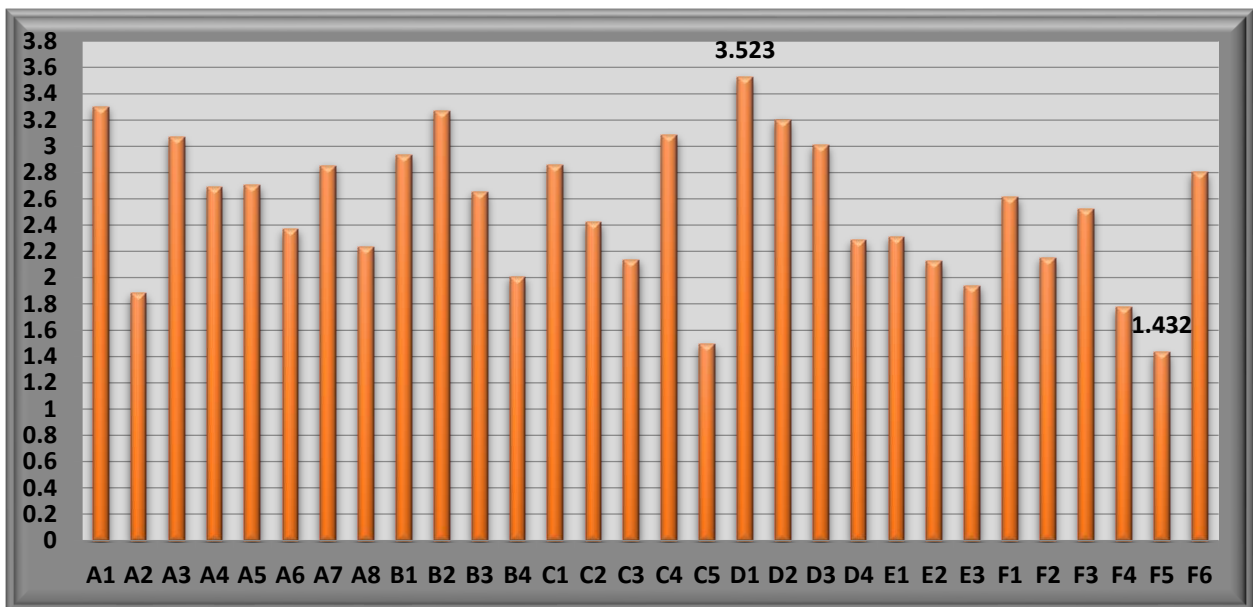
Figure 4-7, The means of all risk factors

The lowest one is risk factor F5 with title "Environmental Protection" with score 1.432 that reflects poor attention to environmental issues. Figure 4-7 represents the mean value for each thirty risk factors that were chosen for our survey and shows the highest value is 3.52 for risk D1 and the lowest value is 1.4 for risk factor F5. Out of the total 30 risks examined, 16 risks, from different risk groups, have a total risk mean of 2.5 or greater (2.5 is the mean of the 30 risk's means); their distribution among the six risk groups is as shown in Table 4-13.

Table 4-13, Breakdown of most critical risks within risk group

Risk Category	Risk Symbol	Number of Risks in group	Risks with Criticality Mean >2.5	%
Construction and Design Risks	A	8	5	62.50%
Financial and Economic Risks	B	4	3	75.00%
Political / Governmental Risks	C	5	2	40.00%
Client-Generated Risks	D	4	3	75.00%
Subcontractors-Generated Risks	E	3	0	0.00%
Miscellaneous Risks	F	6	3	50.00%
Total		30	16	53.33%

The three risk groups A,B &D have the highest percentage of risks with means equal or more than 2.5 as follows: (1) Construction and Design Risks that contains 5 risk factors out of 8, with percentage 62.5%, with means equal or greater than 2.5 that reflect the importance of this group that related to a very critical and sensitive group that belong to the design issues and construction process that always have a lot of risk factors; (2) Financial and Economic Risks that contains 3 risk factors out of 4 ,with high percentage 75%,with means equal or greater than 2.5 that reflect the importance of this group that related to financial and economic risks that can affect deeply in expensive and high quality projects such as our concern shopping mall projects; and (3) Client-Generated Risks are remarkably more critical than the other three risk group.

It has 3 risk factors out of four, with high percentage 75%, with means equal or greater than 2.5 that reflect the importance of this group that related to the client risks or the owner risk factors of the project that can affect directly in such sensitive shopping mall projects. In conclusion, the three groups have totally 11 out of the 16 most critical risks with percentage around 69% that mean this group considered the most criticality groups in shopping mall projects.

4.6.1 CRITICAL RISKS WITHIN DIFFERENT ROLES

A comparison of the risks criticality based on different roles characteristics is presented in Table 4-14. Within risk group A the highest percentage is found within the Project Managers group that matches with the duties of this group to manage mainly construction process. Group B that belong to "Financial and Economic Risks" is evaluated critical with percentage 75% within the three different groups due to the importance of this group. Political / Governmental Risks are evaluated less critical than the other groups with percentage only 60% within two different roles. Subcontractors-Generated Risks do not exist within the critical risks (mean values are less than 2.5). Also Miscellaneous Risks group has low percentages within the different roles with max percentage value equal 50% within three roles.

Table 4-14, Comparing of the most risk criticality (with mean more than 2.5) per group among the different role participates

Risk Category	Risk Symbol	Overall %	Role 1 %	Role 2 %	Role 3 %	Role 4 %	Role 5 %
Construction and Design Risks	A	62.50%	62.50%	62.50%	50.00%	75.00%	62.50%
Financial and Economic Risks	B	75.00%	75.00%	50.00%	75.00%	75.00%	50.00%
Political / Governmental Risks	C	40.00%	60.00%	60.00%	40.00%	60.00%	40.00%
Client-Generated Risks	D	75.00%	75.00%	100.00%	75.00%	75.00%	75.00%
Subcontractors-Generated Risks	E	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Miscellaneous Risks	F	50.00%	50.00%	50.00%	33.33%	16.67%	33.33%

As shown in Figure 4-8 the different participants are: (1) Role 1 is the Owner's group; (2) Role 2 is the Designer's group; (3) Role 3 is the Consultant's group; (4) Role 4 is Project Manager's group; (5) Role 5 is the Contractor's group and the calculated percentage of the number of risks per group with mean value equal or more than 2.5. Owners group consider "Financial and Economic Risks" and "Client-Generated Risks" are the most critical groups same as Consultants group. Designers group selects all Client-Generated Risks as critical risks. Project Managers group

select three groups as critical groups group A, group B and group D. Contractors group selects Client-Generated Risks as the critical one.
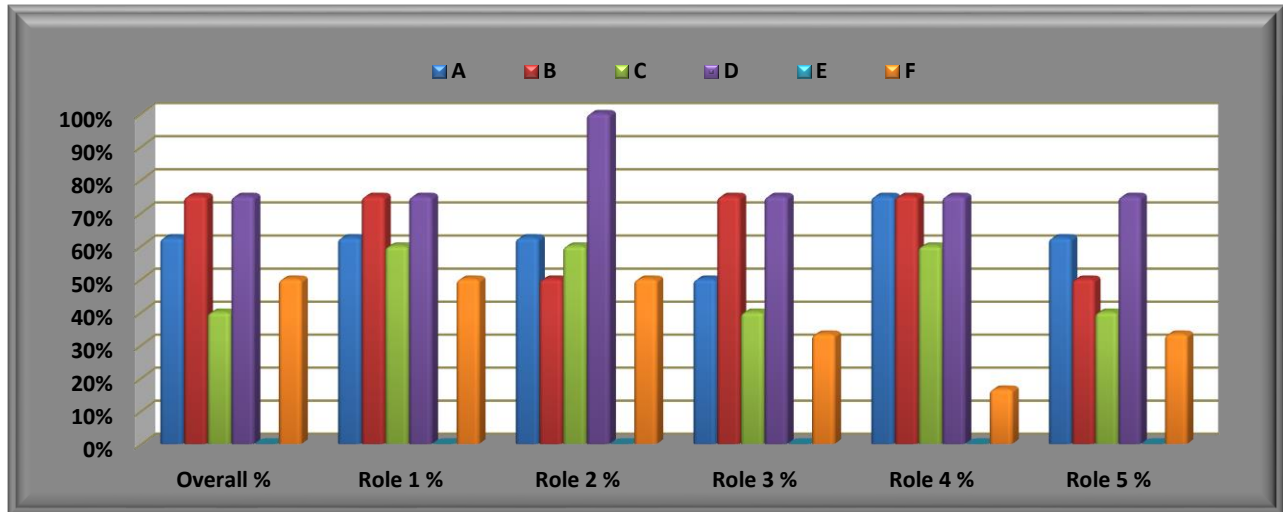
Figure 4-8, Comparing the percentage of the number of risks per group more than 2.5 among the different role participates

4.6.2 TOP TEN CRITICAL RISKS DISTRUBUTION WITHIN DIFFERENT GROUPS

Top ten risks distribution within the different groups as shown in Table 4-15 reflects that groups A & D are more critical than the other four risk groups, whereas, they exclusively include 6 out of ten most critical risks. Group D includes risks that related to Client-Generated Risks that consider the most impact risks for the most construction projects. The three risk factors within group D are D1that related to "Financial Ability", D2 that related to "Changing Needs" and D3 that related to "Claims". The second group is "Group A" that related to the Construction and Design Risks factors. The three risk factors within group A are A1 that related to "Improper Design", A3 that related to "Improper Project Management and A7 that related to "Resources Unavailability". More discussion will be indicated comparing between the top ten risks overall the survey (that indicated as overall results) compared with the top ten risks within different roles who participate in our survey to reflect the difference importance between them.

