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أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

تطبيق عملية التحليل الهرمي (AHP) في تقييم المخاطر لمشاريع إنشاء المباني

Application of Analytic Hierarchy Process (AHP) in Risk Assessment for Construction Building Projects

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تطبيق عملية التحليل الهرمي (AHP) في تقييم المخاطر لمشاريع إنشاء المباني

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة شئون البحث العلمي والدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحثة/ **هديل محمد سعيد ياسين البرقوني** لنيل درجة الماجستير في **كلية *الهندسة*** **قسم الهندسة المدنية–إدارة المشروعات الهندسية** وموضوعها:

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وبعد المناقشة التي تمت اليوم السبت 16 صفر 1437هـ، الموافق 2015/11/28م الساعة الواحدة ظهراً، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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وبعد المداولة أوصت اللجنة بمنح الباحثة درجة الماجستير في **كلية *الهندسة*/** قسم **الهندسة المدنية– إدارة المشروعات الهندسية.**

واللجنة إذ تمنحها هذه الدرجة فإنها توصيها بتقوى الله ولزوم طاعته وأن تسخر علمها في خدمة دينها ووطنها.

والله ولي التوفيق ،،،

نائب الرئيس لشئون البحث العلمي والدراسات العليا

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DEDICATION

I will always appreciate my beloved husband Eng. Hussein Ahmed AliHussein who is my backbone partner who helped me through all stages of this work, so with all respect and love I dedicate this work and give special thanks to him and my little son Ahmed for being there for me throughout the entire work.

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ملخص الدراسة

إن طبيعة صناعة الإنشاءات من أكثر الصناعات تعرضا للمخاطر خلال كافة المراحل التي يمر بها أي مشروع إنشائي، لذلك فإن معظم الأبحاث والدراسات الإدارية تركز على كيفية إدارة هذه المخاطر وأهم الطرق المتبعة للحد أو التقليل من آثارها.

إن الهدف الرئيسي لهذا البحث هو تقييم المخاطر من وجهة نظر المقاول خلال فترة ما قبل التقدم للعطاء الخاص المشروع الإنشائي في قطاع غزة. تم بناء نماذج دعم اتخاذ القرار باستخدام طريقة التحليل الهرمي (AHP)، حيث تمت المقارنات الهرمية بين عوامل المخاطر والمجموعات التي تترأس هذه العوامل لإيجاد العوامل والمجموعات الأكثر أهمية والتي لها التأثير السلبي الأكبر على مشروع المباني، كما وتم تطبيق نفس الآلية لإيجاد أفضل الإجراءات الوقائية/الاحترازية تجاه هذه العوامل.

تم استخدام تقنيات عدة في جمع المعلومات مثل الاستبانة والمقابلات الشخصية بمختلف أنواعها، الفئة المستهدفة كانت فئة المقاولون فقد تم توزيع الاستبانة على 52 شركة مقاولات عامة تصنيف مباني درجة أولى وثانية في قطاع غزة، وتم مقابلة 10 شخصيات ذوات خبرة في عالم المقاولات. بعد عملية التحليل باستخدام تقنية التحليل الهرمي للاستبانة رقم 1 والمقابلات الشخصية الشبه منظمة، وجد أن فشل المقاول ماليا، الظروف الغير مستقرة أمنيا (كالحروب)، الحصار، احتكار الموردين للمواد بسبب إغلاق المعابر وبالتالي زيادة أسعار المواد، تدهور جودة العمل مع قلة الإنتاجية أيضا هي أكثر المخاطر التي يتعرض لها مشروع إنشاء المباني في قطاع غزة، كما أظهرت النتائج أن هناك عدة عوامل المخاطر التي تأتي في ذيل قائمة الأولويات في إدارة المخاطر حيث تعتبر من المخاطر التي يمكن التنبؤ بها وبالتالي الاحتراز منها وتندرج معظم هذه المخاطر تحت قائمة المخاطر الفيزيائية أيضا المخاطر المتعلقة باللوجستيات العامة لإدارة الموقع إلى جانب المخاطر المتعلقة بالتصميم وأخيرا المخاطر القانونية، هذه المجموعات تم استبعادها من الاستبانة 1والمقابلات، وباقي المجموعات ونتائجها كانت القاعدة الأساسية التي اعتمدت عليها الاستبانة رقم 2. نتائج الاستبانة الثانية والمتعلقة بإيجاد أفضل طريقة احترازية للمخاطر خلصت إلى أن الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع هي أفضل الطرق للاحتراز مع أي خطر قد يواجه المشروع، أما الرجوع إلى المشاريع السابقة المشابهة أو الجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها كانت الخيار الثاني التي يجب أن يلجأ إليه المقاول ثم نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى، والبديل الأخير هو إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة هي الطريقة حصلت على المرتبة الأخيرة كطريقة احترازية من المخاطر.

بناء على هذه النتائج، توصلت الدراسة إلى عدة توصيات أهمها أن على المقاول الاهتمام بتقييم المخاطر المتعلقة بالمشروع المنوي التقدم له وأخذها بعين الاعتبار في عملية التسعير حيث سيؤدي إلى الحد أو التقليل من آثار المخاطر في كافة مراحل المشروع. واقترحت الدراسة استخدام النماذج المطورة من قبل الباحث لمساعدة جميع الأطراف في إجراءات اتخاذ القرار التي لها علاقة بإدارة المخاطر.

ABSTRACT

The nature of the construction industry is one of the riskiest nature among other industries, so most of researches focuses on how to manage these risks and the most important methods used to reduce or minimize their effects.

The aim of this research is to assess the risk factors that may exposed to the construction of building projects from contractor's point of view. Multi criteria decision making support models are built using Analytic Hierarchy Process (AHP). Comparing the main risk categories and factors to get the most effective ones, which have the most negative impact on the construction projects, then identifying the optimum preventive actions toward these factors. All these objectives are achieved through two surveyed questionnaires as well as semi-structured interviews conducted in Gaza Strip. The target group was the first and second-class building contractor, so the questionnaires are distributed to 52 contracting company, as well as 10 semi-structured interviews are conducted with professional engineering experts. After the analysis of the first questionnaire, It is been found that the financial failure of a contractor, unstable security circumstances (wars), the closure, the monopolizing of materials due to closure, increasing material prices, deterioration quality of work and the decrease of productivity are the most important risks occurring in the construction of building projects. Another findings of the least effective risks, those risks can be predicted and thus can be prevented, most these risks are been categorized under the list of physical, logistics, design and the legal risks. These groups are been omitted and the rest groups are adopted for the second questionnaire. The findings of the second questionnaire shows that the best preventive response toward the riskiest factors is depending on the subjective judgment to produce a proper program, and the second alternative is referring to previous and ongoing similar projects for accurate program. The third alternative that must be invoked after that is transferring or sharing risk to/with other parties, and the production of proper schedule by getting updated project information is the last alternative.

Based on these results, the study inveterate several recommendations, the most important that the contractor must have attention to perform risk assessment to the project that is intending to bid for, this inevitably would lead to reduce the risk effects in all phases of the project. Another recommendation is to use the models in this research to help all parties in the decision-making procedure related to risk management.

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LIST OF ABBREVIATIONS

Abbreviation	The explanation
GDP	Gross domestic product
RM	Risk management
PMBOK	Project management book of knowledge
PMI	Project management institute
PLC	Project life cycle
MCDM	Multi criteria decision making
AHP	Analytic hierarchy process
WSM	Weighted sum method
WPM	Weighted product method
SAW	Simple additive weighting
ELECTRE	Elimination and choice translating reality
TOPSIS	Technique for order preference by similarity to ideal solutions
PROMETHEE	Preference ranking organization method for enrichment evaluation
COS	Cost of safety
Bsc.	Bachelor of science degree
Msc.	Master of science degree
PCU	Palestinian contractors union
UNRWA	United nations relief and works agency
UNDP	United nations development program
PNA	Palestinian national authority

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CHAPTER 1: INTRODUCTION

This chapter is introducing general information about risk management in construction projects especially in Gaza Strip where the political situation reflect on all aspects of life especially in construction industry. In addition, this chapter demonstrate the research importance, problem statement, research aim and objectives, research scope and limitations, research methodology and finally the research structure.

1.1 Risk management in construction industry

In the last decades the risk management research has grown considerably in the construction industry given that construction projects are exposed to risk at the time of their coming into existence and are perceived to have more inherent risk due to the involvement of many contracting parties such as owners, contractors and designers, among others (El-Sayegh, 2008). It is suspected that, construction industry is categorized as a high-tech industrial sectors it is characterized by high uncertainty, and rapid decision-making, the need for tools and processes to manage risks ought to be greater than in other areas (Raz and Michael, 2001).

1.1.1 Risk management in the bidding phase

Visser and Joubert (2008) said "In construction projects, risk could severely constrain the primary objectives: time, cost, scope, and quality; it could mean additional cost and hence a lower return on investment to the client; and a loss of revenue for the contractor, among others". Alquier et al. (2000) pointed out that the most critical phase in the project life cycle is the bidding phase, where little information is available. Leopoulos et al. (2003) said that the scanty information during the bidding phase is a risk on its own. Once the decision to bid is taken, after the preliminary assessment of the risk factors, there are other decisions that must also be taken, one of the most important decisions is how to deal with risk. In other words, what strategies ought to be followed by the contractor so as to deal with the anticipated risk? Recognizing the risk management procedures, risk response plans and their need for control will allow for better assessment and forecasting of the risk magnitudes and their impact. Hence these allow for more effective measures being included in the preparation and bidding phase.

1.2 Construction situation in Gaza Strip

According to the World Bank Report (2015), Gaza was placed in 2006-2007 under a blockade that prohibited the basic construction materials. Even though the blockade was slightly eased in 2010 to allow in some construction materials, private sector activity continues to be severely constrained. As a result, the situation in Gaza was dire. Similarly, Gaza's labor force productivity is lower than that in the West Bank or in East Jerusalem, mainly because firms in Gaza are able to invest less in capital goods or have had their capital destroyed in the repeated conflicts. Essential infrastructure in the Gaza Strip have been devastated by the lack of construction materials, equipment and spare parts resulting from the blockade, and the destruction incurred during the recent military operations (World-Bank, 2015).

Construction is a vital activity in the Palestinian economy. It contributes substantially in the Palestinian Gross Domestic Product (GDP) and employment. The economy of the Gaza Strip is severely hampered by Egypt and Israel's almost total blockade, the high population density, limited land access, strict internal and external security controls, the effects of Israeli military operations, and restrictions on labor and trade access across the border. The economy of the Gaza Strip improved in 2011, with a drop in unemployment and an increase in GDP. This economic upswing has led to the construction of buildings projects. Wide-scale development has been made possible by the unhindered movement of goods especially the construction materials into Gaza through the Kerem Salem Crossing and tunnels between the Gaza Strip and Egypt. The increase in building activity has led to a shortage of construction workers (World-Bank, 2015).

1.3 Research importance

The management of risks is a central issue in the planning and management of any venture. Construction industry is subject to more risk and uncertainty than many other industries. The process of taking a project, preparing for bidding especially in pricing, is a complex process. Construction industry in Gaza Strip is suffering from the misunderstanding of risk management including risk identification, analysis and risk respond (Enshassi and Abu Mosa, 2008, Enshassi et al., 2008). Therefore, that is why this research is performed, to assess the risk factors that affect the construction of building projects in Gaza Strip. In addition, to provide the preventive actions toward these factors

so the contractors in the pre-bidding stage can use this assessment in price estimating so as to overcome the complications which they are suffering from before.

1.4 Problem statement

Risk management became an essential mission of the management missions. Taking into account that the construction industry is considered one of the most risky industries, unfortunately, there is no clear risk' management way for the construction industry in the local market. The researchers all over the world still doing researches on the risk management in order to reach the satisfied findings and recommendation in which the construction processes can be done with low risk.

This research is done to assess the risk factors affecting the construction of the building projects which considered the most performed projects in Gaza Strip, so that the optimum preventive action toward these factors can be bestowed using Analytic Hierarchy Process (AHP) which is more realistic tool for analysis this type of knowledge than the common statistical way because the concept of pair-wise comparison is the key base of the AHP where the dependent relationship between the studied factors is accomplished.

1.5 Research aim

The key research aim is the risk assessment by developing a multi-decision criteria support system using the Analytic Hierarchy Process (AHP) application in construction building projects in Gaza Strip where little direct scientific evidence is available. This model should provide users with an efficient mechanism that aids identifying risks and determine possible ways that may help avoid or minimize these risks.

1.6 Research objectives

The study is proposed to accomplish the following objectives:

1. To understand the risk issues in construction building projects in order to identify the risk factors and specifically classifying them according to construction processes based on a literature study.
2. To develop a decision support models based on AHP for the risks' factors in addition to risk preventive actions.
3. To prioritize the construction risk factors/groups to determine the most risky factors that have to be focused on

4. To provide the optimum practical suggestions and recommendations through applying the developed models which targeting toward the optimum preventive actions in the risk management that aimed at recovering the performance of contracting companies in this field.

1.7 Research scope and limitations

This research is concerned with building projects only from contractors' point of view who are classified as first and second class with a valid registration through the Palestinian Contractors Union and they are actively working in Gaza Strip.

This research is studying the risk assessment in the pre-bidding stage; the stage where this assessment will be included in pricing phase of the intended bid.

1.8 Brief research methodology

The Literature review and previous studies were filtered to recognize the problem background to collect data needed for determining the aim, main objectives, scope, and limitation of this study, upon these fundamentals the risk factors and groups/criteria that affect the construction of building projects were identified. Also during this stage, different methodologies dealing with risk management were reviewed. The AHP was chosen to be the analysis tool for this study, so the research techniques were chosen to cope with this analysis.

The field survey performed on multi phases; the site visits were the beginning phase to investigate the real problem through real construction projects, then semi-structured interviews were held with 10 experts in addition to structured questionnaires that were distributed. The results of these techniques were ended to be the base of the second questionnaire that was distributed also to the same persons who filled out the first one, the targeted group was the first and second class building contractors in Gaza Strip and the analysis of the collected data was done using Expert Choice and Microsoft Excel 2013, discussion is made for the obtained results. It is worthy to say that in each technique there were a validity and reliability cheeks.

1.9 Research structure

The research is documented as the following:

Chapter (1): This chapter displays the introduction about the research works including the research importance and problem statement, research aim and objectives, as well as the research scope and limitations and brief description of research methodology, finally, the outline of the thesis is summarized to answer the questions about the general information of this thesis.