Table 4-15, Listing the number of critical top ten risks within each group

Serial	Group Code	Group Description	No. of Risks	List	Percentage
1	A	**Construction and Design Risks**	3	A1,A3, A7	30%
2	B	**Financial and economic Risks**	2	B2,B1	20%
3	C	**Political / Government Risks**	2	C1, C4	20%
4	D	**Client- Generated Risks**	3	D2, D1, D3	30%
5	E	**Subcontractors-Generated Risks**	0	0	0
6	F	**Miscellaneous**	0	0	0
		Total	**10**		**100%**

4.6.3 TOP TEN CRITICAL RISKS WITHIN DIFFERENT ROLES

Table 4-16, showing the overall top ten risks compared with the ranking for the different roles that indicates the follows:

There are five common risk factors within the list of top ten critical risks between different roles and also with the overall risk factors as follows: (1) risk D1 with title "Financial Ability"; (2) risk A1 with title "Improper Design" ;(3) risk B2 with title "Cash Shortage"; (4) risk C4 with title "Approvals and Permits"; (5) risk A3 with title "Improper Project Management". Two risk factors out of the common five risks are related to the construction and design group (A1 & A3) that reflect the agreement of all parties that the construction and design issues are very risky, also the client or the owner of the project is very important for any project that improved by selecting the financial ability of the client is the most critical factor within 30 risk factors (D1) and also risk (B2) that related to cash shortage, both of them are related to the owner. Approvals and permits are very important for the construction process and can affect badly and delay any project if it does not deal properly.

Table 4-16, Shows comparative analysis for the top ten risks between main parties- main roles

Ranking	Total Ranked Risk Overall		Total Ranked Risk Role 1		Total Ranked Risk Role 2		Total Ranked Risk Role 3		Total Ranked Risk Role 4		Total Ranked Risk Role 5	
	Risk Code	Mean	Risk Code	Mean	Risk Code	Mean	Risk Code	Mean	Risk Code	Mean	Risk Code	Mean
1	D1	3.523	D1	3.820	D1	4.067	A1	3.525	B2	3.850	D3	3.309
2	A1	3.300	B2	3.480	C4	3.733	D2	3.425	A1	3.600	D1	3.273
3	B2	3.268	D2	3.470	A4	3.700	A3	3.325	D1	3.578	C1	3.182
4	D2	3.200	A1	3.420	A1	3.467	A7	3.300	B1	3.467	C4	3.018
5	C4	3.082	F6	3.240	A3	3.433	D3	3.125	D2	3.378	B2	2.945
6	A3	3.068	B1	3.100	B2	3.360	B2	3.100	A3	3.244	D2	2.891
7	D3	3.005	F1	3.060	C2	3.300	B3	3.029	C4	2.956	A7	2.836
8	B1	2.936	F3	3.000	A7	3.233	D1	3.025	B3	2.950	A1	2.691
9	C1	2.855	C4	2.960	F2	3.233	C4	2.975	F6	2.867	A4	2.691
10	A7	2.850	A3	2.960	C3	3.100	C1	2.925	A6	2.822	A3	2.636

4.7 ANOVA OF RISK CRITICALITY

In this section the means on inferential statistics are applied upon the results of the severity/criticality of risks scores presented earlier in order to be able to generalize the findings of this research to the whole population instead of just the sample selected. Therefore, three ANOVA analyses were employed to define if there is any significant variance between the responses of the Egyptian construction participants' base on: 1) Roles Types, 2) Participants' Position types 3) Number of years of work experience. The three ANOVA analyses were performed on Microsoft Excel (2003) at:

- 5% significance level
- Using an F-distribution
- Null hypothesis: all different roles means are equal,

- Alternative hypothesis: at least one role type mean is different from the rest.
- if F > F crit, the null hypothesis is rejected
- if F < F crit, the null hypothesis is accepted
- if P-value < α (α = 5% significance level) the null hypothesis is rejected
- if P-value > α (α = 5% significance level) the null hypothesis accepted

A printout of the complete analyses presented forth is included in Appendix H

4.7.1 ANOVA Analysis to the Severity of Risks According to the Participants' Role Types

Tables from 1 to 6 in Appendix H show the ANOVA analysis according to Roles Types (1-Owner, 2- Designer, 3- Consultant, 4- Project Manager, 5- Contractor).
Tables from 1 to 6 Appendix H demonstrate that for the different Participants' Roles and at 5% level of significant, there is no significant difference in the results between different roles (in all roles types: F < F crit and P-value > α) and the null hypothesis is accepted. In other words, it has been approved by means of statically significant that the different Egyptian participants' roles from 1 to 5 in the Egyptian construction industry perceive the construction risks studied in this research equally.

4.7.2 ANOVA Analysis to the Severity of Risks According to the Participants' Position Types

Tables from 7 to 12 Appendix H show the ANOVA analysis according to participant position (1- Executive, 2- Project Manager, 3- Department Head, 4- Architect / Engineer).
Tables from7 to 4-12 demonstrate that the different positions types and at a 5 % level of significance, there is no significant difference in the results between different positions (in all Participants' Position Types: F < F crit and P-value > α) and the null hypothesis is accepted. In other word, it has been approved by means of statistical significance that the different positions for the participants perceive the construction risks studied in this study equally.

4.7.3 ANOVA Analysis to the Severity of Risks According to Number of Years of Work Experience

Tables from 13 to 18 Appendix H show the ANOVA analysis according to number of years of work experience (1) Less than 5 years, 2) 5-10 years, 3) 10-15 years, 4) 15-20 years, 5) more than 20 years). Tables 13 through 18 demonstrate that the different number of years of work experience types and at a 5 % level of significance, there is no significant difference in the results between different numbers of years of work experience for three groups. Two groups: Construction and Design Risks group and for Subcontractors- Generated risks group have: F > F crit and P-value < α that means as indicated above the null hypnosis is rejected. In other word, it has been approved by means of statistical significance that the different numbers of years of work experience for the participants perceive the construction risks studied in this study equally except for the Construction and Design risks and for Subcontractors- Generated risks.

Table 4-17, Summary of the ANOVA analysis results

Ser.	Risk Group	Role Type		Position Type		Years Of Experience	
		F	F crit	F	F crit	F	F crit
1	Construction and Design Risks Group A	1.5457	2.6415	2.3122	2.9467	2.6470	2.6415
2	Financial and economic Risks Group B	1.5461	3.0556	0.2846	3.4903	1.2243	3.0556
3	Political / Government Risks Group C	0.3422	2.8661	0.4181	3.2389	0.4406	2.8661
4	Client- Generated Risks Group D	0.3140	3.0556	0.1815	3.4903	1.3873	3.0556
5	Subcontractors- Generated Risks Group E	1.5556	3.4780	0.0856	4.0662	5.4107	3.4780
6	Miscellaneous Group F	0.3622	2.7587	0.5465	3.0984	0.7701	2.7587

Table 4-17 summarize the three ANOVA analysis that were conducted to define if there is any significant variance between respondents in the Egyptian construction industry for: Roles Types;

Participant's Position Types; Number of years of experience. In two sets: Roles Types and Positions Types the null hypnosis is accepted that the different Roles Types and Positions Types for the participants perceive the construction risks studied in this study equally (F < F crit and P-value > α). Examining number of years of experience resulted two groups: Construction and Design Risks Group A and Subcontractors-Generated Risks Group E have with F > F crit and P-value < α. That means the different numbers of years of work experience for the participants perceive the construction risks equally except for the Construction and Design risk factors and for Subcontractors- Generated risk factors.

4.8 RISK RESPONSE METHODS EFFECTIVNESS

The fourth objective of this study is to identify the risk response methods (mitigation methods) related to the Mega shopping mall projects in the construction industry in Egypt and their effectiveness. As previously mentioned, the questionnaire survey is divided of six subsections, which collectively includes 150 response methods for the 30 different construction project risks as listed in Table 4-18. A scale of effectiveness from 1 (not effective) to 5 (extremely effective) was provided for the participants' selection. The 150 response methods are from the four response techniques: elimination, transfer, reduction, retention.

Table 4-18, Number of risks within different groups and the number of associated response measures

ser.	Code	List of Groups	No. of Risks	Response Codes	No. of mitigation methods
1	Group A	Construction and design risks	8	From A11 to A85	43
2	Group B	Financial and economic risks	4	From B11 to B45	23
3	Group C	Political / Government risks	5	From C11 to C54	29
4	Group D	Client-Generated risks	4	From D11 to D44	17
5	Group E	Subcontractors-generated risks	3	From E11 to E34	14
6	Group F	Miscellaneous risks	6	From F11 to F64	24
		Total	**30**		**150**

Table 4-19, List of the 30 risks along with the highest response's method against every risk

Ser.	Risk Data		Mitigation Analysis Data								
	Risk Code	Total risk Mean	Highest Associated Mitigation Code	Mean	Mode	Median	Min	Max	Range	Standard Deviation	Skewness
1	A1	3.3	A11	3.364	3	3	1	5	4	0.932	-0.106
2	A2	1.8773	A25	2.818	4	3	1	5	4	1.154	-0.086
3	A3	3.0682	A31	3.932	4	4	1	5	4	0.889	-0.642
4	A4	2.6909	A42	3.705	4	4	2	5	3	0.894	-0.15
5	A5	2.7	A54	3.841	4	4	2	5	3	0.851	-0.354
6	A6	2.3636	A61	3.739	4	4	2	5	3	0.836	-0.154
7	A7	2.85	A77	3.659	4	4	1	5	4	1.086	-0.465
8	A8	2.2318	A85	3.841	4	4	2	5	3	0.928	-0.362
9	B1	2.9364	B14	3.682	4	4	1	5	4	1.103	-0.465
10	B2	3.2682	B24	3.818	4	4	2	5	3	0.886	-0.421
11	B3	2.65	B35	3.568	3	3.5	2	5	3	0.863	0.107
12	B4	2.0045	B45	3.5	3	3.5	1	5	4	0.917	-0.265
13	C1	2.8545	C11	3.523	4	4	1	5	4	0.965	-0.444
14	C2	2.4182	C24	3.558	4	4	1	5	4	0.897	-0.948
15	C3	2.1318	C36	3.818	4	4	2	5	3	0.96	-0.401
16	C4	3.0818	C41	3.955	4	4	2	5	3	0.824	-0.402
17	C5	1.4909	C54	2.886	2	3	1	5	4	1.152	0.223
18	D1	3.5227	D11	4.295	5	4	3	5	2	0.725	-0.516
19	D2	3.2	D24	4.091	4	4	1	5	4	0.874	-0.993
20	D3	3.0045	D35	3.977	5	4	1	5	4	1.055	-0.651
21	D4	2.2818	D41	4	5	4	2	5	3	0.905	-0.184
22	E1	2.3091	E13	3.932	4	4	2	5	3	0.809	-0.39
23	E2	2.1227	E22	3.409	3	3	2	5	3	0.984	0.111
24	E3	1.9364	E31	3.818	4	4	2	5	3	0.911	-0.174
25	F1	2.6091	F11	3.818	4	4	2	5	3	0.805	-0.181
26	F2	2.15	F21	3.932	4	4	1	5	4	0.889	-0.642
27	F3	2.5182	F31	3.659	4	4	1	5	4	1.043	-0.366
28	F4	1.7727	F41	3.864	5	4	1	5	4	0.991	-0.566
29	F5	1.4318	F53	3.364	3	3	1	5	4	1.11	-0.153
30	F6	2.8	F61	4.023	5	4	2	5	3	0.866	-0.254

The means of descriptive analysis were performed on the data collected from the respondents concerning the risk response method to obtain the mean, median, mode, stander deviation, skewness, and range. The list of the highest response employed for each of the 30 risk is listed in Table 4-19 along with the all responses' statistical analysis.

4.9 EFFECTIVE RISK RESPONSE TECHNIQUES EMPLOYED IN EGYPT

Table 3-2, which presented earlier in subsection 3.2.5, showed grouping of the 150 risk response techniques they follow and the risk category/group that these risk response methods are assumed to eliminate / mitigate their impact. However, after completing the statistical analysis presented above, not all the 150 risk response methods were found to be effective. Furthermore, it is desirable to decide if there is any difference between the perceptions of different participants towards the effectiveness of these risk response methods.

Table 4-20, Number of effective risk response techniques with means ≥ 3 per each risk category

Group Description	Elimination		Transfer		Reduction		Retention		Total	
	No. Effective Methods	% Effective Methods	No. of effective methods	% of effective methods	No. of effective methods	% of effective methods	No. of Effective methods	% Effective Methods	Total No.	% Total
Construction and Design Risks	3	50%	2	29%	14	70%	6	60%	25	58%
Financial and economic Risks	5	100%	0	0%	10	56%	0	0%	15	65%
Political / Government Risks	4	80%	1	33%	7	39%	2	67%	14	48%
Client-Generated Risks	4	80%	0	0%	6	100%	3	50%	13	76%
Subcontractors-Generated Risks	0	0%	1	33%	8	80%	0	0%	9	64%
Miscellaneous	4	80%	3	100%	12	86%	1	50%	20	83%
Total/ affective total Technique	20	21%	7	7 %	57	59%	12	13%	96	64%

Table 4-20 an update of Table 3-2 but showing the percentage of the effective risk response method, which have mean effectiveness score equal to or greater than 3.00, to the total number of response techniques included in the research study, as per Table 3-2, per each category. As can be implied from Table 4-20, only 96 of the 150 response methods considered in this research were found to be effective, resulting in a percentage of 64%.
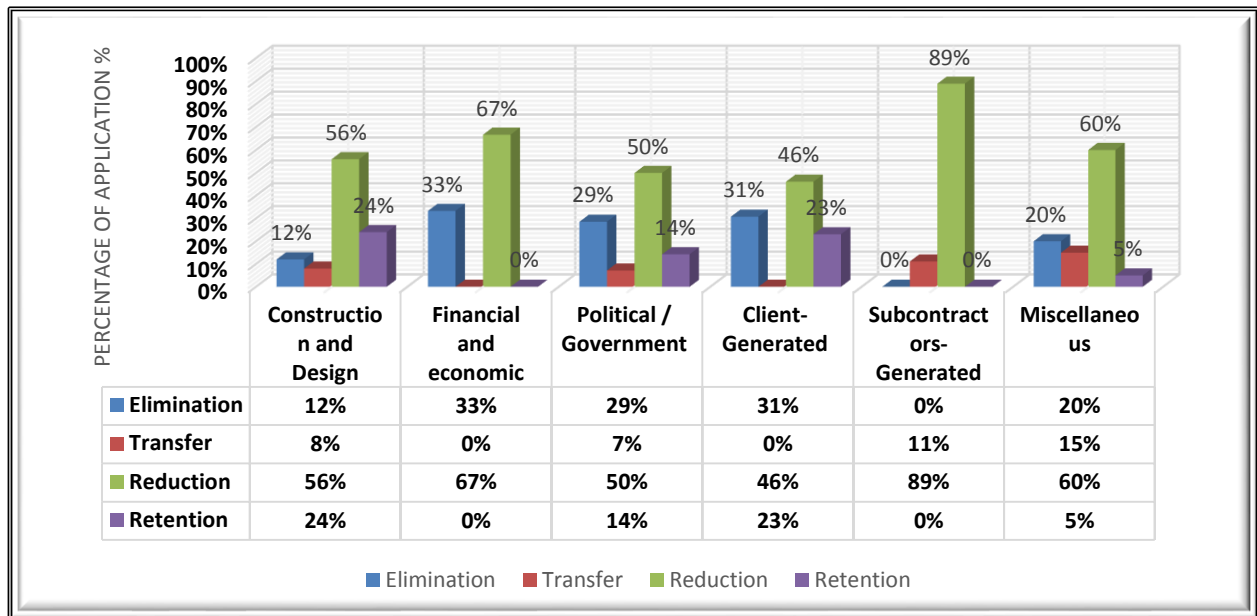
Figure 4-9, Effective risk response techniques employed in Egypt

Figure 4-9 describes the percentage of the risk response technique employed for each risk category. It is noted that reduction technique is the most popular one within all risk groups scoring 89% as a proper tool to mitigate Subcontractors-Generated risks group. The second tool is the elimination technique within the different risk groups.

4.9.1 Studying effective risk response techniques employed by different roles in Egypt

Risk response techniques that are perceived as effectively working by different roles to eliminate/mitigate the consequences of risks may differ between participants according to the participants' roles. Tables 4-21 presents the number of risk response methods which have mean effectiveness score equal to or greater than 3.00, perceived as effectively working by different roles per each risk response technique. According to Table 4-21, the number of effective risk response method employed by the role1, role2 and role4 are higher than those presented in Table 4-20 for the Egyptian construction industry in general. On the other hand, the number of effective

risk response method employed by the role3 and role5 are lesser than those presented in Table 4-20 for the Egyptian construction industry in general.

Table 4-21, Number of effective risk response techniques within different roles

Response technique	Role1	Role2	Role3	Role4	Role5
Elimination	20	21	17	22	15
Transfer	9	14	6	14	6
Reduction	54	68	49	66	48
Retention	15	18	12	16	11
Total	98	121	84	118	80
%	65%	81%	56%	79%	53%

Meanwhile, Figure 4-10, shows the percentage of the effective risk response methods employed by the different Egyptian participants' roles under each risk response techniques to the total number of risk response methods.

	Role1	Role2	Role3	Role4	Role5
Elimination	20%	17%	20%	19%	19%
Transfer	9%	12%	7%	12%	8%
Reduction	55%	56%	58%	56%	60%
Retention	15%	15%	14%	14%	14%
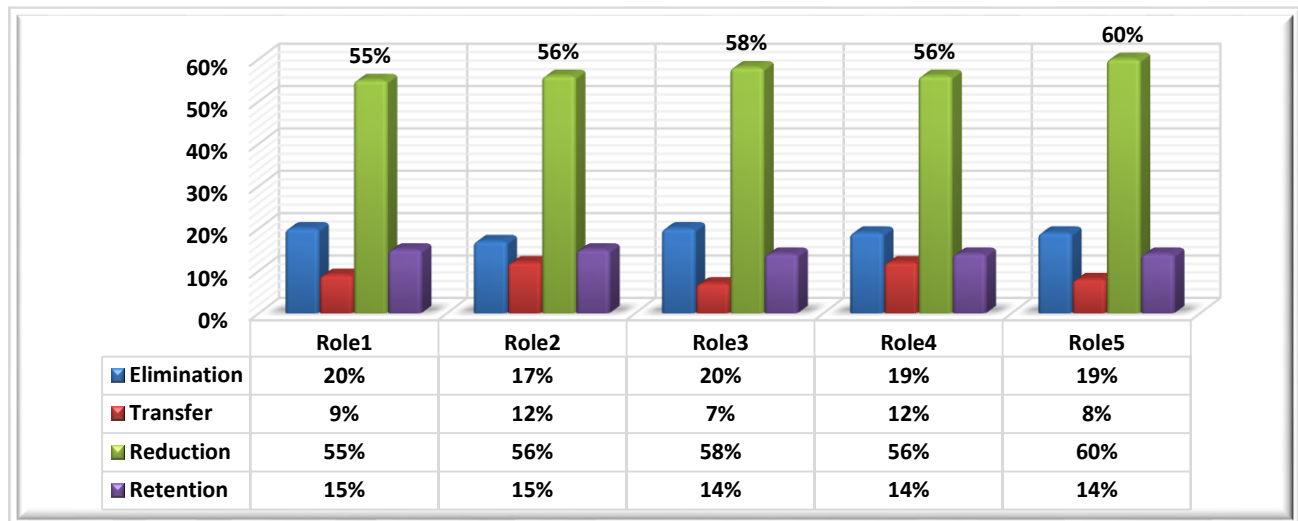
Figure 4-10, Percentage of effective risk response techniques employed by different roles

Reduction technique is the popular and has the highest percentages among different groups with the highest percentage equal 60% within Role 5. That means in the Mega shopping mall projects in Egypt reduction measures are the most popular tool to mitigate risks.