Chapter (2): This chapter displays the theoretical framework of the research field which is the risk management in the construction projects, also decision making related to risk management is pointed out, ending with literature and previous studies reviews in risk management especially when using AHP as an analysis technique.

Chapter (3): This chapter demonstrate the methodology used in this study, beginning with research strategy, then research design which is following by the research techniques used in details. The research validity, reliability and research pretesting and piloting are discussed in details also in this chapter. The sampling documentation and the research location in addition to research limitation are clarified in this chapter followed by the previous methodologies using similar research method. Finally, the research analysis method is illustrated comprehensively.

Chapter (4): This chapter presents the final findings of this research with needed discussion.

Chapter (5): This chapter presents the conclusion of this study as well as the recommendations upon it.

References

Appendixes

CHAPTER 2: THEORETICAL FRAMEWORK

The construction industry has changed rapidly all over the world and especially in Gaza strip over the past years; companies are faced with more uncertainty than ever before. Customers do not want surprises, and are more likely to engage in litigation when things go wrong. Risk management in construction projects is full of deficiencies that affect its effectiveness as a project management function and in the end; projects' performance (Acebes et al., 2014).

This chapter reviews the theoretical concept of risk management in construction projects and the foremost-related previous literature. Besides focusing on the effective decision making as a significant action in the construction project that actually or may be exposed to risk. The Analytical Hierarchy Process (AHP) is discussed intensely as an analysis technique through literature review.

2.1 Risk management in construction projects

Construction projects are complex and dynamic, and involving multiple feedback processes. A lot of participants; individuals and organizations are actively involved in the construction project, and they interests may be positively or negatively affected as a result of the project execution or project completion (Banaitiene and Banaitis, 2012).

Smith et al. (2006) said that "Change is inherent in construction work, that is clear in real construction industry for years as it has had a very poor reputation for coping with the adverse effects of change, with many projects failing to meet deadlines and cost and quality targets. This is not too surprising considering that there are no known perfect engineers, any more than there are perfect designs or that the forces of nature behave in a perfectly predictable way. Change cannot be eliminated, but by applying the principles of risk management, engineers are able to improve the effective management of this change".

Project managers should undertake or propose actions which eliminate the risks before they occur, or reduce the effects of risk or uncertainty and make provision for them if they occur when this is possible and cost effective. It is vital to recognize the root causes of risks, and not to consider risks as events that occur almost at random. Risks can frequently be avoided if their root causes are identified and managed before the adverse consequence – the risk event – occurs. They should also ensure that the remaining risks

are allocated to the parties in a manner which is likely to optimize project performance (Smith et al., 2006).

2.1.1 Risk definition

Many explanations and definitions of risks and risk management have been recently developed, and thus it is difficult to choose one which is always true. Each author provided his own perception of what risk means and how to manage it. The description depends on the profession, project and type of business. Risk management in general is a very broad subject and definitions of risk can therefore differ and be difficult to apply in all industries in general (Ropel and Gajewska, 2011). Risk in construction has been the object of attention because of time and cost overruns associated with construction projects (Jaafari, 2001).

According to the Project Management Body of Knowledge (PMPOK, 2013), project risk is defined as an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives such as scope, schedule, cost, and quality based on the Project Management Institute (1996) that introduced a simple definition for risk as a discrete occurrence that may affect the project for better or worse. PMBOK (2013) also described that project risk management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project. The objectives of project risk management are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events in the project (PMI, 2013).

Often definitions of risk or uncertainty are tailored for the use of a particular project. To make it more systematized, a literature research was done. The findings of this search resulted in a number of definitions of risk and uncertainties. These have been collected and are presented in Table 2-1.

Table 2-1: Definitions of risk and uncertainty

Author	Risk definition	Uncertainty definition
Jaafari (2001)	♠ Risk is defined as the exposure to loss/gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude.	♠ Events are said to be certain if the probability of their occurrence is 100% or totally uncertain if the probability of occurrence is 0%. In between these extremes the uncertainty varies quite widely
Karatam and Karatam (2001)	♠ Risk is the probability of occurrence of some uncertain, un-predictable and even undesirable events that would change prospects for the probability on a given investment.	_____
Webb (2003)	♠ Risk is a situation in which he possesses some objectives information about what the outcome might be. ♠ Risk exposure can be valued either positively or negatively.	♠ Uncertainty is a situation with an outcome about which a person has no knowledge.
Cooper et al. (2005)	♠ Risk is exposure to the consequences of uncertainty.	♠ _____
Smith et al. (2006)	♠ Risks occur where there is some knowledge about the event.	♠ There might be not enough information about the occurrence of an event, but we know that it might occur.
Winch (2010)	♠ A stage where there is a lack of information, but by looking at past experience, it is easier to predict the future. ♠ Events where the outcome is known and expected.	♠ Uncertainty is a part of the information required in order to take a decision. The required information consists of the amount of available information and uncertainty. ♠ The level of uncertainty will decrease the further a project is proceeding throughout the lifecycle.

Table 2-1: Definitions of risk and uncertainty

Author	Risk definition	Uncertainty definition
Darnall and Preston (2010)	• Risk is a possibility of loss or injury.	• ———
Cleden (2012)	• Risk is the statement of what may arise from that lack of knowledge. Risks are gaps in knowledge, which we think, constitute a threat to the project.	• Uncertainty is the intangible measure of what we don't know. • Uncertainty is what is left behind when all the risks have been identified. • Uncertainty is gaps in our knowledge we may not even be aware of.

All risk definitions mentioned in Table 2-1 described risk as a situation where lack of information and knowledge occur in the project. In the other hand uncertainty was defined in a more abstract way. The descriptions provided in Table 2-1 are similar to each other and the common factor is the lack of information and knowledge. The biggest difference by definition is awareness.

Darnall and Preston (2010) found some of the risks to be predictable and easy to identify before they occur, while the others are unforeseeable and can result in unexpected time delays or additional costs. This statement found confirmation in the definition provided by Cleden (2012) who used the same arguments defining uncertainty as rather unpredicted, unforeseeable events, while risk should be possible to foresee.

The overview of definitions which can be found in literature regarding those two terms implies that uncertainty is a broad concept and risk is a part of it. This confirms close relation between those two concepts but at the same time distinguishes them.

The description provided by Cleden (2012) is the best fit to the purpose of this research; it concerned how risk is defined as a gap in knowledge which, if not handled correctly, will create a threat to the project. Moreover, in the following chapters, the focus is on risk itself and how it should be handled. Uncertainty is not a tangible term and thus is not be further developed in the research.

2.1.2 Risk management benefits

The benefits from risk management are concerning the project itself, as well as the actors involved, Eida and Pandey (2015) denote that risk management contributes to the big picture of possible consequences resulting from unmanaged risks and how to avoid them at early stages of the project.

According to Mills (2001), the systematic risk management is deemed to have the following advantages:

1. Questioning of the assumptions that most affect the success of the project
2. Concentrates attention on actions to best control risks, and
3. Assesses the cost benefit of such actions

2.2 Risk management processes

PMBOK overviewed the risk management processes for any project, which interact with each other and with processes in other knowledge areas as summarized in Table 2-2.

Table 2-2 Project risk management processes (PMBOK, 2013)

Process	Description
Planning risk management	The process of defining how to conduct risk management activities for a project.
Identifying risks	The process of determining which risks may affect the project and documenting their characteristics
Performing qualitative risk analysis	the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact
Performing quantitative risk analysis	The process of numerically analyzing the effect of identified risks on overall project objectives.
Planning risk responses	The process of developing options and actions to enhance opportunities and to reduce threats to project objectives.
Controlling risks	The process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project.

2.2.1 Planning risk management

Planning risk management is the process of defining how to conduct risk management activities for a project. The key benefit of this process is it ensures that the degree, type, and visibility of risk management are commensurate with both the risks and the importance of the project to the organization. The risk management plan is vital to communicate with and obtain agreement and support from all stakeholders to ensure the risk management process is supported and performed effectively over the project life cycle. The inputs, tools and techniques, and outputs of this process are depicted in Figure (2-1).

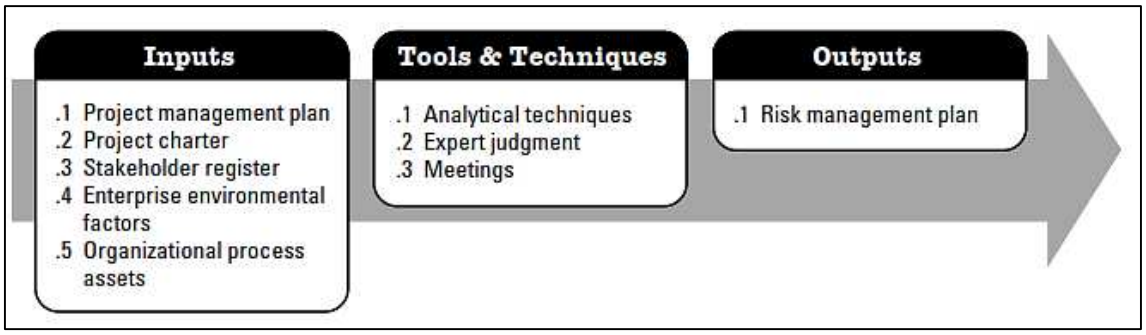

Figure 2-1: Planning risk management (PMBOK, 2013)

2.2.2 Risk identification

Identify risks is the process of determining which risks may affect the project and documenting their characteristics. The key benefit of this process is the documentation of existing risks and the knowledge and ability it provides to the project team to anticipate events. The inputs, tools and techniques, and outputs of this process are illustrated in Figure (2-2).

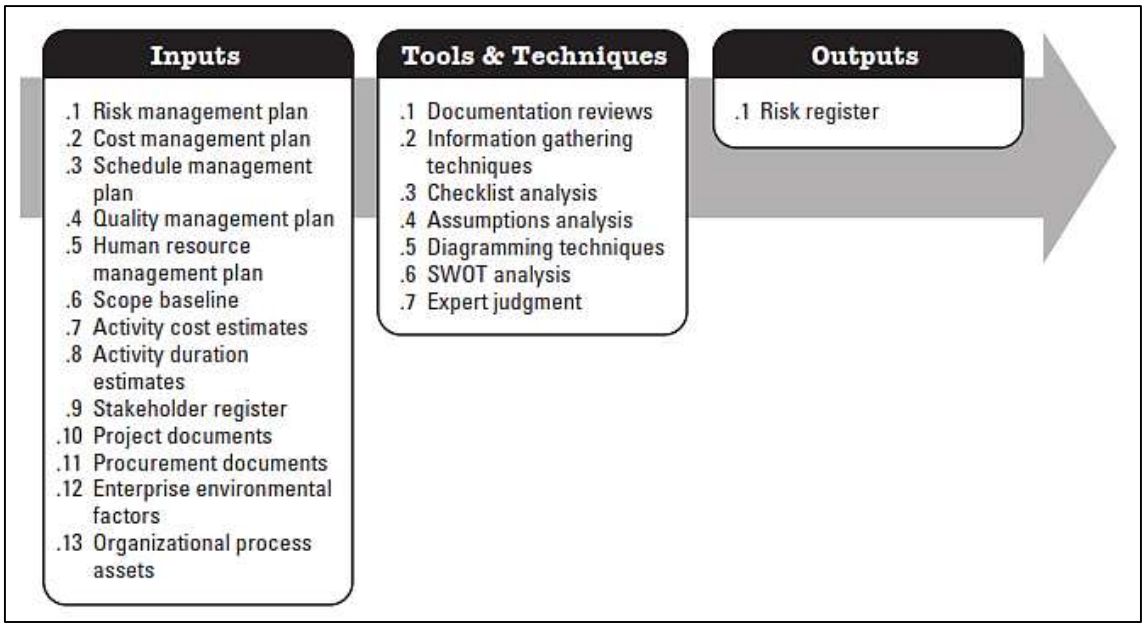

Figure 2-2 Identifying risk (PMBOK, 2013)

Risks and other threats can be hard to eliminate, but when they have been identified, it is easier to take actions and have control over them. If the causes of the risks have been identified and allocated before any problems occur, the risk management will be more effective (PMI, 2013). The purpose of identifying risks is to obtain a list with potential risks to be managed in a project (PMBOK, 2013). In order to find all potential risks which might affect a specific project, different techniques can be applied. It is important to use a method that the project-t team is most familiar with and the project will benefit from. The aim is to highlight the potential problems, in order for the project team to be aware of them (Yimam, 2011).

Identifying risks is an iterative process, because new risks may evolve or become known as the project progresses through its life cycle. The frequency of iteration and participation in each cycle will vary by situation. The risk statement should support the ability to compare the relative effect of one risk against others on the project. The process should involve the project team so they can develop and maintain a sense of ownership and responsibility for the risks and associated risk response actions (Issa, 2013). Stakeholders outside the project team may provide additional objective information and possible risks which can be found in the literature are combined in Table 2-3.

Table 2-3: Risk categories (Smith et al., 2006, Darnall and Preston, 2010, Bing et al., 2005, Edwards, 1995, Jeynes, 2012, Potts, 2008)

Risk groups	Related factors
Monetary	Financial
	Economical
	Investment
Political	Legal disputes
	Political crisis
Environmental	Environmental risks
	Natural, Physical risks
Technical	Technical risks
Project	Contractual, Client
	Project Objectives
	Planning, Scheduling
	Construction
	Design
	Quality
	Operational
	Organizational
Human Market	Labor, Stakeholders
	Human Factors
	Cultural
	Market
Safety	Safety
	Security, Crime
Material	Resources
	Logistics

The main problem with categorizing risk is that there is a danger of confusing sources, causes, effects and fields of study for the risk domain, a source approach to risk categorizations is shown in Table 2-4 (Abu Mousa, 2005, Enshassi et al., 2008). Abu Mousa (2005) proposed that the risks can be considered with respect to nine categories: physical, environmental, design, logistics, financial, legal, construction, political, and management factors. While the list of potential risks in every category is neither complete nor exhaustive, it does represent the majority of typical project risks and demonstrates the advantage of a logically developed classification scheme.