4.10 COMPARISON WITH THE EGYPTIAN MARKET

As mentioned before, Orabi's (2003) risk identification and assessment of their associated mitigation measures for Egyptian construction industry, is the closet and most comparable to this research. The advantage of this comparison with Orabi's study, as already explained contain most of the risks that have been examined in this research, but in another time period and in other circumstances experienced by the country now from the revolutions and unrest of the order, such incidents changed the importance and ranking of some of the risks as will be explained in detail in this section. Moreover, Orabi's study was conducted in 2003, eleven years before this study, targeting large scale domestic, international and multinationals contractors group only, but on the other hand, this study targets the first category of different roles in the Egyptian construction industry. This comparison is made of all the 30 risk factors and some of the risk factors of this study are not applicable to Orabi's (2003) study, but the majority of the risks as shows below are comparable.

Table 4-22 shows that the most critical risk factors (top ten most critical risks) in both research are almost the same with slight different in risks' orders. Financial ability of the client risk is the most critical risk in the both studies. Each study identifies same seven risks in the top ten list of the other study. Only three risk factors are different within the top ten risk factors that relate to the changing needs risk factor that can be very critical in some projects such as shopping mall projects. Political instability risk's order is changed from twenty seven to be nine in this study that reflect how the country is still suffering from serious internal conflict. Approvals and Permits risk is found in both studies with ranking much higher in this study due to the sensitivity of shopping mall projects.

Table 4-22, Comparison of this research's results with the results of Orabi's (2003) research

Ser.	Risk Description	Risk Code	This Study	Orabi Study
1	Financial Ability	D1	1	1
2	Improper Design	A1	2	6
3	Cash Shortage	B2	3	4
4	Changing Needs	D2	4	24
5	Approvals and Permits	C4	5	13
6	Improper Project Management	A3	6	2
7	Claims	D3	7	7
8	Foreign Exchange and Convertibility	B1	8	5
9	Political Instability	C1	9	27
10	Resources Unavailability	A7	10	8
11	Legal Risks	F6	11	N/A
12	Low Construction Productivity	A5	12	15
13	Site Safety	A4	13	17
14	Inflation and Interest Rate	B3	14	3
15	Differing Site Conditions	F1	15	23
16	Force Majeure	F3	16	18
17	Change in Laws	C2	17	19
18	Defective Work	A6	18	9
19	Technical qualifications	E1	19	10
20	Possession of site	D4	20	25
21	Defective Material	A8	21	12
22	Physical Damages	F2	22	29
23	Corruption	C3	23	21
24	Financial Ability for subcontractors	E2	24	22
25	Competition	B4	25	16
26	Variation of Bids	E3	26	20
27	Constructability	A2	27	26
28	Partnership	F4	28	14
29	Expropriation	C5	29	11
30	Environmental Protection	F5	30	28

4.11. COMPARISON WITH THE INERNATIONAL MARKET

The fifth objective of this research is to compare the nature of construction risks encountered in the Egyptian market to data extracted from literature for other international construction market. As was mentioned earlier in Section 2.10, four researches followed a similar methodology to this research's. The first research was Alwan (2006) that targeted Sudanese' construction industry market and the second research was conducted by El-Sayegh (2007) that identifies and assesses the significant risks in the UAE. Finally, the fourth research was conducted by Tang et al. (2007) who reports the findings of an empirical Chinese industry survey on the importance of project risks, application of risk management techniques, status of the risk management system, and the barriers to risk management, which were perceived by the main project participants. This research conduct the comparison with three similar studies that more closely to this study.

4.11.1. Comparison with the international market- Sudanese construction industry

This research focuses on the identification of risks and their respective mitigation measures for construction projects in a developing country, namely Sudan. This comparison is made of all the 30 risk factors and some of the risk factors of this study are not applicable to Alwan's (2006) study, but the majority of the risks as shows below are comparable. Table 4-23 shows that each study identifies six risks in the top ten list of the other study. Only two risk factors are different within the top ten risk factors and only one risk factor was not found in the other research. Improper project management was found less important in the Alwan's (2007) study and also foreign exchange and convertibility was ranked leas critical in Sudanese construction industry.

Financial ability is the most critical risk in both studies that reflect the importance of this risk within the construction industry. Changing needs ranking almost the same also Approvals and Permits risk is the same. Political Instability is the same ranking in both studies because both of them has unrest conditions. Resources Unavailability is ranked as the tenth critical risk factor in both studies that reflects the same resource problems that can be found in the developing countries like Egypt and Sudan.

95

Table 4-23, Comparison of this research's results with the results of Alwan's (2006) research

Ser.	Risk Description	Risk Code	Study ranking	Alwan ranking
1	Financial Ability	D1	1	1
2	Improper Design	A1	2	7
3	Cash Shortage	B2	3	6
4	Changing Needs	D2	4	3
5	Approvals and Permits	C4	5	4
6	Improper Project Management	A3	6	13
7	Claims	D3	7	N/A
8	Foreign Exchange and Convertibility	B1	8	14
9	Political Instability	C1	9	9
10	Resources Unavailability	A7	10	10
11	Legal Risks	F6	11	N/A
12	Low Construction Productivity	A5	12	N/A
13	Site Safety	A4	13	18
14	Inflation and Interest Rate	B3	14	2
15	Differing Site Conditions	F1	15	N/A
16	Force Majeure	F3	16	26
17	Change in Laws	C2	17	19
18	Defective Work	A6	18	N/A
19	Technical qualifications	E1	19	5
20	Possession of site	D4	20	18
21	Defective Material	A8	21	N/A
22	Physical Damages	F2	22	24
23	Corruption	C3	23	8
24	Financial Ability for subcontractors	E2	24	N/A
25	Competition	B4	25	N/A
26	Variation of Bids	E3	26	N/A
27	Constructability	A2	27	15
28	Partnership	F4	28	17
29	Expropriation	C5	29	N/A
30	Environmental Protection	F5	30	28

4.11.2. Comparison with the international market- UEA construction industry

This study, is conducted by El- Sayegh (2007), identifies and assesses the significant risk in the UEA construction industry and addresses their proper allocation. Data were collected through a questionnaire distributed to construction expert that makes this study is closed to this research since both researches target construction experts. Moreover, there is also an agreement in culture, language and customs as well as the number of the Egyptian engineers who have worked or are still working there is not a little, and therefore many of the circumstances are common between the two countries.

This comparison is made for all the 30 risk factors and some of the risk factors of this study are not applicable to El- Sayegh (2007) study, but the majority of the risks as shows above are comparable. Table 4-24 shows that each study identifies same three critical risks within the top ten list of the other study in different orders. Three risk factors in El- Sayegh's (2007) study are not most critical factors within the top ten risk factors and three risks factor are not found in the other research. Financial ability risk is not found in the other study because UEA does not face such financial problems in construction industry. Improper design is found less important in the El- Sayegh (2007) study, and also foreign exchange and convertibility was ranked leas critical in UEA construction industry. Changing Needs is critical risk in both studies that reflect the existing of this risk in both construction industry.

Table 4-24, Comparison of this research's results with the results of El-Sayegh's (2007) research

Ser.	Risk Description	Risk Code	This Study	El-Sayegh Study
1	Financial Ability	D1	1	N/A
2	Improper Design	A1	2	16
3	Cash Shortage	B2	3	14
4	Changing Needs	D2	4	5
5	Approvals and Permits	C4	5	8
6	Improper Project Management	A3	6	N/A
7	Claims	D3	7	12
8	Foreign Exchange and Convertibility	B1	8	32
9	Political Instability	C1	9	N/A
10	Resources Unavailability	A7	10	7
11	Legal Risks	F6	11	22
12	Low Construction Productivity	A5	12	20
13	Site Safety	A4	13	N/A
14	Inflation and Interest Rate	B3	14	1
15	Differing Site Conditions	F1	15	30
16	Force Majeure	F3	16	34
17	Change in Laws	C2	17	35
18	Defective Work	A6	18	25
19	Technical qualifications	E1	19	N/A
20	Possession of site	D4	20	26
21	Defective Material	A8	21	21
22	Physical Damages	F2	22	33
23	Corruption	C3	23	37
24	Financial Ability for subcontractors	E2	24	N/A
25	Competition	B4	25	N/A
26	Variation of Bids	E3	26	23
27	Constructability	A2	27	27
28	Partnership	F4	28	N/A
29	Expropriation	C5	29	N/A
30	Environmental Protection	F5	30	N/A

4.11.3. Comparison with the international market- in the Chinese Construction Industry

In similar studies, Tang et al. (2007) conducted a study to report the findings of an empirical Chinese industry survey on the importance of project risks, application of risk management techniques, status of the risk management system, and the barriers to risk management, which were perceived by the main project participants. This comparison is made of all the 30 risk factors and some of the risk factors of this study are not applicable to Youmei et al. (2007) study, but the majority of the risks as shows below are comparable.

Table 4-25 shows that each study identifies five risks in the top ten list of the other study. Three risk factors in the Youmei et al. (2007) study are less in ranking within the top ten risk factors and two risk factors are not found in the other research. The top three risk factors are existing in both studies with slight difference in the ranking order. Changing Needs risk is not found in Youmei et al. (2007) study also Political Instability is not found. Claims risk is found less important in the Youmei et al. (2007) study, and also foreign exchange and convertibility is ranked leas critical in Chinese Construction Industry that means Chinese Construction Industry do not suffer from foreign exchange risk. Also Resource Unavailability is less criticality in the Chinese Construction Industry. Approvals and Permits risk and Improper Project Management risk both risks are found in both studies with slightly deference in the ranking position that means both countries have the same risk in equal severity.

Table 4-25, Comparison of this research's results with the results of Tang et al. (2007) research

Ser.	Risk Description	Risk Code	This Study	Tang's Study
1	Financial Ability	D1	1	5
2	Improper Design	A1	2	4
3	Cash Shortage	B2	3	5
4	Changing Needs	D2	4	N/A
5	Approvals and Permits	C4	5	9
6	Improper Project Management	A3	6	9
7	Claims	D3	7	11
8	Foreign Exchange and Convertibility	B1	8	21
9	Political Instability	C1	9	N/A
10	Resources Unavailability	A7	10	15
11	Legal Risks	F6	11	N/A
12	Low Construction Productivity	A5	12	7
13	Site Safety	A4	13	3
14	Inflation and Interest Rate	B3	14	N/A
15	Differing Site Conditions	F1	15	13
16	Force Majeure	F3	16	8
17	Change in Laws	C2	17	19
18	Defective Work	A6	18	23
19	Technical qualifications	E1	19	12
20	Possession of site	D4	20	31
21	Defective Material	A8	21	N/A
22	Physical Damages	F2	22	N/A
23	Corruption	C3	23	N/A
24	Financial Ability	E2	24	N/A
25	Competition	B4	25	N/A
26	Variation of Bids	E3	26	N/A
27	Constructability	A2	27	14
28	Partnership	F4	28	N/A
29	Expropriation	C5	29	N/A
30	Environmental Protection	F5	30	30

4.12 USER-FRIENDLY SPREADSHEET SUMMARY FILE

The fourth objective of this research is to develop a simple spreadsheet file that summarizes the findings of this study, which could be a helpful tool in the preparation of effective risk management in the Egyptian construction industry for all participants washing to prepare an effective risk management process for new projects. All findings in section 4.6, Construction Project Risks Criticality and section 4.8 Risk Response Method Effectiveness were collected   and summarized in Microsoft Excel workbook. This workbook contains nine worksheets,: 1) the first worksheet is a welcome screen that gives the user two options: either (1) to view risks classified according to nature or (2) to view risks ranked according to their mean criticality. The second worksheet lists the name of the six risk categories: (A) Construction and Design; (B) Financial and economic; (C) Political / Government; (D) Client- Generated; (E) Subcontractors-Generated Risk; and (F) Miscellaneous risks. The third worksheet lists the 30 construction risks that were concerned for this research in a descending order according to their criticality mean scores. The remaining six worksheets are for the six categories and the response methods associated with each risk.

The file works with hyperlink shortcuts, one click over an option leads to the worksheet of the option. For example, if the name of the foreign and exchange rate risk was clicked from either the risks rating worksheet or the financial and economic risks worksheet, it will lead to the response methods associated with the said risk in the worksheet of the financial and economic risks.

Other hyperlink shortcuts were added on the workbook to ease the navigation process, e.g. links to the welcome page or the top of each worksheet. A complete printout of the worksheets of this spreadsheet is included in Appendix D

5.0 STUDY OF ACTUAL SHOPPING MALL PROJECT'S CONTRACTS

5.1 VALIDATION OF THE TOP TEN RISK FACTORS WITH REAL CASE CONTRACTS' CLAUSES

The last objective in this study is examining how a sample of contracts responded to the most critical risks in these kinds of specialized projects (top ten critical ranked risks in this study) by analyzing-selected but important commercial shopping malls projects either finished or under construction in Egypt as case studies.

Three projects were selected for this study, all of them are considered as a Super Regional Center projects with same featured described in chapter 3. For the confidentiality issues all the following data are cancelled from the Contract's Clauses and from the interpretations as well: the project name, exact location, Contract Price, Owner's name, Contractor's name and any similar data may be considered confidential to any party of these Contracts. Thus the three projects are indicated as: Project # 1, Project # 2 and Project # 3.

The following documents were examined for each of the three Contracts:

- Contract Agreement
- Contract Data
- Condition of Contract (General and Particular)

The three Contracts are a re-measured Contracts and use the Fédération Internationale des Ingénieurs Conseils (FIDIC) for the condition of contract as follows:

- **For Projects' Contracts Number 1 & 2**:
  - o **Part I (General Conditions):** The General Conditions of Contract is considered the Conditions of Contract for Works of Civil Engineering Construction, Part 1, Fourth Edition 1987; (reprinted 1992 with editorial amendment) published by the Fédération Internationale des Ingénieurs Conseils (FIDIC).

- o   **Part II Conditions of Particular Applications:** The General Conditions are amended and supplemented by the Conditions of Particular Application, Part II, which follow. In the event of any conflict between the General Conditions, Part I, and the Conditions of Particular Application, Part II, the latter shall govern.

- **For project Contracts number 3**:

  - o   **Part I (General Conditions):** The General Conditions of Contract is considered the Conditions of Contract for Works of Civil Engineering Construction, Part 1, First Edition 1999; published by the Fédération Internationale des Ingénieurs Conseils (FIDIC).

  - o   **Part II Conditions of Particular Applications:** The General Conditions are amended and supplemented by the Conditions of Particular Application, Part II, which follow. In the event of any conflict between the General Conditions, Part I, and the Conditions of Particular Application, Part II, the latter shall govern.

The following tables represent the top ten critical risks, in accordance with the ranking procedures set out in chapter 4 and listed in Table 4-12, and the Clauses of three selected shopping mall projects 'Contracts. The tables indicates only the Clause number and title if it is found, using Contract Agreement, Contract Data, and Condition of Contract (General and Particular) along with interpretation for each risk.

The exact wording of the related clauses that addressed one of the top ten risk factors is listed for each project (with cancelling all confidential data) along with the interpretation can be found in Appendix N.

Risk ranked # 1: Financial Ability

	Project #1		Project #2		Project #3	
	Clause#	**Description**	**Clause#**	**Description**	**Clause#**	**Description**
Contract Agreement Clauses	6	Payment Conditions	8	**Contract Price**	5	Payment Conditions
	7	Payment Conditions	15	The percentage of invoice value	9	Payment Conditions
	8	Payment Conditions	17	The amount due to the Contractor under any Payment	13	Payment Conditions
	9	Payment Conditions			14	Payment Conditions
Condition of Contract (General and Particular)	60.1	Monthly Statements	60.1	Monthly Statements	2.4	Employer's Financial Arrangements (Cancelled)
	60.2	Monthly Payments	60.2	Monthly Payments	14.2	Advance Payment
	60.3	Payment of Retention Money	60.3	Payment of Retention Money	14.7	Payment
	60.4	Correction of Certificates	60.4	Correction of Certificates		
	60.8	Final Certificate	60.8	Final Certificate		
	60.10	Time for Payment	60.10	Time for Payment		
	60.12	Advance Payment	60.12	Advance Payment		

Risk ranked # 1: Financial Ability

Interpretation	
	The three contracts addressed this risk mainly by the payment conditions Clauses.
	All payment terms for the three examined contracts reflect the employer ability to finance his project such as:
	The amount of the advance payment in the beginning of the project.
	Monthly payment on progressive basis of the works actually executed and certified by the Engineer (Issue of Interim Payment Certificate and Payment).
	Payment in Egyptian and USD to assist the contractor to procure all project's equipment and fulfill the project requirements from forging currency.
	All the above mentioned terms and more concerning payment conditions reflect the Employer ability to finance the project but in the other hand in the three contracts no reference for where certified payments are delayed beyond the period stated in the contract and solely attributed to the Owner default. For example in project's contract number 3 Clause # 2.4 named "Employer's Financial Arrangements", this Clause was cancelled.
	In project's Contract number 3 Clause # 2.4 named" Employer's Financial Arrangements", this Clause is cancelled which indicates *"The Employer shall submit, within 28 days after receiving any request from the Contractor, reasonable evidence that financial arrangements have been made and are being maintained which will enable the Employer to pay the Contract Price (as estimated at that time) in accordance with Clause 14 [Contract Price and Payment]. If the Employer intends to make any material change to his financial arrangements, the Employer shall give notice to the Contractor with detailed particulars".*

Interpretation
Also in projects 'contracts 1 & 2, provision # 60.10 was cancelled which indicate *"In the eve of the failure of the Employer to make payment within the times stated, the Employer shall pay to the Contractor interest at the rate stated in the Appendix to Tender upon all sums unpaid from the date by which the same should have been paid. The provision of this Sub-Clause is without prejudice to the Contractor's entitlement under Clause 69 or otherwise*. Also Clause 69.1 was cancelled named "Default of Employer" in the first and second projects' Contracts.
All such cancellation put a great risk into the Contractor's side because there is no any compensation for delayed payment from the Employer.

Risk ranked #2: Improper Design

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
Condition of Contract (General and Particular)	6.3	Disruption of Progress	6.3	Disruption of Progress	1.8	Care and Supply of Documents
	6.4	Delays and Cost of delay of Drawings	6.4	Delays and Cost of Delay of Drawings	1.9	Delayed Drawings or Instructions
	6.5	Failure by Contractor to submit Drawings	6.5	Failure by Contractor to submit Drawings	18.11	Design Indemnity Insurance
	7.1	Supplementary Drawings and Instructions	7.1	Supplementary Drawings and Instructions	13.2	Value Engineering
	7.2	Permanent Works Designed by Contractor	7.2	Permanent Works Designed by Contractor		

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
	7.3	Responsibility Unaffected by Approval	7.3	Responsibility Unaffected by Approval		
	8.1	Contractor's General Responsibilities	8.1	Contractor's General Responsibilities		
	20.4	Employer risks are:	8.2	Site Operations and Methods of Construction		
	21.1	Insurance of Works and Contractor's Equipment	20.4	Employer's Risks		
			21.1	Insurance of Works and Contractor's Equipment		
			21.2	Scope of Cover		

Risk ranked #2: Improper Design

	Interpretation
	In the three examined Contracts there are some Clauses address the delay of drawings, errors, defects or missing of drawings and how it will be addressed.
	The three Contracts indicate in case of any disruption of progress due to missing drawings or instructions requested from the Engineer and the planning or execution of the works is likely to be delayed the Contractor suffer delay or increase costs, the Contractor shall send notice to the Engineer and copy to the Employer and within a time reasonable (maximum 7 days) the Engineer shall determine any extension of time or the amount for such coasts.