Table 2-4: Risk factors (Enshassi et al., 2008, Abu Mousa, 2005)

Group	Risk Factor
Physical	Occurrence of accidents because of poor safety procedures
	Supplies of defective materials
	Varied labor and equipment productivity
Environmental	Environmental factors (floods, earthquakes,…, etc.)
	Difficulty to access the site (very far, settlements)

Table 2-4: Risk factors (Enshassi et al., 2008, Abu Mousa, 2005)

Group	Risk Factor
	Adverse weather conditions
Design	Defective design (incorrect)
	Not coordinated design (structural, mechanical, electrical, etc.)
	Inaccurate quantities
	Lack of consistency between bill of quantities, drawings and specifications
	Rush design
	Awarding the design to unqualified designers
Logistics	Unavailable labor, materials and equipment
	Undefined scope of working
	High competition in bids
	Inaccurate project program
	Poor communications between the home and field offices (contractor side)
Financial	Inflation
	Delayed payments on contract
	Financial failure of the contractor
	Unmanaged cash flow
	Exchange rate fluctuation
	Monopolizing of materials due to closure and other unexpected political conditions
Legal	Difficulty to get permits
	Ambiguity of work legislations
	Legal disputes during the construction phase among the parties of the contract
	Delayed disputes resolutions
	No specialized arbitrators to help settle fast
Construction	Rush bidding
	Gaps between the Implementation and the specifications due to misunderstanding of
	drawings and specifications
	Undocumented change orders
	Lower work quality in presence of time constraints
	Design changes
	Actual quantities differ from the contract quantities
Political	Segmentation of Gaza Strip
	Working at hot (dangerous) areas (close to IDF positions)
	New governmental acts or legislations
	Unstable security circumstances (Invasions)
	Closure
Management	Ambiguous planning due to project complexity
	Resource management

Table 2-4: Risk factors (Enshassi et al., 2008, Abu Mousa, 2005)

Group	Risk Factor
	Changes in management ways
	Information unavailability (include uncertainty)
	Poor communication between involved parties

2.2.3 Risk assessment/ Analysis

Within the quantitative and qualitative categories, a number of methods can be found, which used different assumptions, and it may be problematic to choose an appropriate risk assessment model for a specific project. The methods should be chosen depending on the type of risk, project scope as well as on the specific methods requirements and criteria. Regardless of the method chosen, the desired outcome of such assessment should be reliable (Mahendra et al., 2013). Chapman (2001) mentioned that the selection of the right technique often depends on past experience, expertise, and nowadays it also depends on the available computer software.

PMBOK (2013) summarized the qualitative and quantitative risk analysis as follows:

A) **Perform qualitative risk analysis** is the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact. The key benefit of this process is that it enables project managers to reduce the level of uncertainty and to focus on high-priority risks. The inputs, tools and techniques, and outputs of this process are depicted in Figure (2-3).

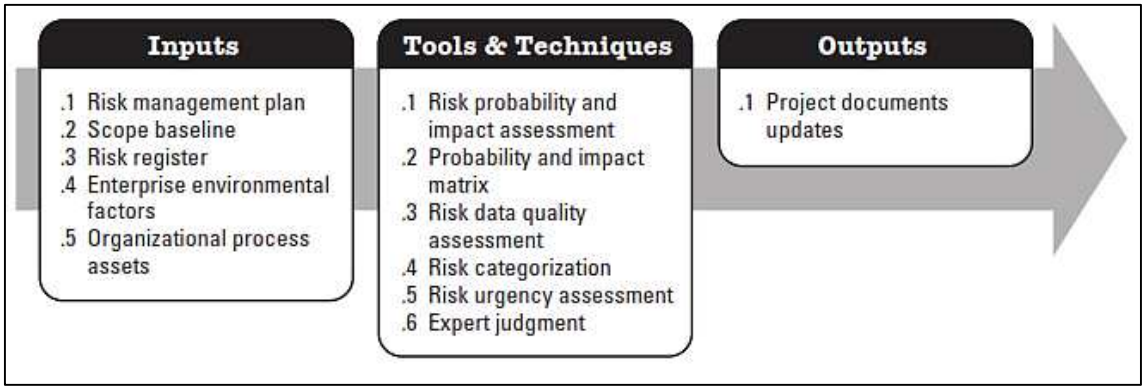

Figure 2-3 Perform qualitative risk analysis (PMBOK, 2013)

B) **Perform quantitative risk analysis** is the process of numerically analyzing the effect of identified risks on overall project objectives. The key benefit of this process is that it produces quantitative risk information to support decision making in order

to reduce project uncertainty. The inputs, tools and techniques, and outputs of this process are depicted in Figure (2-4).

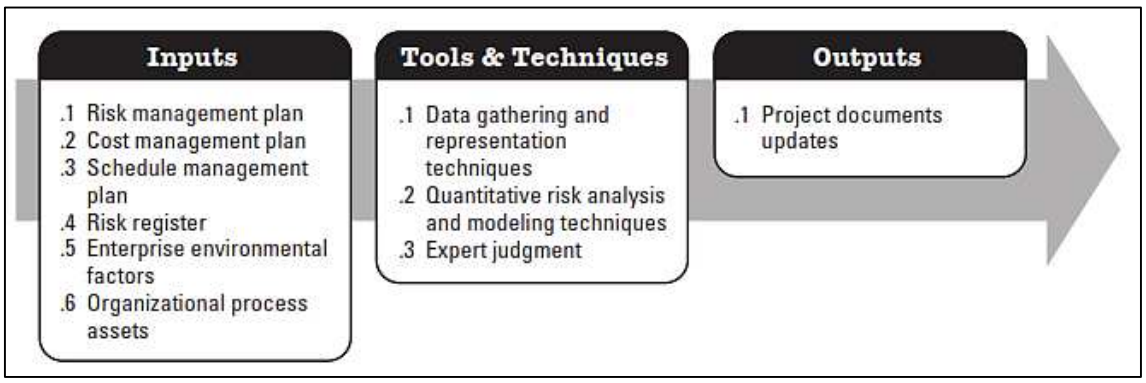

Figure 2-4 Perform quantitative risk analysis (PMBOK, 2013)

2.2.4 Risk response

Plan risk responses is the process of developing options and actions to enhance opportunities and to reduce threats to project objectives. The key benefit of this process is that it addresses the risks by their priority, inserting resources and activities into the budget, schedule and project management plan as needed. The inputs, tools and techniques, and outputs of this process are depicted in Figure (2-5) (PMBOK, 2013).

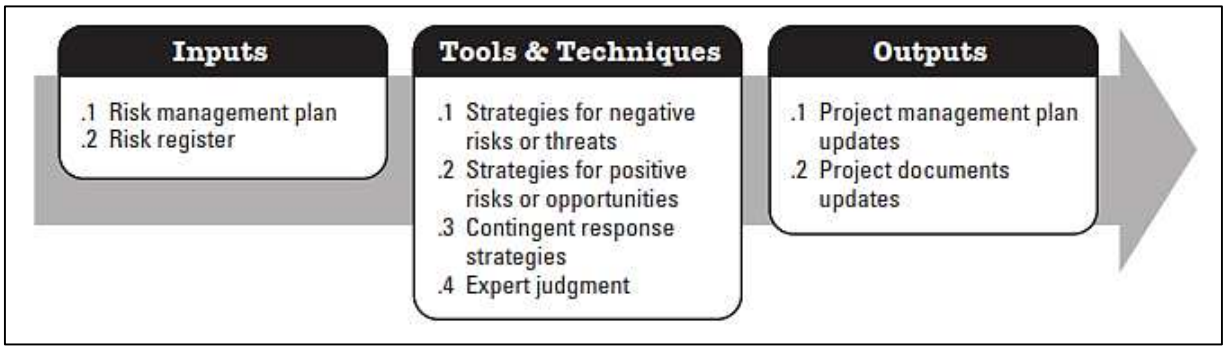

Figure 2-5 Plan risk responses (PMBOK, 2013)

The plan risk responses process follows the Perform quantitative risk analysis process (if used). Each risk response requires an understanding of the mechanism by which it will address the risk. This is the mechanism used to analyze if the risk response plan is having the desired effect. It includes the identification and assignment of one person (an owner for risk response) to take responsibility for each agreed-to and funded risk response (Chien et al., 2014).

Several risk response strategies are available. The strategy or mix of strategies most likely to be effective should be selected for each risk. Risk analysis tools, such as decision tree analysis can be used to choose the most appropriate responses. Specific actions are developed to implement that strategy, including primary and backup strategies, as necessary. A fallback plan can be developed for implementation if the selected strategy turns out not to be fully effective or if an accepted risk occurs. Secondary risks should also be reviewed. Secondary risks are risks that arise as a direct result of implementing a risk response. A contingency reserve is often allocated for time or cost. If developed, it may include identification of the conditions that trigger its use (Taillandier et al., 2015). Risk responses should be appropriate for the significance of the risk, cost-effective in meeting the challenge, realistic within the project context, agreed upon by all parties involved, and owned by a responsible person. Selecting the optimum risk response from several options is often required. The plan risk responses process presents commonly used approaches to planning responses to the risks. Risks include threats and opportunities that can affect project success (PMI, 2013).

2.2.4.1 Strategies for negative risks or threats

Three strategies, which typically deal with threats or risks that may have negative impacts on project objectives if they occur, are: avoid, transfer, and mitigate. The fourth strategy, accept, can be used for negative risks or threats as well as positive risks or opportunities. Each of these risk response strategies have varied and unique influence on the risk condition. These strategies should be chosen to match the risk's probability and impact on the project's overall objectives. Avoidance and mitigation strategies are usually good strategies for critical risks with high impact, while transference and acceptance are usually good strategies for threats that are less critical and with low overall impact. The four strategies for dealing with negative risks or threats are further described as follows (PMI, 2014).

A. Avoid

The avoidance means that by looking at alternatives in the project, many risks can be eliminated. If major changes are required in the project in order to avoid risks, Darnall and Preston (2010) suggested 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. Cooper et al. (2005) listed some activities that can help to avoid potential risk:

- More detailed planning
- Alternative approaches
- Protection and safety systems
- Operation reviews
- Regular inspections
- Training and skills enhancement
- Permits to work
- Procedural changes
- Preventive maintenance

B. Reduction/mitigation

When revising the whole documents as well as the available resources of the project; in another word by having an overview over the whole project, it will be easy to identify problems and predict the situations that may be occur that are causing damage. In order to reduce the level of risk, the exposed parts should be changed. This is a way of minimizing the potential risks by mitigating their likelihood (Wu, 2010). 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 (Wu, 2010). 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).

C. Transfer

It must be recognized that the risk is not eliminated, it is only transferred to the party that is best able to manage it (Pritchard and PMP, 2014). 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 (2010) recommended that the risks that are beyond the management's control should be transferred through insurance policies.

D. Accept

Risk acceptance is a risk response strategy whereby the project team decides to acknowledge the risk and not take any action unless the risk occurs. This strategy is adopted where it is not possible or cost-effective to address a specific risk in any other way. This strategy indicates that the project team has decided not to change the project management plan to deal with a risk, or is unable to identify any other suitable response strategy. This strategy can be either passive or active. Passive acceptance requires no action except to document the strategy, leaving the project team to deal with the risks as they occur, and to periodically review the threat to ensure that it does not change significantly. The most common active acceptance strategy is to establish a contingency reserve, including amounts of time, money, or resources to handle the risks (PMI, 2013).

2.2.5 Control risks

PMBOK (2013) defined the control risks as the process of implementing risk response plans, tracking identified risks monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project. The key benefit of this process is that it improves efficiency of the risk approach throughout the project life cycle to continuously optimize risk responses. The inputs, tools and techniques, and outputs of this process are depicted in Figure (2-6).

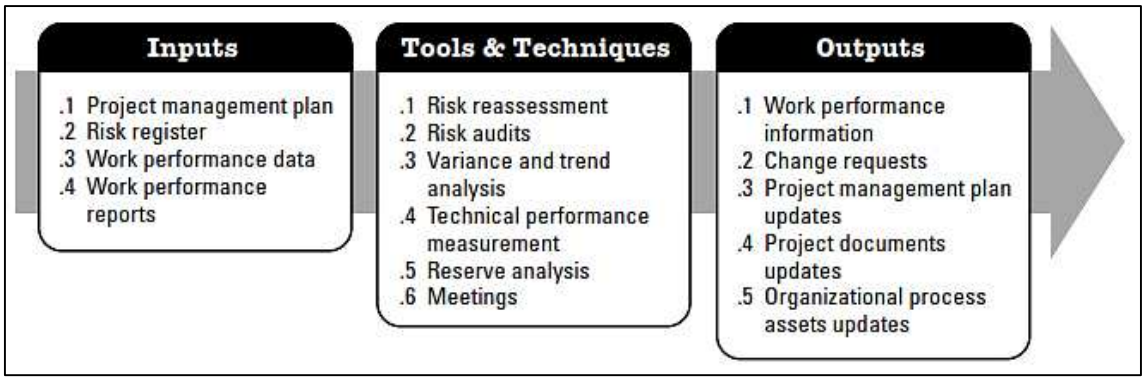

Figure 2-6 Control risks (PMBOK, 2013)

Control risks can involve choosing alternative strategies, executing a contingency or fallback plan, taking corrective action, and modifying the project management plan. The risk response owner reports periodically to the project manager on the effectiveness of the plan, any unanticipated effects, and any correction needed to handle the risk appropriately. Control risks also includes updating the organizational process assets, including project lessons learned databases and risk management templates, for the benefit of future projects (Rafindadi et al., 2014).

2.3 Decision making in risk management

It is vitally important that the way decisions are made on projects is structured, ordered and controlled. The decisions made at any particular stage should reflect the activities that are being undertaken at that stage. They should not backtrack, as this will involve abortive costs and the repetition of tasks that have already been undertaken, and they should not leap ahead as this will prejudice activities that have not been undertaken and may produce to inappropriate outcomes (Castillo et al., 2010).

Project risk management techniques have matured over time to become a fundamental facilitator in decision making (Smith et al., 2006). Nevertheless, risk management in practice is heavily orientated towards the techniques of managing risks and normally less attention is given to the identification of risks. It is not possible to manage risks if the risks are not identified and hence the underestimation of the importance of the risks identification process will negatively affect the effectiveness of a decision (Chapman, 2001).

In general, the modules of Multi Criteria Decision Making (MCDM) can include three parts: input, output, and the solution approach: The input can be expressed

as *m* alternatives with *n* criteria. On the other hand, the output can be classified as two types: a single optimal output or a set of ranking outputs preferred by decision makers. Finally, there are several solution approaches applied in MCDM problems; such as Weighted Sum Method (WSM), Weighted Product Method (WPM), Analytic Hierarchy Process (AHP), Simple Additive Weighting (SAW), the Elimination and Choice Translating Reality (ELECTRE), the Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS), and Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) (Huang et al., 2015).

Based on the risk assessment, an appropriate decision should be made regarding additional actions or proceeding to the next phase. For project management to be effective, an evaluation should be made including all phases of the project (Mohamed Shaffril et al., 2015).

Ward and Chapman (1995) used 'go', 'maybe' and 'no go' options in a decision making process. A 'go' status constituted a green light for proceeding on to the next phase while 'no go' stopped the project. Evaluation resulting in a 'maybe' decision led to return to a previous phase or even phases for further improvements and minimizing risk. The further on in the stages the 'maybe' decision was made, which took the process back to the initial phases, the more problems it caused. Decisions at the end of each stage should be made after a careful study of the possible risks which might be encountered.

This research proposed risk based on AHP model for supporting decision making in construction projects to evaluate the risks associated with various preventive actions as alternatives to be carried out before the bidding stage.

2.4 Literature review of risk management in construction projects

“Risk analysis of project duration or cost is prevalent. Further, no risk assessment approach was discovered that deploys a common scale to simultaneously assess the alternative impacts of a risk on the various project objectives. Most of the existing approaches provide a risk rating; very few actually quantify risk. The limitations of the existing theories and tools indicate the need for improved alternatives” (Taroun et al., 2011).

The Table 2-5 is showing the most common risk factors which are related to the construction projects accordind to previous literatures.

Table 2-6 Construction project' risk factors from literatures

Risk Category / Author		Abu Mousa J, 2005	El Maqousi, 2007	Meghann M. Valeo, 2010	Yelin Xu, 2010	Wen-Fang Liu et al.,2011	Hong Xian Li et al., 2013	Usama Hamed Issa, 2013	Patel Ankit Mahendra et al. ,2013	Yao-Chen Kuo and Shih-Tong Lu, 2013	Saman Aminbakhsh, et al., 2013	Acelya Ecem Yildiz et al, 2014	Kuo-Feng Chien,et al., 2014	Aminu Darda'u Rafindadi et al., 2014
Risk Group	**Risk factors**													
Physical	Occurrence of accidents because of poor safety procedures	✓	✓	✓	✓				✓		✓			
	Supplies of defective materials	✓	✓						✓					
	Equipment damage	✓	✓	✓					✓		✓			
	Varied labor and equipment productivity	✓	✓				✓	✓	✓					
Environmental	Environmental factors (floods, earthquakes, etc.)	✓			✓		✓			✓				
	Difficulty to access the site (very far)	✓												
	Adverse weather conditions	✓	✓		✓	✓			✓	✓				✓
Design	Defective design (incorrect)	✓	✓			✓	✓	✓	✓	✓		✓		✓

Table 2-6 Construction project' risk factors from literatures

Risk Category / Author		Abu Mousa J, 2005	El Maqousi, 2007	Meghann M. Valeo, 2010	Yelin Xu, 2010	Wen-Fang Liu et al.,2011	Hong Xian Li et al., 2013	Usama Hamed Issa, 2013	Patel Ankit Mahendra et al. ,2013	Yao-Chen Kuo and Shih-Tong Lu, 2013	Saman Aminbakhsh, et al., 2013	Acelya Ecem Yildiz et al, 2014	Kuo-Feng Chien,et al., 2014	Aminu Darda'u Rafindadi et al., 2014
	Not coordinated design (structural, mechanical, electrical, etc.)	✓												
	Inaccurate quantities	✓												
	Lack of consistency between bill of quantities, drawings and specifications	✓	✓				✓	✓		✓				
	Rush design	✓												
	Awarding the design to unqualified designers	✓												
Logistics	Unavailable labor, materials and equipment	✓								✓				
	Undefined scope of working	✓					✓	✓	✓		✓			
	High competition in bids	✓												
	Inaccurate project program	✓												

Table 2-6 Construction project' risk factors from literatures

Risk Category / Author		Abu Mousa J, 2005	El Maqousi, 2007	Meghann M. Valeo, 2010	Yelin Xu, 2010	Wen-Fang Liu et al.,2011	Hong Xian Li et al., 2013	Usama Hamed Issa, 2013	Patel Ankit Mahendra et al. ,2013	Yao-Chen Kuo and Shih-Tong Lu, 2013	Saman Aminbakhsh, et al., 2013	Acelya Ecem Yildiz et al, 2014	Kuo-Feng Chien,et al., 2014	Aminu Darda'u Rafindadi et al., 2014
	Poor communications between the home and field offices (contractor side)	✓						✓						
Financial	Inflation	✓			✓	✓								
	Delayed payments on contract	✓												
	Financial failure of the contractor	✓						✓						
	Unmanaged cash flow	✓							✓					
	Exchange rate fluctuation	✓	✓		✓	✓			✓			✓	✓	✓
	Increasing of materials prices		✓										✓	
	Cost Overrun			✓				✓	✓	✓		✓	✓	
	Monopolizing of materials due to closure and other unexpected political conditions	✓												
Legal	Difficulty to get permits	✓			✓				✓					

Table 2-6 Construction project' risk factors from literatures

Risk Category / Author		Abu Mousa J, 2005	El Maqousi, 2007	Meghann M. Valeo, 2010	Yelin Xu, 2010	Wen-Fang Liu et al.,2011	Hong Xian Li et al., 2013	Usama Hamed Issa, 2013	Patel Ankit Mahendra et al. ,2013	Yao-Chen Kuo and Shih-Tong Lu, 2013	Saman Aminbakhsh, et al., 2013	Acelya Ecem Yildiz et al, 2014	Kuo-Feng Chien,et al., 2014	Aminu Darda'u Rafindadi et al., 2014
	Ambiguity of work legislations	✓			✓		✓		✓			✓		✓
	Legal disputes during the construction phase among the parties of the contract	✓	✓						✓					
	Delayed disputes resolutions	✓												
	No specialized arbitrators to help settle fast	✓												
Construction	Rush bidding	✓												
	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	✓					✓							
	Undocumented change orders	✓												
	Lower work quality in presence of time constraints	✓	✓				✓	✓				✓		✓

Table 2-6 Construction project' risk factors from literatures

Risk Category / Author		Abu Mousa J, 2005	El Maqousi, 2007	Meghann M. Valeo, 2010	Yelin Xu, 2010	Wen-Fang Liu et al.,2011	Hong Xian Li et al., 2013	Usama Hamed Issa, 2013	Patel Ankit Mahendra et al. ,2013	Yao-Chen Kuo and Shih-Tong Lu, 2013	Saman Aminbakhsh, et al., 2013	Acelya Ecem Yildiz et al, 2014	Kuo-Feng Chien,et al., 2014	Aminu Darda'u Rafindadi et al., 2014
	Adverse change in availability of resources	✓					✓	✓				✓		✓
	Decrease in productivity	✓					✓					✓		
	Design changes	✓				✓	✓	✓	✓	✓				✓
	Actual quantities differ from the contract quantities	✓										✓		✓
Political	Working at hot (dangerous) areas	✓												
	New governmental acts or legislations	✓								✓				
	Unstable security circumstances (wars)	✓	✓		✓				✓					✓
	Closure	✓												
Management	Ambiguous planning due to project complexity	✓							✓					✓
	Poor resource management	✓					✓	✓						

Table 2-6 Construction project' risk factors from literatures

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	Changes in management ways	✓												
	Information unavailability (include uncertainty)	✓												
	Lack of experience							✓	✓	✓			✓	✓
	Poor communication between involved parties	✓				✓		✓						
	Lack of software capabilities	✓							✓				✓	

2.4.1 Previous studies using AHP in risk management

The AHP method provided the decision-makers with the information that is required to specify numerical weights representing the relative importance of each criteria and important factors with respect to the goal (Hwang et al., 2014). Perhaps the greatest strength of the AHP is that, although its foundation lies in complex matrix manipulation, its employment is readily available to those with little knowledge of optimization theory. Mustafa and Al-Bahar (1991) carried out a review of the AHP and a description of its application in the assessment of the riskiness of constructing the Jamuna multipurpose bridge in Bangladesh.

In another study of Zayed et al. (2008), two main projects were identified: company (macro) and project (micro) levels; assessing their effect on risk; and the researchers introduced a risk model (R) that facilitate the assessment procedure and prioritized these projects, and they introduced a risk model (R) that facilitate the assessment procedure and prioritized these projects. Four Chinese case studies (projects A, B, C, and D) were selected to implement the designed model (R) and test its results, the R index model is developed using the analytic hierarchy process (AHP).

It is important to refer to the research of Dey (2010) who developed an integrated framework for managing project risks by analyzing risk across project; work packages and activity levels, and developing responses. A conceptual risk management framework was developed using combined analytic hierarchy process (AHP) and risk map for managing project risks. The researcher found that The combined AHP and risk map approach is very effective to manage project risks across project work package and activity levels where the risk factors in project level are caused because of external forces such as business environment (e.g. customers, competitors, technological development, politics, socio-economic environment). The risk factors in work package and activity levels were operational in nature and created due to internal causes such as lack of material and labor productivity, implementation issues, team ineffectiveness, etc.

Kansal and Sharma (2012) assessed the use and method of risk identification techniques in the construction industry which were classified in specialized industrial construction, infrastructure and heavy construction. As each method of risk assessment had its limitation, It was observed that the used risk assessment methods can be integrated into

new approach that can aid the decision makers applying the risk assessment effectively Analytic Hierarchy Process (AHP). Befor that, a conclusion was showed by Liu et al. (2011) as they sat up the index system by Delphi method, structured model by AHP method, then made assessment on risk of engineering project by Fuzzy Comprehensive Evaluation.

Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects was conducted by Aminbakhsh et al. (2013), they presented a robust method for prioritization of safety risks in construction projects to create a rational budget and to set realistic goals without compromising safety. a safety risk assessment framework is presented based on the theory of cost of safety (COS) model and the analytic hierarchy process (AHP). The finding of this research was the framework that provided a decision tool for the decision makers to determine the adequate accident/injury prevention investments while considering the funding limits.

CHAPTER 3: METHODOLOGY

This chapter describes the method employed in this research; it is initiated with finding the research area and formulating research questions. Further, the investigation method is chosen along with research strategy, research design, population, sample size and various approaches for data collection techniques to achieve the main objectives and so the main purpose of this research. Finally, the collected data is analyzed and interpreted what leads to illuminate the conclusions. The research was carried out in Gaza Strip- Palestine.

3.1 Research strategy

Creswell (2013) supposed that often the distinction between qualitative and quantitative research is framed in terms of using words (qualitative) rather than numbers (quantitative), or using closed-ended questions (quantitative hypotheses) rather than open-ended questions (qualitative interview questions). A more complete way to view the gradations of differences between them is in the basic philosophical assumptions researchers bring to the study. The triangulating data sources-a means for seeking convergence a cross qualitative and quantitative methods -were born. From the original concept of triangulation emerged additional reasons for mixing different types of data. For example, the results form one method can help develop or inform the other method. Alternatively, one method can be nested within another method to provide insight into different levels or units of analysis. According to Johnson and Onwuegbuzie (2004), "Mixed methods research is formally defined here as the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study. Mixed methods research also is an attempt to legitimate the use of multiple approaches in answering research questions, rather than restricting or constraining researchers' choices (i.e., it rejects dogmatism). It is an expansive and creative form of research, not a limiting form of research. It is inclusive, pluralistic, and complementary, and it suggests that researchers take an eclectic approach to method selection and the thinking about and conduct of research".

In this research, a mixed approach -qualitative and quantitative approach - is selected to determine the variables and factors that affect the risk management practices in building projects in Gaza Strip through the contracting companies.

3.2 Research design

In this research, site visits, semi-structured interviews, unstructured interviews and literatures review are used to collect data and information. A framework has been done by the researcher in order to understand the real situation of risk management of construction projects in Gaza strip. Figure (3-1) is summarized the research design and showed integration of the methodology.

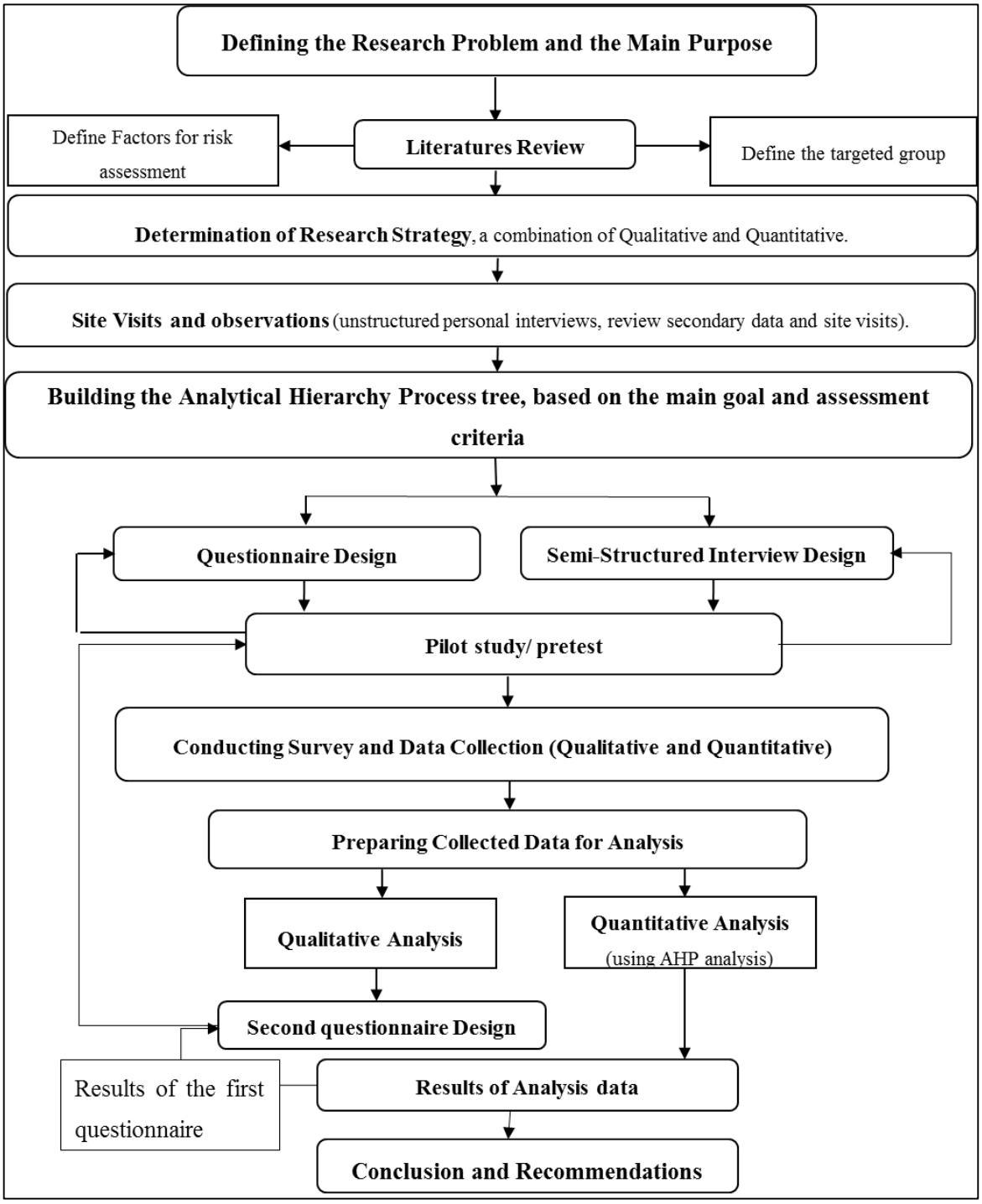

Figure 3-1: The Flow Chart of the Research Methodology

3.3 Research techniques/ Data collection

In this research, the main approach is descriptive analytical one; so the most suitable techniques to elicit the required data were:

1. Literatures review to form the theoretical framework.
2. Site visits and observations (write down notes).
3. The personal interview (face-to-face) either unstructured or semi structured.
4. The questionnaire.