	In addition, projects' Contracts 1 and 2 indicate in the Contractor's general responsibilities clause related to any error, omission, fault or other defects in the design or the specification for the works.
	Project's contract #3 refer to the care and supply of documents that include the same mining of give notice in case of any error or defect of a technical nature in tender documents.
	Also contract # 3 refer to the Design Indemnity Insurance for any design carried out by the Contractor and incorporated in the permanent works. Value engineer can be carried out by the Contractor and submitted to the Employer in some cases as indicated above that may enhance and facilitate or rectify the design. All these clauses and more as mentioned above shifted the risk of the improper design little bit to the Contractor.

Risk #3: Cash Shortage

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
Condition of Contract (General and Particular)	14.3	Cash Flow Estimate to be Submitted	14.3	Cash Flow Estimate to be Submitted	14.3	Application for Interim Payment Certificates
	60.1	Monthly Statements	60.1	Monthly Statements	14.4	Schedule of Payments
	60.2	Monthly Payments	60.2	Monthly Payments	14.8	Delayed Payment
	60.3	Payment of Retention Money	60.3	Payment of Retention Money		
	60.4	Correction of Certificates	60.4	Correction of Certificates		
	60.8	Final Certificate	60.10	Time of Payment		
	60.10	Time for Payment				

Risk #3: Cash Shortage

	Interpretation
	No clear Clause to mitigate cash shortage by the owner only non-binding estimates of the payments shall be submitted by the Contractor within a specific time and revised estimates shall be submitted at quarterly intervals until the Taking –Over. Such Clause could give the Employer good vision for the project cash flow and that may reduce the risk of cash shortage due to the absence of cash flow schedule.
	No clear Clause for "Delay of Payment", for example in project's Contract number 3 Clause # 2.4 named" Employer's Financial Arrangements", this Clause is cancelled which indicates *"The Employer shall submit, within 28 days after receiving any request from the Contractor, reasonable evidence that financial arrangements have been made and are being maintained which will enable the Employer to pay the Contract Price (as estimated at that time) in accordance with Clause 14 [Contract Price and Payment]. If the Employer intends to make any material change to his financial arrangements, the Employer shall give notice to the Contractor with detailed particulars".*
	Also in projects 'contracts 1 & 2, provision # 60.10 was cancelled which indicate "In the eve of the failure of the Employer to make payment within the times stated, the Employer shall pay to the Contractor interest at the rate stated in the Appendix to Tender upon all sums unpaid from the date by which the same should have been paid. The provision of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69 or otherwise.
	Also Clause 69.1 was cancelled named "Default of Employer" in the first and second projects' contracts. All such cancellation put a great risk into the Contract side that there is no grantee for Employer's Cash Shortage nor for any compensation for delayed payment.

Risk # 4: Changing Needs

	Project #1		Project #2		Project #3	
	Clause #	**Description**	**Clause #**	**Description**	**Clause #**	**Description**
Contract Agreement Clauses			14	**Changing Needs**		
Condition of Contract (General and Particular)	44.1	**Extension of Time for Completion**	44.1	**Extension of Time for Completion**	1.13	**Compliance with Laws**
	44.2	**Contractor to Provide Notification and Detailed Particulars**	44.2	**Contractor to Provide Notification and Detailed Particulars**	13.1	**Right to Vary**
	44.3	**Interim Determination of Extension**	44.3	**Interim Determination of Extension**	13.3	**Variation Procedure**
	51.1	**Variations**	51.1	**Variations**	13.6	**Day work**
	51.2	**Instructions for Variation**	51.2	**Instructions for Variation**		
	52.1	**Valuation of Variations**	52.1	**Valuation of Variations**		
Condition of Contract (General and Particular)	52.2	**Power of Engineer to Fix Rates**	52.2	**Power of Engineer to Fix Rates**		
	52.3	**Variations exceeding ±25 Percent (of the effective contract price)**	52.3	**Variations exceeding ±25 Percent (of the effective contract price)**		
	52.4	**Day work**	52.4	**Day work**		
	53.4	**Failure to Comply**				
	6.3	**Disruption of Progress**				
	6.4	**Delays and Cost of delay of Drawings**				

Risk # 4: Changing Needs

	Interpretation
	Project's Contract # 2 indicate direct Clause regarding changes that may be needed due to the nature of the shopping mall projects and indicate clear statement (Clause # 14 in the Contract Agreement) how the two parties can deal with such changes cost and time wise. The three examined contracts indicate variation roles and how it will proceed and approved. All these measures can mitigate the changing needs in addition to Clause 14 in the second project's Contract that clarify the need for changes and the agreement between two parties to do so and the exact procedures to do that.

Risk # 5: Approvals and Permits

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
Contract Agreement Clauses	11	The contractor (Second Party) shall fulfill all the necessary permits and approvals for each party of the Joint Venture to allow them to carry out the construction works inside Egypt according to the relevant Egyptian law.	6.4	Compliance with Laws and Ordinances		
			6.5	Permits		
Condition of Contract (General	26.1	Compliance with Statutes, Regulations	26.1	Compliance with Statutes, Regulations	1.13	Compliance with Laws

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
and Particular)	**29.1**	**Interference with Traffic and Adjoining Properties**	**29.1**	**Interference with Traffic and Adjoining Properties**	**2.2**	**Permits, Licenses or Approvals**
	44.1	**Extension of Time for Completion**	**44.1**	**Extension of Time for Completion**	**8.4**	**Extension of Time for Completion**
					8.5	**Delays Caused by Authorities**

Risk # 5: Approvals and Permits

	Interpretation
	The three Contracts define clearly the responsibilities of each Employer and the Contractor in this issue. The Employer shall have obtained the planning, zoning or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or being) obtained by the Employer; and the Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so.
	The Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.
	Moreover, the three Contracts give the Contractor the right for an extension of time if the delay caused by the Employer's responsibilities to get the required approval or any delay or disruption will be considered caused by the authorities. Other than that the Contractor shall be responsible for any delay related to delay of getting permits and approvals.

	Interpretation
	Such clear Clauses define the responsibility for the Employer and the Contractor shall mitigate this risk

Risk # 6: Improper Project Management

	Project #1		Project #2		Project #3	
	Clause #	**Description**	**Clause #**	**Description**	**Clause #**	**Description**
Condition of Contract (General and Particular)	**1.1A(iv)**	**Engineer means: Project Manager and Employer Representative**	**1.1(iv)**	**Engineer means Engineer appointed from time to time by the Employer**	**1.1A(iv)**	**Engineer means: Project Manager and Employer Representative**
Condition of Contract (General and Particular)	**1.1A(vi)**	**"Supervision Consultant" means : The supervisor construction works of the project**	**1.1(vi)**	**"Architect" means 00 appointed by the Employer to design and monitor the architectural, and decoration aspects of the works.**	**1.1A(vi)**	**"Supervision Consultant" means : The supervisor construction works of the project**
	2.1	**Engineer's Duties and Authority**	**1. (vii)**	**"Project Manager" means00 appointed by the Employer to administer the Contract, co-ordinate and manage the works.**	**3.1**	**Engineer's Duties and Authority**
	2.3	**Engineer's Authority to Delegate**	**2.1**	**Engineer's Duties and Authority**	**3.2**	**Delegation by the Engineer**

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
	2.5	Instructions in Writing	2.5	Instructions in Writing	3.3	Instructions of the Engineer
	2.6	Engineer to Act Impartially	2.6	Engineer to Act Impartially	3.4	Replacement of the Engineer
	2.7	Limitation on Engineer's Responsibilities			3.5	Determinations
	7.3	Responsibility Unaffected by Approval				

Risk #6: Improper Project Management

	Interpretation
	The three examined Contracts explain carefully and in details the Engineer/Project Manager's Duties and Authority; Engineer/Project Manager's Representative; Engineer/Project Manager's Authority to Delegate; Appointment of Assistants; Instructions in Writing; Engineer/Project Manager Act Impartially. Such Clauses give a clear understanding for The Engineer or the Engineer's Representative may appoint any number of persons to assist the Engineer's Representative in the carrying out of his duties.
	So, all the above mentioned Clauses are enough to clarify the Engineer/Project Manager's duties but only project's contract #3 added Sub-Clause 3.4 named "Replacement of The Engineer" that refer that *"the Employer may intend to replace the Engineer, and the Employer shall give notice to the Contractor in considerable time and if the Contractor has any objection against the new Engineer, the Contractor shall send a notice to the Employer concerning that"*.

	Interpretation
	So, based on the above mentioned the Engineer/Project Manager's shall have his right to complete his team and ask for assistance to manage the contract and the project properly and also from time to time the Employer can replace Engineer/Project Manager's. All these measures reduce the risk of Improper Project Management.

Risk # 7: Claims

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
Condition of Contract (General and Particular)	53.1	Notice of Claims	53.1	Notice of Claims	20.1	Contractor's Claims
	53.2	Contemporary Records	53.2	Contemporary Records	20.2	Amicable Settlement
	53.3	Substantiation of Claims	53.3	Substantiation of Claims		
	53.4	Failure to Comply	53.4	Failure to Comply		
	53.5	Payment of Claims	53.5	Payment of Claims		

Risk #7: Claims

	Interpretation
	The three Contracts' measures and Clauses for Claims explain all the procedures for how it shall be submitted, to whom, the time limit for review and taking action and failure to comply. All these Clauses and Sub-Clauses give faire procedures for Claiming and submit all necessary documents to evidence the right to claim. Moreover, if a dispute arises, amicable settlement can be the right measure to solve such dispute before using more complicated measure.

Interpretation
So, the above indicated clauses can mitigate the Claims and reduce the number of disputes.

Risk # 8: Foreign Exchange and Convertibility

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
Contract Agreement Clauses	6	Payment Conditions				
	7	Payment Conditions				
	8	Payment Conditions				
	9	Payment Conditions				
Condition of Contract (General and Particular)	60.11	Currency of Account and Payments	85.1	It is agreed that the proportion of currencies applicable to this contract shall be 50% in United State dollars and 50% in Egyptian Pounds.	13.4	Payment in Applicable Currencies
					14.15	Currencies of Payment

Risk # 8: Foreign Exchange and Convertibility

	Interpretation
	The first project's Contract address this risk by giving the Contractor amount of USD to assist him in the procurement process and to be paid within the interim monthly payment.
	In addition, the Contractor shall not bear any changes in the exchange rates during the contract period and the Employer shall pay to the Contractor a part of the interim payment certificates in USD for other expenses inside Egypt. Such Clauses shall mitigate the risk of fluctuation in currency exchange rate and/or difficulty of convertibility.
	The second project's contract also mitigate this risk by fixing the proportion of currencies applicable to the Contract shall be 50% in United States dollars (fixed rate of LE 00=1 US$) and 50% in Egyptian pounds. The project's Contract # 3 dealt with this risk typical as project's Contract # 2.
	So, indicating such Clauses in the Contract shall reduce the severity of tis risk in a proper way.

Risk # 9: Resources Unavailability

	Project #1		Project #2		Project #3	
Risk # 9 : Resources Unavailability						
	Clause #	**Description**	**Clause #**	**Description**	**Clause #**	**Description**
Condition of Contract (General and Particular)	8.1	Contractor's General Responsibilities	8.1	Contractor's General Responsibilities	6.1	Records of Contractor's Personnel and Equipment
	16.1	16.1 Contractor's Employees	80.1	Delay Clause		
			80.2	Additional Resources Requirements		

Risk # 9: Resources Unavailability

	Interpretation
	Within the Contractor's general responsibilities, the three projects' contracts indicate that the Contractor shall provide all superintendence, labor, materials, plant, contract's equipment and all other things and give the Engineer/Project Manager the authority to monitor such issues and send notice to the Contractor for any delay or shortage may be found during project progress.
	In addition, rate of progress that monitored by the Engineer/Project Manager shall reflect and delay in providing the resources to the site whatever such resource labors, materials or equipment.
	The three contracts put penalties for any delay may be happened. All the above mentioned measures can mitigate this risk if implemented properly.

Risk # 10: political Instability

	Project #1		Project #2		Project #3	
	Clause #	Description	Clause #	Description	Clause #	Description
Condition of Contract (General and Particular)	20.3	Loss or Damage due to Employer's Risks	20.3	Loss or Damage due to Employer's Risks	17.3	Employer's Risks
	20.4	Employment Risks	20.4	Employment Risks	17.4	Consequences of Employer's Risks
	21.1	Insurance of Works and Contractor's Equipment	21.1	Insurance of Works and Contractor's Equipment	19.1	Definition of Force Majeure
	21.2	Scope of Cover	21.2	Scope of Cover	19.2	Notice of Force Majeure
					19.3	Duty to Minimize Delay
					19.4	Consequences of Force Majeure

Risk # 10: Political Instability

	Interpretation
	Two of the three examined projects' contracts dealt with the Political Instability as a risk through all his consequences as a result of this risk such as strike, riot, rebellion, revolution, civil commotion or disorder within the country. Such detailed consequences listed in both contracts because both of them were signed after the recent revolution so, both of them considered this risk and mitigate this risk by using insurance tool to cover any loses or damages and in one of them consider this risk as a Force Majeure risk mitigate it with the insurance policy. Insurance policy as a tool to mitigate this risk is a proper way up till now although it adds a lot of expenses to the project total cost.

5.2 MAJOR OUTCOME OF CONTRACT VALIDATION

According to the above study, it is concluded that the top ten critical risk factors are existing and covered under the examined three Contracts. The examine Contracts include in some cases clear and direct clauses to mitigate specific risk and sometimes include general clauses that can be used to mitigate one or more risks. Shopping mall projects have a special need for Contracts that can deal with many changes that may be needed due to the multi-tenant's requirements that may be needed in different times and for different trades. Such phenomena needs clear and direct Contract's clauses to arrange such changes in proper fashion as Contract # 2 did account for such a risk by agreeing between the Employer and the Contractor to do such changes using different Clause that arrange this issue, so such clause can be very helpful in shopping mall contracts.

Financial ability for the Employer mitigation measures is found within the payment conditions that reflect how the Employer can finance the project. Advance payment, monthly interim statements and time of payment are examples for clauses that represent the Employer ability to finance the project. Moreover, as indicated in Contract # 1 the Employer agrees to give the Contractor amount of foreign currency to assist the Contractor to procure the equipment. Such Contract's clauses can reflect the Employer ability to finance and also address Cash Shortage risk.

Political Instability ranked within the top ten critical risk factors due to the current situation in Egypt after two revolutions, rebellion and terrorism in many places throughout the country. The three Contracts cover this issue specially Contract #3 who indicate these issues and consider them as a Force Majeure and mitigate them by the insurance mitigation tool that could reduce the consequence of these events for both the Employer and the Contractor.

To summarize, the top ten critical risks are addressed with the three examined contracts in a proper way in general. Need for changes clauses should be indicated in the shopping mall contracts to arrange this risk. Delay of payment should be clarified to avoid any claims or deputies between two parties. Political instability can be reduced by the insurance tool to mitigate their consequences.

6.0 CONCLUSION AND RECOMMENDATION

6.1 INTRODUCTION

The aim of this research is to highlight the most critical risks that face Mega shopping mall projects in Egypt and the associated most effective response methods currently employed in Egypt.

The following chapter present an overview of this research and a summary of its findings, their applicability to the Egyptian construction industry, recommendations for improvements, and suggestions for future research.

6.2 RESEARCH OVERVIEW AND FINDINGS

This research presents an analytical study that is aimed to highlight the most critical risks that face the Mega shopping mall projects in Egypt encountered by different participants and the associated most effective response methods currently employed in Egypt. A questionnaire survey was designed and administrated to a carefully selected sample from different perspectives by including Owners/Developers, Designers, Consultants, Project Managers, and Contractors that have previous experience in large scale projects such as shopping mall projects to explore their perceptions of risks and their associated response methods. Moreover, the results of this research were compared to the results of similar research that addressed national and international construction markets to define their variance. In addition, case studies of real projects are included by analyzing the related contracts and how they do address the most critical risks. A simple spreadsheet file that summarizes the findings of this study, which could be a helpful tool in the preparation of effective risk management in the Egyptian construction industry for all participants washing to prepare an effective risk management process for new projects was created.

The following sections introduce a synopsis of the results and findings related to the aforementioned issues.

6.2.1 IDENTIFICATION OF RISKS

The most critical risks that face the Mega shopping mall projects in Egypt encountered by different participants (Owners, Designers, Consultants, Project Managers, and Contractors) in their projects were compiled in a form of checklist. These risks were identified by analyzing the data collected employing the descriptive and inferential statistical means. The descriptive statistical procedures applied were computing the mean, range, standard deviation, and skewness. Moreover, the inferential statistical procedures employed where analysis of variance (ANOVA) between the perceptions of the different participants surveyed of the different risks they are expected to encounter in their projects.

According to the results of the statistical analyses procedures employed, the top ten most critical risks encountered in different perspectives by including Owners/Developers, Designers, Consultants, Project Managers, and Contractors that have previous experience in large scale projects such as shopping mall projects in the Egyptian construction industry in a descending criticality order are:

1. Financial Ability: Client is unable to finance the project-Risk D1
2. Improper Design: Incomplete design scope, design changes, defective design, errors and omissions, or inadequate specifications- Risk A1
3. Cash Shortage: Unavailability of sufficient in-house cash flow or of funds from owner- Risk B2
4. Changing Needs: Client expectations from the project are changed from those stated in the project through change orders- Risk D2
5. Approvals and Permits: Delay or refusal of project approval and permit by government or authority- Risk C4
6. Improper Project Management: Improper project planning, budgeting; inadequate project organization structure; or incompetence of project team- Risk A3
7. Claims: Client refuses or questions compensating the contractor for any submitted claims Risk D3
8. Foreign Exchange and Convertibility: Fluctuation in currency exchange rate and /or difficulty of convertibility- Risk B1

9. Political Instability: Frequent changes in government; agitation for change of government or disputes between political parties- Risk C1
10. Resources Unavailability: Difficulty to provide the project with the needs of labor , material, or equipment- Risk A7

Conversely, the least five critical risks in a descending criticality order were:

1. Variation of Bids: Big deviation between subcontractor bid due to their coalition to raise the subcontractor price- Risk E3
2. Constructability: difficulty or complexity of completing the project according to the design- Risk A2
3. Partnership: Unqualified partner, Disputes with partner, or cultural differences with partner - Risk F4
4. Expropriation: Due to political, social or economic pressures, local government takes over the facility run by the firm without giving reasonable compensation- Risk- C5
5. Environmental Protection: stringent regulation which will have an impact on construction firms' poor attention to environmental issues - Risk F5

These results indicate that in Mega projects such as shopping mall projects in the Egyptian construction industry, the financial risks are the most critical risks that endanger Mega shopping mall projects. Changing needs due to the existence of multi-tenants in Mega projects is also considered within the most critical risks in such type of projects. Due to the political instability after 25th January 2011 political instability risk is consider a critical risk that can affect the project's completion.

On the other hand, risks related to constructability, partnership or environmental protection are the least critical risks that face the different participants working in the shopping mall projects in the Egyptian construction industry.

Meanwhile, according to the top ten critical risk factors that have been found within each different role (Owners, Designers, Consultants, Project Managers, and Contractors) there are five risks are common within the top ten critical risks: Financial Ability, Improper Design, Cash Shortage, Approvals and Permits, and Improper Project Management. The remaining five risk factors are different according to the interest of each role. The most compatible results with the overall top

ten critical risks is the Contractors' group that has nine out of ten common risks that reflects the Egyptian Contractors' awareness of the critical risks for such type of projects. Also, the Owners group has seven out of ten top critical risks within the overall top ten risks that indicate the Egyptian Owners' understanding of the critical risks.

The following section includes a summary of the critical analysis for each risk category following the same category order as indicated in the questionnaire survey:

Construction and Design Risks

Construction and design risks category is ranked third in criticality among the six risk categories. Improper design, improper project management and resources unavailability are the most critical risks within this category from different types of roles. Great attention needs to be paid by all participants for such critical risks in the Mega shopping mall projects. The rest of the risks under this category seem to be manageable from the different participants.