3.3.1 Literatures review

A literature review is performed to collect data. In this study, 49 parameters are found from literatures but 35 parameters were considered to be measured using the application of AHP due to risk management in the construction industry. These parameters are divided into main nine categories. The main categories are taken from previous studies of Enshassi et al. (2008) and EL-Maqousi (2007) but a validation test questionnaire and pilot study is performed after that to validate and eliminate the factors to cope with the present conditions in Gaza Strip. Site visits and observations

At the beginning, unstructured interviews are conducted for the study area; interviews took the form of 'open-ended' or 'open' questions (exploratory interviews). Here, there is no set order or wording of questions, purely an exploratory questions and it is given as much as data about the problem and opinions of the interviewees, this helped a lot at the next step of designing the semi-structured interview questionnaire. Nine visits are conducted with professional experts in construction management in Gaza Strip. Table 3-1 is presented the qualification level of these professionals and their occupation.

Table 3-1: Qualification of unstructured interviewees

Name	Qualification	Years of experience	Occupation
Name 1	Msc. in civil engineering	More than 10 years	Owner of contracting company
Name 2	Bsc. in civil engineering	More than 10 years	Project coordinator at non-governmental organization
Name 3	Msc. in civil engineering	More than 10 years	Gaza area manager at non-governmental organization
Name 4	Msc. in civil engineering	More than 10 years	Construction supervision manager at Palestinian Water Authority

Table 3-1: Qualification of unstructured interviewees

Name	Qualification	Years of experience	Occupation
Name 5	Bsc. in civil engineering	More than 10 years	Owner and projects manager at contracting company
Name 6	Msc. in civil engineering	More than 10 years	Project manager at consultation office
Name 7	Msc. in civil engineering	More than 10 years	Project manager at the Palestinian ministry of housing and public works
Name 8	Bsc. in civil engineering	More than 10 years	Site engineer at contracting company
Name 9	Bsc. in civil engineering	More than 10 years	Projects coordinator at Gaza municipality

3.3.2 Personal interviews

The interview survey and ending up with qualitative data is used as a strategic choice. It is realized that having a dialog about risk management issues as well as filling in some inquiries are the best way to avoid any confusions. By using the semi-structured open-ended interviews, the respondents were free to add additional information and the researcher was free to adjust the interview questions for each situation and over time, to answer the research questions through interviews, the interview questions are key to success (Creswell, 2013).

The process used to develop the interview questions is described in Figure (3-2) where the major inputs to the interview questions come from three areas. Research questions, theoretical framework and theories of research methods, and the applied method. The background and delimitations for the thesis in Gaza Strip also give certain guidelines for both the research and interview questions. The format and function of the interview questions then set the scene for the interview, as does the overall context for the interviews, such as the number of interviews, selection of construction projects' types involved and selection of key individuals to interview.

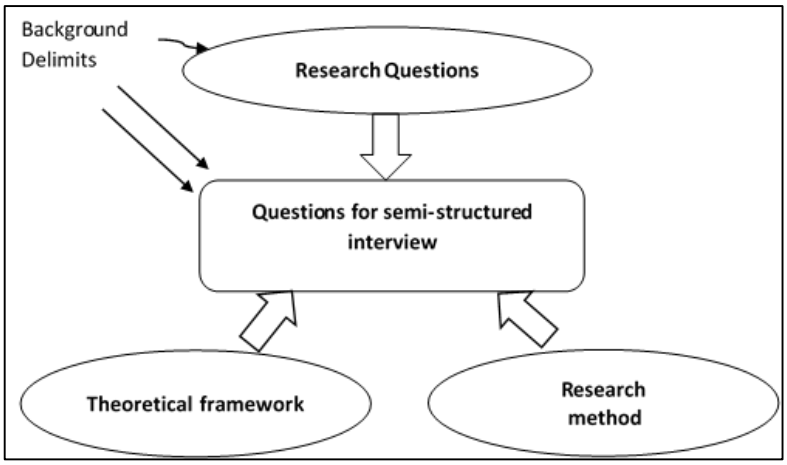

Figure 3-2: The basis for formulation the interview questions (Creswell, 2013)

In this research, ten semi-structured interviews were conducted with professional experts in construction industry, the questions focused on the factors of risk management that recorded as common in the construction of building projects and if the contracting companies use the knowledge of risk management or not in their work especially during pre-bidding phase. On the other hand, the preventive actions toward the risk that may be exposed the construction projects also were discussed as open ended questions. In the same interviews, the interviewees filled out the first questionnaire.

Table 3-2 is summarized the interviewees who were sharing in the main step of the research method.

Table 3-2: Qualification of the semi-structured interviewees

Name	Qualification	Years of experience	Occupation
Name 1	Msc. in civil engineering	More than 10 years	Owner of contracting company
Name 2	Bsc. in civil engineering	More than 10 years	Project manager at contracting company
Name 3	Bsc. in civil engineering and Msc. in business administration	More than 10 years	Procurement manager at contracting company
Name 4	Msc. in civil engineering	More than 10 years	Construction Supervision Manager at contracting company
Name 5	Bsc. in civil engineering	More than 10 years	Owner and projects manager at contracting company
Name 6	Bsc. in civil engineering	More than 10 years	Project manager at contracting company

Table 3-2: Qualification of the semi-structured interviewees

Name	Qualification	Years of experience	Occupation
Name 7	Msc. in civil engineering	More than 10 years	Project manager at contracting company
Name 8	Msc in environmental management and Bsc. in architecture	5 years	Procurement engineer at contracting company
Name 9	Bsc. in civil engineering	More than 10 years	Projects manager at contracting company
Name 10	Msc. in civil engineering	More than 10 years	Executive officer at contracting company

3.3.3 Questionnaires development

The questionnaire is a widely used data collection technique for conducting surveys. It is widely used for descriptive and analytical surveys in order to find out facts, opinions and views. It enhances confidentiality, supports internal and external validity, facilitates analysis, and saves resources (Naoum, 2012).

Two questionnaires are developed in this research; the first one is prepared to determine the priority of the main groups and the risk factors for construction projects. Then, these findings are conducted to be a part of the second questionnaire, which is developed upon the literature review besides the output of the descriptive analysis of semi-structure interview about the preventive actions that the contractor must take into account in the pre-bidding stage. The questionnaires are discussed with the supervisor and amended according to his advice.

3.3.3.1 Pilot Study

"During the construction of the questionnaire, it is necessary to conduct the pilot study, and it is advisable to conduct a pilot study before the collection of final data for the whole sample. By a pilot study, a trial run for the questionnaire can be done, which includes test for the wording of the questions identifying ambiguous questions, test for the technique that used to collect the data, measurement of the effectiveness of standards invitations to respondents" (Naoum, 2012).

Naoum (2012) said that pilot study is an effective way of improving question wording and avoiding mistakes in the questionnaires and to ensure obtaining complete, meaningful and reasonable outputs as well as to validate the objective of each part of the questionnaire and to gain any relevant data.

In this research, a pilot study is conducted to adapt the questionnaires before using them in the main survey. Respondents were then requested to feedback on any comments in the questionnaires design and any suggestions for refining the questionnaires so as to test the reliability and validity of them before committing to the complete sample population, the pilot study was undertaken by inviting 10 professionals. These professionals is selected with more than 10 years of experience in construction work.

Minor modifications were done to the design of the first questionnaire where the part 2 was displayed firstly but after the pilot study, it has been moved to the last section of the questionnaire. The second questionnaire has no major modifications.

Some factors were repeated, weak, or not effective so that they are omitted. Other factors are modified to suit Gaza strip construction work nature. In addition, the pilot study corrected some grammatical and spilling mistakes. All that is shown in Table 3-3 in term of selected and modified risk factors.

Table 3-3: Selected risk factors

	Construction Project Risk Factors	**Action**	**Final modified factors**
Physical	Occurrence of accidents because of poor safety procedures	Selected factor	Occurrence of accidents because of poor safety procedures
	Supplies of defective materials	Selected factor	Supplies of defective materials
	Equipment damage	Selected factor	Equipment damage
	Varied labor and equipment productivity	Merged with the decreasing productivity in construction group	---
Environmental	Environmental factors (floods, earthquakes,…, etc.)	Not considering a high risk factors in Gaza Strip	---
	Difficulty to access the site (very far)	Not considering a high risk factors in Gaza Strip	---
	Adverse weather conditions	Not considering a high risk factors in Gaza Strip	---
Design	Defective design	Selected factor	Defective design (incorrect)
	Not coordinated design (structural, mechanical, electrical, etc.)	Selected factor	No coordination between design departments (structural, mechanical, electrical, etc.)

Table 3-3: Selected risk factors

	Construction Project Risk Factors	Action	Final modified factors
	Inaccurate quantities	Merged with the next factor as it is a direct consequence of it	---
	Lack of consistency between bill of quantities, drawings and specifications	Merged with the next factor as it is a direct consequence of it	---
	Rush design	Selected factor	Preparing designs with urgent haste (Rush Design)
	Awarding the design to unqualified designers	Selected factor	Awarding the design to unqualified designers
Logistics	Unavailable labor, materials and equipment	Selected factor	Unavailable labor, materials and equipment
	Inaccurate project program	Selected factor	Inaccurate project program
	Poor communications between the home and field offices	Selected factor	Poor communications between the home and field offices (contractor side)
Financial	Inflation	Selected factor	Inflation
	Delayed payments on contract	Selected factor	Delayed payments on contract
	Financial failure of the contractor	Selected factor	Financial failure of the contractor
	Unmanaged cash flow	Selected factor	Unmanaged cash flow
	Exchange rate fluctuation	Selected factor	Exchange rate fluctuation
	Increasing of materials prices	Selected factor	Increasing of materials prices
	Cost Overrun	Merged with the previous and next factors as it is a direct consequence of them	---
	Monopolizing of materials due to closure and other unexpected political conditions	Selected factor	Monopolizing of materials due to closure and other unexpected political conditions
Legal	Difficulty to get permits	Not considering a rea risk in Gaza Strip	---

Table 3-3: Selected risk factors

	Construction Project Risk Factors	Action	Final modified factors
	Ambiguity of work legislations	Not considering a rea risk in Gaza Strip	---
	Legal disputes during the construction phase among the parties of the contract	Selected factor	Legal disputes during the construction phase among the parties of the contract
	Delayed disputes resolutions	Selected factor	Delayed disputes resolutions
	No specialized arbitrators to help settle fast	Selected factor	No specialized arbitrators to help settle fast
Construction	Rush bidding	Selected factor	Rush bidding
	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	Selected factor	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications
	Undocumented change orders	Selected factor	Undocumented change orders
	Lower work quality in presence of time constraints	Selected factor	Lower work quality in presence of time constraints
	Adverse change in availability of resources	---	---
	Decrease in productivity	Selected factor	Decrease in productivity
	Design changes	Merged with changing order factor	---
	Actual quantities differ from the contract quantities	Merged with the second factor in this group	---
Political	Working at hot (dangerous) areas	Selected factor	Working at hot (dangerous) areas
	New governmental acts or legislations	Selected factor	New governmental acts or legislations
	Unstable security circumstances (wars)	Selected factor	Unstable security circumstances (wars)
	Closure	Selected factor	Closure
Management	Changes in management ways	Selected factor	Changes in management ways
	Information unavailability	Selected factor	Information unavailability (include uncertainty)
	Lack of experience	Selected factor	Lack of experience

Table 3-3: Selected risk factors

	Construction Project Risk Factors	Action	Final modified factors
	Poor communication between involved parties	Categorized in logistic group	---------
	Lack of software capabilities	Selected factor	Lack of software capabilities
	Undefined scope of working	Selected factor	Undefined scope of working
	Ambiguous planning due to project complexity	Selected factor	Ambiguous (unclear) planning due to project complexity
	Poor resource management	Merged under the previous factor	---------

The first questionnaire consists of three parts as the following:

Part One: Contractor organization profile and personal information of the respondent who is filling the questionnaire.

Part Two: The risk factors (sub-criteria tables), this part is consisted of eight tables related to the main risk categories, in each table there is comparison between factors as pairs.

Part Three: The main risk categories/groups, this table concern about the comparison between the main categories of risk management in construction projects.

The questionnaire was developed in Arabic (Appendix No. 2) to be more understandable by respondents. An English version was prepared (Appendix No. 1) to help in documenting this research.

After finding the results of the first questionnaire, the most important and effective risk factors were resolute so then they were taken to be the main groups/criteria of the preventive actions questionnaire.

The second questionnaire consists of eleven tables upon the results of the first questionnaire, each table is headed with the risk factor which is need to obtain its preventive action from the contractor. The questionnaire was developed in Arabic (Appendix No. 4) to be more understandable by respondents. An English version was prepared (Appendix No. 3) to help in documenting this research.