Financial and economic risks

The financial and economic risks category was perceived as the most critical risk category among the six risk categories considered in this research. This is attributed to the fact that the ultimate purpose behind any business is raising firm's profitability as a first priority for the different participants (Owners, Designers, Consultants, Project Managers, and Contractors). Therefore, any threat to any participant's financial standing can severity affects their profitability. Moreover, according to several economic audit reports, one of which is "Egypt for a Bright Future" December 2013 Published by General Authority for Investment and Free Zones (GAFI) , Egypt is suffering from unstable, unrest, and fluctuating economic states since 25th January 2011, which is reflected in the high inflation and the fluctuating foreign exchange rates.

Political/Government Risks

Political / Government risks category have a critical risk factors that can affect the projects' objectives and different partners. This category is considered the fifth critical group of risks from all different viewpoints among the six risk categories. Approvals and Permits which rank as the highest mean risk within this group and the fifth within overall risks reflect the importance of this

risk. Political Instability is ranked in the tenth position within the thirty selected risks that reflect the importance of this risk especially after the recent events in Egypt, which experienced by all Egyptians from lack of political and security instability that has had a significant impact on the construction industry in Egypt. The rest risks within this category are not considered critical such as corruption and expropriation risks.

Client-Generated Risks

Client-Generated risks' category is considered the most critical category between the six categories including the most critical risk within the thirty examined risks. Moreover, this group contains three out of four critical risks within the top ten most critical risks. Such results reflect the importance of the financial ability of the Client/Owner in the Mega shopping mall projects. In such types of projects characterized by multi-tenants with different requirements, changing needs risk is very critical and to be considered by all participants. Claims issues and the contractual procedures to deal with such issues is very critical and should be clear in the contract agreement in such type of projects.

Subcontractors-Generated Risks

Subcontractors generated risks have a low important and low critical risks that can effect on the projects' objectives and can affect the other partners. Due to the nature of the Mega shopping mall projects that needs large, qualified general contractor to be able to construct such big, complex, and expensive projects, subcontractors-generated risks hardly form a threat to the Mega shopping mall projects in Egypt. Within almost all the risk categories addressed in this Thesis, the participants working in the Egyptian construction industry perceive these risks as a low critical risk to their construction projects.

Miscellaneous Risks

Miscellaneous risks group includes many of the various risks and that has the effect of significantly to the construction industry and some special items related to the legal aspects and force majeure, which may occur and negatively affect projects. Miscellaneous risks are considered a moderate critical group of risks from all different viewpoints. Legal Risks which ranking as the highest mean risk within this group and the eleventh within overall risks that reflect the high

criticality of this risk. The rest of risks within this category seem to be manageable to the different participants in the Mega shopping mall projects due to the type of such projects that require top qualifications for all the partners.

6.2.2 RISK RESPONSE METHODS AND TECHNIQUES

Under the four different commonly recognized risk response techniques, 96 risk response methods were found to be effective from the150 methods studies in this research. Mainly, the most commonly used risk response technique was the risk reduction technique. It was concluded that it is widely used among the different participants in the Mega shopping mall projects in Egypt to eliminate/mitigate the effect of all the risks under the six different categories considered in this research.

Risk transfer and retention techniques were found not suitable for eliminating and /or mitigating the impact of such risks as the financial and economic risks and subcontractor-generated risks. Using contractual measures was the key response method that was perceived by all different participants as the most effective method to eliminate/mitigate the effect of most of the risks considered in this research. In addition to these contractual measures, dealing with reputable Owners is also a very effective risk response method that did well in eliminating/ mitigating the impact of different risks especially those that have to do with the financing of shopping mall projects.

Meanwhile, seeking support of the government was within the least effective risk response method. This could reflect the current situation in Egypt and the rapid change of governments in Egypt over the last period. Also, undertaking pre- project planning to minimize design error was considered a low effective measure to mitigate construction and design risks although this measure could mitigate a lot of risks in the early stage of the project.

Other risk response methods, e.g. insuring all insurable risks and setting contingencies for unforeseen items, were perceived as moderate construction project risk elimination/mitigation measures. In other words, these measures are perceived as effective for certain cases, especially that they inflates tender price and could affect different participants business. Furthermore, adopt proper quality control procedures was also perceived as moderately effective risk response method.

In general, no apparent difference in the perception of the effectiveness of the different risk response techniques studied between different roles participant were witnessed in this study.

6.3 COMPARING WITH EXISTING DATA

A comparison was performed between the top ranked risks identified in Egypt in this study, and the Egyptian market, as well as with the international market, in order to determine if the top ranked risks in Egypt are similar to the top ranked risks identified previously in the national and international market.

The first comparison with the Egyptian market was with Orabi's (2003) which is the closet and most comparable to this research. The comparison highlighted that the most critical risk factors (top ten most critical risks) in both research are almost the same with slight different in risks' orders. It was concluded that financial ability of the client risk, political instability risk, and approvals and permits risk are the most critical risk in the Egyptian construction industry and especially in the Mega shopping mall projects.

The second comparison was with the international's findings extracted from previous research papers, conducted by Alwan (2006) that targeted Sudanese' construction industry market, El-Sayegh (2007) in the UAE, and Tang et al. (2007) in Chinese. It was concluded that the financial risk, in particular the Client's financial abilities was perceived the most critical risk facing both international and the Egyptian construction industry. Changing needs, approvals and permits, and Resources Unavailability are identified in various countries and are top ranked terms of their impact on the large scale projects.

6.4 STUDYING OF ACTUAL SHOPPING MALL PROJECT'S CONTRACTS

Based on examining how a sample of contracts responded to the most critical risks in these kinds of specialized projects (top ten critical ranked risks in this study), it was concluded that using contractual measures was the key response method that was perceived by all different participants as the most effective method to eliminate/mitigate the effect of most of the risks considered in this research. Payment conditions' Clauses in the contract agreement reflect the financial ability of the Client and can be mitigate many risks that related to the foreign exchange and convertibility risks

which considered the most critical risks for Mega projects in Egypt. Need for changes clauses should be addressed in the shopping mall contracts to account for this risk. Delay of payment should be clarified to avoid any claims or disputes between parties. Political instability can be reduced by using insurance tools to mitigate their consequences.

6.5 USER-FRIENDLY SPREADSHEET SUMMARY FILE

A simple spreadsheet file that summarizes the findings of this study, which could be a helpful tool in the preparation of effective risk management in the Egyptian construction industry for all participants washing to prepare an effective risk management process for new projects. All findings related to Construction Project Risks Criticality and Risk Response Method Effectiveness were collected   and summarized in Microsoft Excel workbook. The file works with hyperlink shortcuts, one click over an option leads to the worksheet of the option.. A complete printout of the worksheets of this spreadsheet is included in Appendix D

6.6 CONCLUSIONS

The following conclusions were drawn from the results and findings of this study:

6.6.1 RISK IDENTIFICATION

- Financial and economic risks category is perceived as the most critical risk category.
- Client-Generated Risks is ranked as the second in the criticality perception order
- Construction and Design risks as the third in the criticality perception order
- Political / Governmental and Miscellaneous risks have a perceived moderate impact on the Mega shopping mall projects
- Subcontractors-Generated risks have the least impact on the Mega shopping mall projects
- A financial unable client is the riskiest factor facing different participants in different roles in the Mega shopping mall projects.

6.6.2 RISK RESPONSE

- Risk reduction is the most commonly used risk response technique.

- Risk transfer and retention response technique are not suitable for eliminating and/or mitigating impact of financial and economic risks.

- Employing contractual measures is a key risk response method.

- Working for reputable Owners is a very effective risk response method especially for Mega shopping mall projects in Egypt.

- Seeking cooperation and support of the government is the least effective risk response method.

- Insurance and setting contingencies aside have moderate risk mitigation/elimination effectiveness.

6.6.3 APPLICABILLITY TO THE DIFFERENT PARTICIPANTS

The results of this research are applicable to the Mega shopping mall projects and any other large scale commercial projects, for different participants (Owners, Designers, Consultants, Project Managers, and Contractors).

6.7 SUGGESTION FOR FUTURE RESEARCH

In order to establish sound risk management practices for the construction industry in Egypt, a series of additions to this research are recommended as follows:

- Reapplying the same methodology of this research to identify the critical risks and the associated response methods for different types of projects.
- Testing of the best practice employed to control and monitor the effectiveness of the risk management processes employed by different roles.
- Research the quantification of the identified risks and their impact on cost and duration.
- Comparing the different contract's types used in the Mega shopping mall projects in Egypt to identify the best clauses for such projects.

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APPENDICES

APPENDIX A, TABLES FOR SIMILAR STUDIES

APPENDIX B, PRINTOUT OF AN EMPTY QUESTIONNAIRE SURVEY

APPENDIX C, PRINTOUT OF SPREADSHEET RESPONDENTS'DETAILS

APPENDIX D, SAMPLE DESCRIPTION AND CHRACTERISTICS

APPENDIX E, PRINTOUT OF SPREADSHEET RESPONDENTS'ANSWERS

APPENDIX F, STATICAL ANALYIS RESULTS FOR EACH RISK

APPENDIX G, PRINTOUT OF SPREADSHEET RELIABILITY ANALYSIS OUTPUT

APPENDIX H, PRINTOUT OF SPREADSHEET RISK CRITICALITY ANOVA TABLES

APPENDIX I, PRINTOUT OF SPREADSHEET SUMMURY

APPENDIX J, RISK PROBABILITY

APPENDIX K, RISK IMPACT

APPENDIX L, RISK CRITICALITY/ TOTAL RISK

APPENDIX M, RISK RESPONSE METHODS

APPENDIX N, SHOPPING MALL PROJECT'S CONTRACTS

Note:

A soft copy including all the above mentioned Appendices along with a soft copy for the "User-Friendly Spreadsheet Summary file are attached to this research.