3.4 Research validity and reliability

Validity refers to the degree to which an instrument measures what it is supposed to be measuring. High validity is the absence of systematic errors in the measuring instrument. When an instrument is valid; it truly reflects the concept it is supposed to measure. Reliability of an application is the degree of consistency with which it measures the attribute/quality that is supposed to be measured. The less variation a production produces in repeated measurements of an attribute, the higher its reliability. Reliability can be equated with the stability, consistency, or dependability of a measuring tool (Panas and Pantouvakis, 2011).

In this research, the consistency test is used as a specific measureable method for reliability and it is described in sec 3.10. A pilot study was conducted to evaluate the questionnaires validity, the results are shown in Table 3-3.

3.5 Research population

A population consists of the totality of the observation with which we are concerned (Creswell, 2013). In this research, the population is the total number of contractors (60 building contracting companies) of the first and second class who have valid registration by the Palestinian Contractors Union.

3.6 Sampling

Dawson (2002) discussed in her book about the sampling that in quantitative research, it is believed that if this sample is chosen carefully using the correct procedure, it is then possible to generalize the results to the whole of the research population. For many qualitative researchers however, the ability to generalize their work to the whole research population is not the goal. Instead, they might seek to describe or explain what is happening within a smaller group of people. This, they believe, might provide insights into the behavior of the wider research population, but they accept that everyone is different and that if the research were to be conducted with another group of people the results might not be the same.

The objective of sampling is to provide a practical means of enabling the data collection and processing components of research to be carried out whilst ensuring that the sample provide a good representation of the population (Fellows and Lui, 1997).

Simple sampling is used to represent the total sample size, since it is the most basic of the probability plans. A list of contractors is obtained from Palestinian Contractors Union and the samples are selected from the stratum of target population of first and second class building contracting companies.

A statistical calculation is used in order to calculate the sample size. The formula below is used to determine the sample size of unlimited population:

$$SS = \frac{z^2 \times P \times (1-P)}{C^2} \quad \text{.....Equation 3-1}$$

Where SS= Sample size.

Z= Z value (e.g. 1.69 for 95% confidence interval).

P= Percentage picking a choice, expressed as decimal, (0.50 used for sample size needed).

C= Confidence interval (0.05).

$$SS = \frac{1.69^2 \times 0.50 \times (1 - 0.50)}{0.05^2} = 384$$

Correction for finite population

$$SS_{new} = \frac{SS}{1+\frac{SS-1}{pop}} \quad \text{.....Equation 3-2}$$

The total population has been 76 companies. 32 of them is first class, and 44 of them is second class. Nonetheless, there are 16 of idle contracting company that are registered in the Palestinian Contractors Union but have no construction projects since a while, so the actual total population is 60 contracting company.

$$SS_{new} = \frac{384}{1 + \frac{384 - 1}{60}} = 52.09 \approx 52$$

52 copies of the questionnaire were distributed by direct contact to building contractors. 40 copies were answered; 76.9% represent a good percentage of response compared to similar cases. 12 questionnaires were excluded due to incorrect and incomplete answers.

3.7 Research location

The research was carried out in Gaza Strip, which consists of five governorates; the North, Gaza, the Middle, Khan-Younus and Rafah. These five areas are considered the southern territories of Palestinian National Authority (PNA).

3.8 Limitation of the research

- Due to time limitation, this research is concerned with building projects only and that other categories of construction industry like heavy engineering construction (tunnels, bridges, dams, etc.), industrial projects (factories and workshops), and infra-structure projects (sewage and water supply) were not taking into account.

- This research is limited to the contractors who have a valid registration through the Palestinian Contractors Union. All other organizations that have its own classification for contracting companies such as UNRWA, UNDP, etc. will be excluded.

- Also, contractors of first and second class represent the population of this study, other classes were excluded as the researcher believes that their work is too limited to let them consider properly risk factors.

- This study is limited to the construction industry contractors in Gaza Strip who are intended to bid any building construction project, in the pre-bidding phase.

3.9 Previous methodologies

A survey research was conducted by Kansal and Sharma (2012), their methodology was started by data collection for risk assessment then followed by analysing of data using Risk Significant Index Method. It was found that the used methods for risk assessment were Brainstorming, checklist, Flowchart Delphi method, Risk significant index method. As each method of risk assessment had its limitation, It was observed that the used risk assessment methods can be integrated into new approach that can aid the decision makers applying the risk assessment effectively.

Based on "human - machine - environment - Management" complex system Shi et al. (2012) developed the risk assessment index system which is about 4 major categories include the quality of factors of production personnel and the production equipment factors and the environmental conditions factors and the safety management factors, in

addition to 23 subcategories which was established. The AHP-Fuzzy evaluation model of risk assessment of falling from height and weight sets were established based on AHP and fuzzy comprehensive evaluation method. The risk assessment example was given and the results were conformed to reality.

In a nother way Li et al. (2013) identified and ranked risk factors in the context of project duration and cost, based on the characteristics of modular construction; first they quantified risk factor variations and their impact on projects, then they assessed the cost and duration risks for a modular construction project. The risk identification and ranking were evaluated by a focus group of experts from the modular construction industry; t-distribution and chi-squared distribution were applied to analyze the results. The case of a project in Edmonton, Canada was presented to illustrate application of the proposed methodology.

Yildiz et al. (2014) developed a risk mapping tool and a case study was conducted to explain how the risk ratings are defined by different decision makers and identify the reasons of possible divergence between assigned ratings. This case study was complemented with three construction experts by using data of a real construction project and risk assessment exercise had been repeated using different strategies to collect expert opinion on risk ratings. The results of the case study show that although the subjectivity of ratings and sensitivity to risk attitude cannot be totally overcome, some strategies may be used to ensure a more reliable risk rating process. Those strategies mainly cover minimization of divergence of assumptions made by the decision-makers, clarifying what is included under the identified risk factors by defining sub-risk attributes and facilitating group decision-making. So that AHP methos is used in this research to overcome thses issues.

3.10 AHP as a research analysis method

The Analytical Hierarchy Process (AHP) is a decision-aiding method developed by (Saaty, 1990, Saaty, 1994a, Saaty, 1999, Saaty and Vargas, 2012). AHP, since its invention, has been a tool at the hands of decision makers and researchers; and it is one of the most widely used multiple criteria decision-making tools. It aims at quantifying relative priorities for a given set of alternatives on a ratio scale, based on the judgment of the decision-maker, and stresses the importance of the intuitive judgments of a decision-maker as well as the consistency of the comparison of alternatives in the decision-making

process. Since a decision-maker bases judgments on knowledge and experience, then makes decisions accordingly, the AHP approach agrees well with the behavior of a decision-maker.

The strength of this approach is that it organizes tangible and intangible factors in a systematic way, and provides a structured yet relatively simple solution to the decision-making problems. In addition, by breaking a problem down in a logical fashion from the large, descending in gradual steps, to the smaller and smaller, one is able to connect, through simple paired comparison. In addition, AHP is flexible to be integrated with different techniques like Linear Programming, Quality Function Deployment, Fuzzy Logic, etc. This enables the user to extract benefits from all the combined methods, and hence, achieve the desired goal in a better way.

Many outstanding works have been published based on AHP: they include applications of AHP in different fields such as planning, selecting a best alternative, resource allocations, resolving conflict, optimization, etc., and numerical extensions of AHP (Saaty and Vargas, 2012).

The AHP procedure involves six essential steps (Saaty, 1990).

1. Define the unstructured problem
2. Developing the AHP hierarchy
3. Pair-wise comparison
4. Estimate the relative weights
5. Check the consistency
6. Obtain the overall rating

First step: Define the unstructured problem, in this step the unstructured problem and their characters should be recognized and the objectives and outcomes stated clearly.

In the first questionnaire, the main goal is to identify the most important risk factors that have the optimum negative impact on a construction of building projects in Gaza Strip according their categorized groups. In the second questionnaire, the main goal is to identify the optimum preventive action to every risk factor in a construction of building projects in Gaza Strip according their categorized groups.

Second step: Developing the AHP hierarchy; the first step in the AHP procedure is to decompose the decision problem into a hierarchy that consists of the most important elements of the decision problem (Lee, 2010) .In this step the complex problem is decomposed into a hierarchical structure with decision elements.

In the first questionnaire, the hierarchy is illustrated in Figure (3-3).

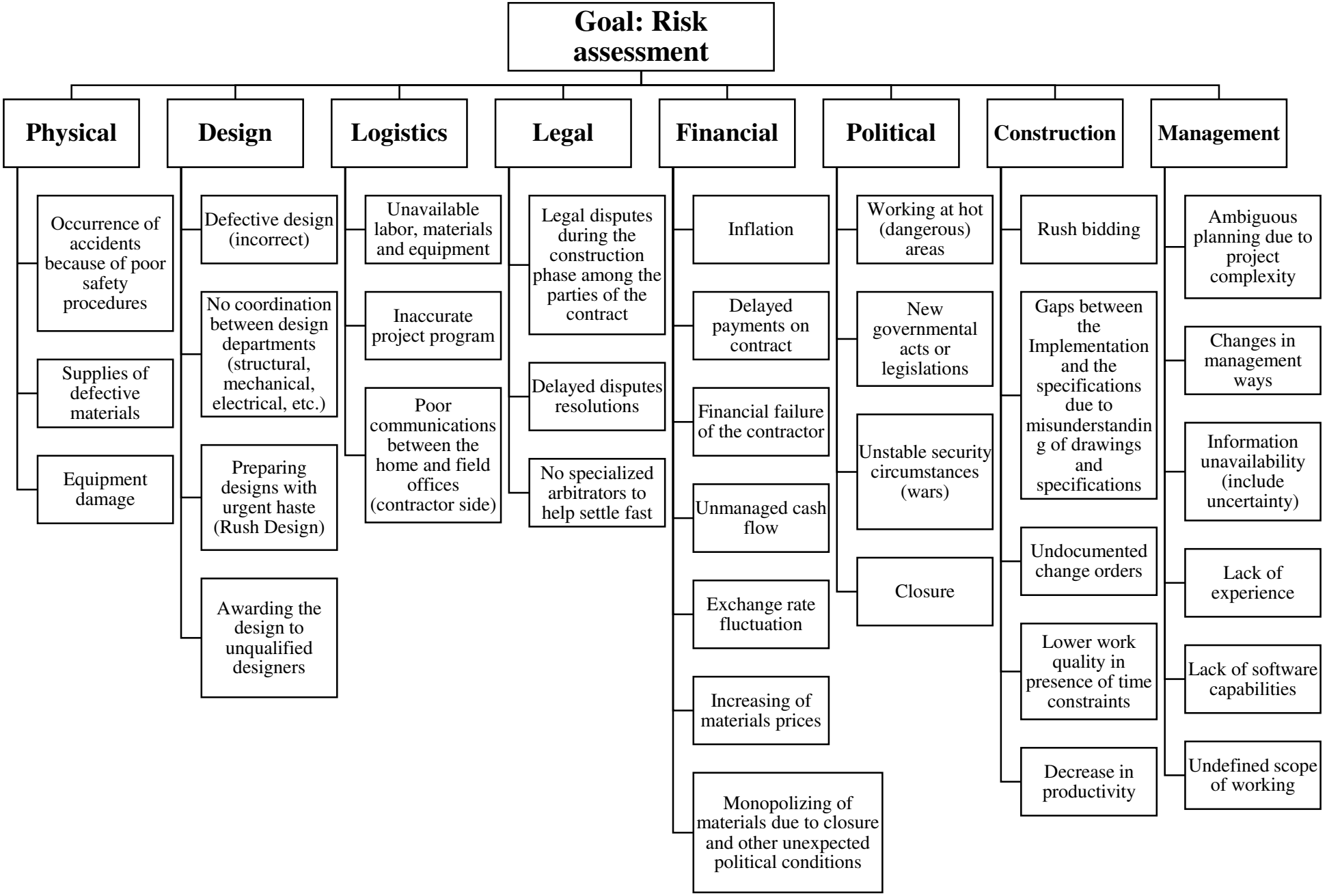

Figure 3-3 Hierarchy model of the first questionnaire

In the second questionnaire, the hierarchy is illustrated in Figure (3-4).

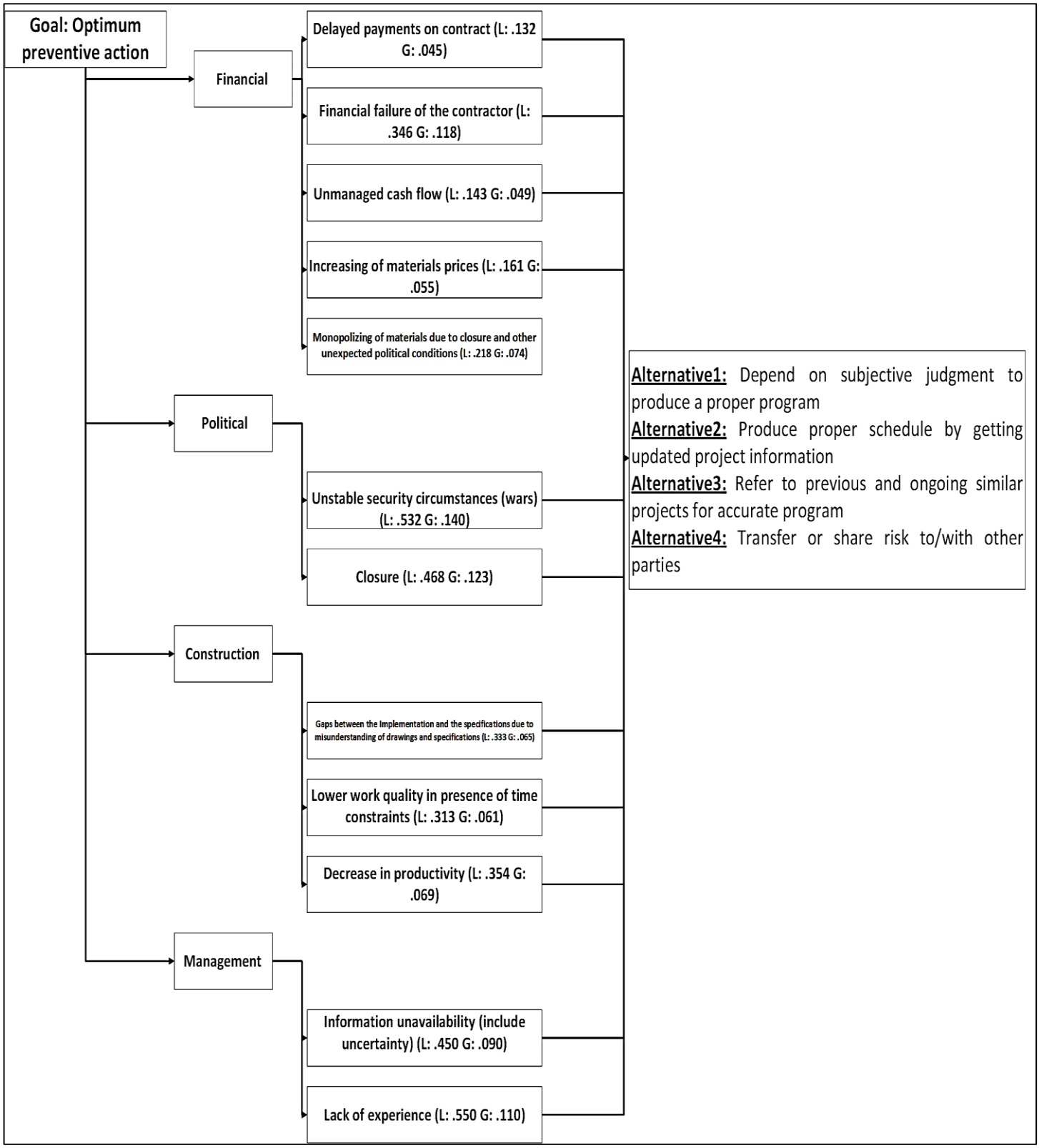

Figure 3-4: Hierarchy model of the second questionnaire

Third step: Pair-wise comparison; for each element of the hierarchy structure all the associated elements in low hierarchy are compared in pair-wise comparison matrices as follows:

$$A = \begin{bmatrix} 1 & \frac{w_1}{w_2} & \dots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & 1 & \dots & \frac{w_2}{w_n} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \vdots & 1 \end{bmatrix} \quad \text{.....Equation 3-3}$$

Where A = comparison pair-wise matrix,

w_1 = weight of element 1,

w_2= weight of element 2,

w_n= weight of element n.

In order to determine the relative preferences for two elements of the hierarchy in matrix A, an underlying semantically scale is employs with values from 1 to 9 to rate Table 3-4.

Table 3-4: Scales for pair-wise comparison (Saaty, 1990)

Preference expressed in numeric variables	Preference expressed in linguistic variables
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Intermediate values between adjacent scale values

This step is developed in the two questionnaires (Appendix No. 1 and No 3).

Fourth step: Estimate the relative weights

Some methods like eigenvalue method are used to calculate the relative weights of elements in each pair-wise comparison matrix. The relative weights (W) of matrix A is obtained from following equation:

$$A \times W = \lambda_{max} \times W \quad \text{.....Equation 3-4}$$

Where: λmax = the biggest eigenvalue of matrix A,

Pair-wise comparisons; the normal procedure of a pair-wise comparison is to invite experts to compare two sub-cluster's elements with respect to their respective cluster's element. Saaty (1990) has developed a 9-point priority scale of measurement, with a score of 1 representing equal importance of the two compared elements and 9 being overwhelming dominance of one element (row element) over another element (column element). When there is overwhelming dominance of a column element over a row element, a score of 1/9 is given.

Fifth step: Check the consistency

After the pair-wise comparison matrices are developed, a vector of priorities (i.e. a proper or Eigen-vector) in each matrix is calculated and is then normalized to sum to 1.0 or 100 per cent. This is done by dividing the elements of each column of the matrix by the sum of that column (i.e. normalizing the column); then, obtaining the eigen vector (e-Vector) by adding the elements in each resulting row (to obtain 'a row sum') and dividing this sum by the number of elements in the row (to obtain 'priority or relative weight') (Cheng and Li, 2004).

In this step the consistency property of matrices is checked to ensure that the judgments of decision makers are consistent. For this end, some pre-parameter is needed. As priorities make sense only if derived from consistent or near consistent matrices, a consistency check must be applied. Saaty (1977) has proposed a consistency index (CI), which is related to the eigenvalue method: Consistency Index is calculated as:

$$CI = \frac{\lambda_{max} - n}{n-1} \quad \text{.....Equation 3-5}$$

The consistency index of a randomly generated reciprocal matrix shall be called to the random index (RI), RI is the random index (the average CI of 500 randomly filled matrices), that can be seen in (Saaty, 1990). Generally, if CR is less than 0.1, the judgments are consistent, so the derived weights can be used. The formulation of CR is:

$$CR = \frac{CI}{RI} \quad \text{.....Equation 3-6}$$

For ascertaining the consistency of the judgment matrices, Saaty (1994b) suggested three threshold levels:

1. 0.05 for 3-by-3 matrix;
2. 0.08 for 4-by-4 matrix; and

3. 0.10 for all other matrices.

Those who want to know the algorithm for computing consistency ratio may refer to Wind and Saaty (1980) and Cheng and Li (2004).

Sixth step: Obtain the overall rating

In last step, the relative weights of decision elements are aggregated to obtain an overall rating for the alternatives as follows:

$$p_i = \sum w_j \times l_{ij} \quad \text{.....Equation 3-7}$$

Where:

$p_{i:}$ global priority of the alternative *i*

lij: local priority

wj: weight of criterion j

The combined assessments are calculated by geometric mean values of the individual assessments made. The multiplicative error is commonly accepted to be log normal distributed (similarly the additive error would be assumed to be normal distributed).

$$Pi = \sqrt[n]{\sum_{j=1}^{n} a_{ij}} \text{.....Equation 3-8}$$

Where:

Pi: the final judgment weight of the all respondents.

n: number of respondents

a: the judgment weight of the respondent i.

The geometric mean will minimize the sum of these errors. The geometric mean (also sometimes known as Logarithmic Least Squares Method) can be easily calculated by hand and has been supported by a large segment of the AHP community.

3.10.1 Sensitivity analysis

Bertolini et al. (2006) said that to investigate the consequences of the variation of the weight of a criterion. With the sensitivity analysis, it is possible to measure the robustness of the solution and determine the criteria that have more relevance on the final result and it is performed with an interactive graphical interface, where the input data are slightly

modified in order to observe the impact on the results. If the ranking does not change, the results are said to be robust.

The sensitivity analysis in Expert Choice varies the weights of the criteria as input data. It is also imaginable to have in future a sensitivity analysis by varying interactively the local priorities of the alternatives (there is no mathematical challenge in it). However, sensitivity analysis is a fundamental process in the decision with AHP; it has received little attention from the academic literature.

In this research, the sensitivity analysis is carried out to investigate the sensitivity of the results to changes in the priorities of the criteria. This will be explained in details in Chapter 4.

CHAPTER 4: RESULTS AND DISCUSSION

This study, conducted in the Gaza Strip, is to evaluate the risk situation in construction projects specially in building projects for contractors; to determine the main risk factors in building projects, and to determine different preventive actions that must be considered during the planning stage before tendering. The results are illustrated in this chapter. The profile of contracting company and the personal information is discussed in addition the final results of the questionnaire are compared with the results from semi-structure interview as well as the descriptive analysis of the open-ended questions are conversed and then developed to be another questionnaire that its results are also discussed in this chapter .

4.1 Results of the general information (part 1 of the first questionnaire)

This part consists of two sections; the first section investigates the sample respondent's personal information with four categories; gender, qualification level, specialization and work experience. The second section investigates the contracting company profile with four categories; company's experience, average amount of contract for construction project, average period of construction project and average percentage of subcontractor' share.

The same first questionnaire is used in semi-structure interviews, conducted with ten experts, the results is compared with surveyed questionnaire results in Table 4-1 and Table 4-2. As well as open ended questions were asked to them and the qualitative analysis results are also presented.

4.1.1 The personal information (the first section in part 1)

Personal information of the questionnaire respondents:

In gender category, there were 55% males and 45% females who are filling the first and second questionnaire. Their qualifications were vary between bachelor degrees with 43%, master degree with 55% and 3% were the percentage of personnel who have doctoral degree. The specialization of the respondents were just civil engineers with 80% and architectural engineers with 20%. The variation in the respondents' gender, qualification level and specialization is owing to multi-disciplinary situation in construction industry. All the respondents were working in the building contracting company and their work

experiences were very strong as 50% of them have been working in construction filed more than 10 years and only 13% of them have less than 5 years' experience. This designates that respondents are generally mature in construction business.

Personal information of the interviewees:

Table 4-1 designates that 80% of interviewees were males; most of them hold master degrees with 70% percentage among others. 90% of interviewee were civil engineers and the rest were architects. 90% of the respondents have more than 10 years' work experience in construction industry and 10% of them have experience from 5 to less than 10 years. The overall information about the interviewees indicate that they are very trusted, influential qualifying personnel with high experience

Table 4-1: Personal general information

Personal general information	Categories	Questionnaires' respondents		Interviewees	
		Frequency	Percentage %	Frequency	Percentage %
Gender	Male	22	55%	8	80%
	Female	18	45%	2	20%
	Total	**40**	**100%**	**10**	**100%**
Qualification level	Bachelor	17	43%	2	20%
	Master	22	55%	7	70%
	Doctoral	1	3%	1	10%
	Total	**40**	**100%**	**10**	**100%**
Specialization	Architecture	8	20%	1	10%
	Civil	32	80%	9	90%
	Electrical	0	0%	0	0%
	Mechanical	0	0%	0	0%
	Total	**40**	**100%**	**10**	**100%**
Work experience	Less than 5 years	5	13%	0	0%
	5 to less than 10 years	15	38%	1	10%
	10 years and more	20	50%	9	90%
	Total	**40**	**100%**	**10**	**100%**

4.1.2 The profile of the contracting companies (the second section in part 2)

In Table 4-2, 45% of companies have an experience about 5 to less than 15 years as well as 35% have 15 to less than 25 years in construction industry which means that most

companies have been working since a very long time and have a very good experience to be useful in this research. Estimating the monetary volume for a construction project, 58% of respondents executed projects with an average amount of contract of $1 million and more while only 5% of respondents worked with less than $ 250,000, this indicates that most respondents are taken the financial risk of construction projects. In this contest, it should be noticed that the average period of a construction project is reasonable as 63% of respondents have been executed 12 months to less than 2 years project, which is the dominant period between others.

In this section there is final question about the sharing percentage with subcontractor, most of respondents (55%) are sharing 25 to less than 50% of the work to subcontractors and 20% of respondents sharing 50 to less than 75% of the construction works to subcontractors, the remnants are 25% and they are sharing less than 25% of the construction work with subcontractors. This action means that most contractors are using subcontractors to sharing the risk of the construction project but without losing the dominance of the construction contract.

Table 4-2: Profiles of companies for questionnaires' respondents

Company profile	**Categories**	**Questionnaires' respondents**	
		Frequency	**Percentage %**
Company's experience	Less than 5 year	1	3%
	5 to less than 15year	18	45%
	15 to less than 25year	14	35%
	25 years and more	7	18%
	Total	**40**	**100%**
Average amount of contract for construction project	less than $ 250,000	2	5%
	$ 250,000 to less than $ 500000	5	13%
	$ 500000 to less than $1,000,000	10	25%
	$1,000,000 and more	23	58%
	Total	**40**	**100%**
Average period of an project	Less than 6 months	0	0%
	6 to less than 12 months	11	28%
	12 months to less than 2 years	25	63%
	2 years and more	4	10%
	Total	**40**	**100%**

Table 4-2: Profiles of companies for questionnaires' respondents

Company profile	Categories	Questionnaires' respondents	
		Frequency	**Percentage %**
Average percentage of subcontractor share	Less than 25%	10	25%
	25 to less than 50%	22	55%
	50 to less than 75%	8	20%
	75 to less than 100%	0	0%
	Total	**40**	**100%**

4.2 Results of risk factor' assessment (part 2 of the first questionnaire)

As mentioned in chapter 3, the questionnaire included 35 risk factors, which have been categorized in eight main groups; these groups were physical group, design group, logistics group, financial group, legal group, construction group, political group and management group. The comparison is performed for each pair of factors in a recurrence way under the same group taking into account that this assessment for the main goal of risk assessment in construction building projects during the pre-bid phase from contractor point of view in Gaza Strip.

4.2.1 Results of the assessment of the overall factors

Table 4-3 presents the outcome rank of all factors form both the first surveyed questionnaire and the interviews as well as the rank of each.

The coding system is used to identify each factor as well as each group for example: Ph related to Physical group and the numbered item is identified the ID number of the risk factor under this group, the same coding system is used for the rest group as following:

De related to design group, Lo related to Logistics group, Le related to Legal group, Fi related to Financial group, Po related to Political group, Co related to Construction group and Ma related to Management group.

Table 4-3: Global priorities for all risk management factors

Item	Risk management factors	From Questionnaires' respondents		Rank	From interviewees		Rank
		Priority	Percentage (%)		Priority	Percentage (%)	
Ph1	Occurrence of accidents because of poor safety procedures	0.024	2.40%	**21**	0.02	2.00%	**22**
Ph2	Supplies of defective materials	0.023	2.30%	**23**	0.011	1.10%	**30**
Ph3	Equipment damage	0.023	2.30%	**24**	0.01	1.00%	**32**
De1	Defective design (incorrect)	0.017	1.70%	**29**	0.009	0.90%	**33**
De2	No coordination between design departments (structural, mechanical, electrical, etc.)	0.015	1.50%	**32**	0.009	0.90%	**34**
De3	Preparing designs with urgent haste (Rush Design)	0.015	1.50%	**33**	0.008	0.80%	**35**
De4	Awarding the design to unqualified designers	0.029	2.90%	**13**	0.027	2.70%	**14**
Lo1	Unavailable labor, materials and equipment	0.024	2.40%	**22**	0.023	2.30%	**19**
Lo2	Inaccurate project program	0.014	1.40%	**34**	0.022	2.20%	**20**
Lo3	Poor communications between the home and field offices	0.021	2.10%	**26**	0.026	2.60%	**16**

Table 4-3: Global priorities for all risk management factors

Item	Risk management factors	From Questionnaires' respondents		Rank	From interviewees		Rank
		Priority	Percentage (%)		Priority	Percentage (%)	
	(contractor side)						
Le1	Legal disputes during the construction phase among the parties of the contract	0.025	2.50%	**20**	0.026	2.60%	**17**
Le2	Delayed disputes resolutions	0.027	2.70%	**16**	0.02	2.00%	**23**
Le3	No specialized arbitrators to help settle fast	0.028	2.80%	**14**	0.027	2.70%	**15**
Fi1	Inflation	0.020	2.00%	**27**	0.013	1.30%	**28**
Fi2	Delayed payments on contract	0.030	3.00%	**12**	0.033	3.30%	**10**
Fi3	Financial failure of the contractor	0.070	7.00%	**1**	0.084	8.40%	**1**
Fi4	Unmanaged cash flow	0.033	3.30%	**9**	0.026	2.60%	**18**
Fi5	Exchange rate fluctuation	0.026	2.60%	**19**	0.021	2.10%	**21**
Fi6	Increasing of materials prices	0.0395	3.95%	**5**	0.032	3.20%	**11**
Fi7	Monopolizing of materials due to closure and other unexpected political conditions	0.049	4.90%	**4**	0.045	4.50%	**6**

Table 4-3: Global priorities for all risk management factors

Item	Risk management factors	From Questionnaires' respondents		Rank	From interviewees		Rank
		Priority	Percentage (%)		Priority	Percentage (%)	
Po1	Working at hot (dangerous) areas	0.022	2.20%	**25**	0.015	1.50%	**27**
Po2	New governmental acts or legislations	0.016	1.60%	**30**	0.016	1.60%	**26**
Po3	Unstable security circumstances (wars)	0.053	5.30%	**2**	0.067	6.70%	**3**
Po4	Closure	0.051	5.10%	**3**	0.073	7.30%	**2**
Co1	Rush bidding	0.016	1.60%	**31**	0.03	3.00%	**12**
Co2	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	0.032	3.20%	**10**	0.044	4.40%	**7**
Co3	Undocumented change orders	0.027	2.70%	**17**	0.04	4.00%	**9**
Co4	Lower work quality in presence of time constraints	0.031	3.10%	**11**	0.046	4.60%	**4**
Co5	Decrease in productivity	0.038	3.80%	**7**	0.046	4.60%	**5**
Ma1	Ambiguous planning due to project complexity	0.027	2.70%	**18**	0.018	1.80%	**25**

Table 4-3: Global priorities for all risk management factors

Item	Risk management factors	From Questionnaires' respondents		Rank	From interviewees		Rank
		Priority	Percentage (%)		Priority	Percentage (%)	
Ma2	Changes in management ways	0.014	1.40%	**35**	0.013	1.30%	**29**
Ma3	Information unavailability (include uncertainty)	0.034	3.40%	**8**	0.029	2.90%	**13**
Ma4	Lack of experience	0.039	3.90%	**6**	0.044	4.40%	**8**
Ma5	Lack of software capabilities	0.019	1.90%	**28**	0.011	1.10%	**31**
Ma6	Undefined scope of working	0.028	2.80%	**15**	0.019	1.90%	**24**
Total		**1**	**100%**		**1**	**100%**	

The priorities of all risk factors resulted from the first surveyed questionnaire are sorted from the largest weight to the least so that the majority of them are taken to be studied in the second questionnaire. These results are shown in Table 4-4 that proposes the top priority risks that must be taken into account during preparing for bidding form building contractor side in construction building projects in Gaza Strip. Priority weight and rank is shown in the same table as well as a cumulative percentage of these factors, which have 49.95% of overall weight.

The questionnaire results shows that the "Financial failure of the contractor" has the most priority weight of 7% among the 35 risk factors when risk assessment is done during pre-bidding phase and it is not surprising which is as expected. "Unstable security circumstances (wars)" has a priority weight of 5.3% and "Closure" 5.1%, which means that these political factors affect negatively in a high level in the building construction projects so they must be taking into account in pre-bid stage for the intended project.

So the responsibility of such risks must be handled from a specific party, which will reflect in pricing phase. Many contractors suffered damages due to these factors during the last five years.

"Closure" with 5.1% priority has the third rank , closure risk factor has a big effect on "Monopolizing of materials due to closure and other unexpected political conditions" which has 4.9% priority (forth rank) in addition to the negative effect on increasing of material prices which has 3.9% priority (fifth rank) these findings is supported from EL-Maqousi (2007) conclusions also.

Table 4-4: Top risk management factors from the fist surveyed questionnaire

Item	Risk management factors	Priority weight	Priority (%)	Cumulative priority (%)	Rank
Fi3	Financial failure of the contractor	0.070	7.00%	7.00%	1
Po3	Unstable security circumstances (wars)	0.053	5.30%	12.30%	2
Po4	Closure	0.051	5.10%	17.40%	3
Fi7	Monopolizing of materials due to closure and other unexpected political conditions	0.049	4.90%	22.30%	4
Fi6	Increasing of materials prices	0.0395	3.95%	26.25%	5
Ma4	Lack of experience	0.039	3.90%	30.15%	6
Co5	Decrease in productivity	0.038	3.80%	33.95%	7
Ma3	Information unavailability (include uncertainty)	0.034	3.40%	37.35%	8
Fi4	Unmanaged cash flow	0.033	3.30%	40.65%	9
Co2	Gaps between the Implementation and the specifications due to misunderstanding of	0.032	3.20%	43.85%	10

Table 4-4: Top risk management factors from the fist surveyed questionnaire

Item	Risk management factors	Priority weight	Priority (%)	Cumulative priority (%)	Rank
	drawings and specifications				
Co4	Lower work quality in presence of time constraints	0.031	3.10%	46.95%	11
Fi2	Delayed payments on contract	0.030	3.00%	49.95%	12

The priorities of all risk factors resulted from interviews are sorted from the largest weight to the least, Table 4-5 proposes the top of these risks that must be taken into account during preparing for bidding form building contractor side in construction building projects in Gaza Strip. Priority weight and rank is shown in the same table as well as a cumulative percentage of these factors, which have 52% of overall weight.

The interviews results shows that the "Financial failure of the contractor" has the most priority weight of 8.4% among the 35 risk factors when risk assessment is don during pre-bidding phase and it is not surprising which is as expected its financial effect is the highest, and this is the same result from the surveyed questionnaire.

Many contractors suffered damages due to financial failure during the last five years. "Closure" with 7.3% priority has the second rank then "Unstable security circumstances (wars)" has a priority of 6.7% in the third rank. Unlike the questionnaire findings, the interviewees are seeing that the closure risk is more risky than unstable political situations as the preceding factor must be handled from contractor alone and this political risks are the most high risks in EL-Maqousi (2007) findings as well.

This means that these political factors affect negatively in a high level in the building construction projects so they must be taking into account in pre-bid stage especially during planning for the intended project so as the responsibility of such risks must be handled from a specific party, which will reflect in pricing phase.

"Lower work quality in presence of time constraints" with 4.61% priority has the fourth rank. Then "Decrease in productivity" with 4.6%

Table 4-5: Top risk management factors from the interviews

Item	Risk management factors	Priority weight	Priority (%)	Cumulative priority (%)	Rank
Fi3	Financial failure of the contractor	0.084	8.40%	8.40%	1
Po4	Closure	0.073	7.30%	15.70%	2
Po3	Unstable security circumstances (wars)	0.067	6.70%	22.40%	3
Co4	Lower work quality in presence of time constraints	0.046	4.61%	27.00%	4
Co5	Decrease in productivity	0.046	4.60%	31.60%	5
Fi7	Monopolizing of materials due to closure and other unexpected political conditions	0.045	4.50%	36.10%	6
Co2	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	0.044	4.4%	40.50%	7
Ma4	Lack of experience	0.043	4.30%	44.80%	8
Co3	Undocumented change orders	0.041	4.10%	48.90%	9
Fi2	Delayed payments on contract	0.033	3.30%	52.20%	10

The priority weight for all factors under each group (main criteria) are mentioned in the next tables for both surveyed questionnaire and interviews.

4.2.2 Assessment of the physical group (Ph)

Table 4-6 itemizes the group No.1, physical criteria, and its recorded factors with their priority weights. The "Occurrence of accidents because of poor safety procedures" factor with 35 % is resulted from the first questionnaire, has the first priority as well as it has 49.30% from interview' results if the physical criterion is chosen to be considered. Conversely, the least priority factor is "Equipment damage" with 32.40% from questionnaire's results, but the "Supplies of defective materials" factor with 26.30% is resulted from interviews as the least priority factor to be considered if physical criterion is chosen.

These findings is conflicting with the findings of Abu Mousa (2005) as the supply of defect materials was the most important risk in the physical group, then occurrence of accidents was the second from importance and the third was the variation in labor and equipment productivity.

Table 4-6: Risk factors priorities under physical group

Item	Physical factors	Priority from survey	Rank	Priority from interviews	Rank
Ph1	Occurrence of accidents because of poor safety procedures	0.350	1	0.493	1
Ph2	Supplies of defective materials	0.324	3	0.263	2
Ph3	Equipment damage	0.326	2	0.244	3
Total		**1**		**1**	

4.2.3 Assessment of the design group (De)

Table 4-7 itemizes the group No.2, Design criteria, and its recorded factors with their priority weights. The "Awarding the design to unqualified designers" factor with 39.60% from questionnaire' results has the first priority as well as it has 50.50% from interview' results if the design criterion is chosen to be considered this is the same findings of (Abu Mousa, 2005, Kartam and Kartam, 2001). Conversely the priority of "No coordination

between design departments" is 19.10% with the third rank from questionnaire and 17.7% with the second rank from interviews.

"Preparing designs with urgent haste (Rush Design)" has 19% priority from questionnaire's results and has the last priority like the result from interviews with 15% as the least priority in design criterion.

Table 4-7: Risk factors priorities under design group

Item	Design factors	Priority from survey	Rank	Priority from interviews	Rank
De1	Defective design (incorrect)	0.222	2	0.168	3
De2	No coordination between design departments (structural, mechanical, electrical, etc.)	0.191	3	0.177	2
De3	Preparing designs with urgent haste (Rush Design)	0.191	4	0.150	4
De4	Awarding the design to unqualified designers	0.396	1	0.505	1
Total		**1**		**1**	

4.2.4 Assessment of the logistics group (Lo)

Table 4-8 itemizes the group No.3, Logistics criteria, and its recorded factors with their priority weights. The least priority factor is "Inaccurate project program" with 25.90% which is resulted from the first surveyed questionnaire and it has 30.70% which is resulted from interviews. It is obvious that the mentioned issues are serious risks that could be faced. However the "Unavailable labor, materials and equipment" factor with 39.70 % from questionnaire' results has the first priority, the "Poor communications between the home and field offices" factor has the first priority with 36.30% from interview' results if the logistics criterion is chosen to be considered. These results are similar with the findings of Abu Mousa (2005).

The unavailability of labor and materials is somehow connected to political situations; if closure takes place, materials will be subject to increase in prices; reinforcement steel is a good example. Contractors worried about poor communications in their side; this reflects its occurrence, contractors should take care of this problem.

Table 4-8: Risk factors priorities under logistics group

Item	Logistics factors	Priority from survey	Rank	Priority from interviews	Rank
Lo1	Unavailable labor, materials and equipment	0.397	1	0.331	2
Lo2	Inaccurate project program	0.259	3	0.307	3
Lo3	Poor communications between the home and field offices (contractor side)	0.344	2	0.363	1
Total		**1**		**1**	

4.2.5 Assessment of the legal group (Le)

Table 4-9 itemizes the group No.4, Legal criteria, and its recorded factors with their priority weights. The "No specialized arbitrators to help settle fast" factor with 34.80% from questionnaire' results has the first priority as well as it has 37.40% from interview' results if the legal criterion is chosen to be considered. This finding is disagree with as he found that this factor has the third rank.

The priority of "Legal disputes during the construction phase among the parties of the contract" factor is 31.90%, which has the third and last rank from questionnaire's results. But the "Delayed disputes resolutions" factor with 26.90%priority has the least priority resulted from interviews if the legal criterion has to be considered.

These findings are unlike previous studies, Abu Mousa (2005) found that "Legal disputes during the construction phase among the parties of the contract" and "delayed disputes resolution and lack of specialized arbitrators" had the highest weights in the legal group.

Table 4-9: Risk factors priorities under legal group

Item	Legal factors	Priority from survey	Rank	Priority from interviews	Rank
Le1	Legal disputes during the construction phase among the parties of the contract	0.319	3	0.357	2
Le2	Delayed disputes resolutions	0.333	2	0.269	3

Table 4-9: Risk factors priorities under legal group

Item	Legal factors	Priority from survey	Rank	Priority from interviews	Rank
Le3	No specialized arbitrators to help settle fast	0.348	1	0.374	1
Total		**1**		**1**	

4.2.6 Assessment of the financial group (Fi)

Table 4-10 itemizes the group No.5, Financial criteria, and its recorded factors with their priority weights. The "Financial failure of the contractor" factor with 26.30% from questionnaire' results has the first priority as well as it has 33.10% from interview' results and the same rank of questionnaire result if the financial criterion is chosen to be considered. This finding is the same highest factor in the study of Abu Mousa (2005).

The second rank is "Monopolizing of materials due to closure and other unexpected political conditions" resulted from questionnaire 18.3% priority as well as from interviews with 17.7% priority. The "Inflation" factor has the least priority factor from questionnaire and from interviews results with 7.40%, and 5.10% respectively.

Table 4-10: Risk factors priorities under financial group

Item	Financial factors	Priority from survey	Rank	Priority from interviews	Rank
Fi1	Inflation	0.074	7	0.051	7
Fi2	Delayed payments on contract	0.116	5	0.131	3
Fi3	Financial failure of the contractor	0.263	1	0.331	1
Fi4	Unmanaged cash flow	0.119	4	0.101	5
Fi5	Exchange rate fluctuation	0.098	6	0.084	6
Fi6	Increasing of materials prices	0.147	3	0.125	4
Fi7	Monopolizing of materials due to closure and other unexpected political conditions	0.183	2	0.177	2
Total		**1**		**1**	

4.2.7 Assessment of the political group (Po)

Table 4-11 itemizes the group No.6, Political criteria, and its recorded factors with their prioritize weights. The "Unstable security circumstances (wars)" with 37.40% from questionnaire' results has the first priority but the first priority is the "Closure" factor with 42.70% from interview' results if the political criterion is chosen to be considered. "New governmental acts or legislations" has the least priority factor from questionnaire with 11% and the "Working at hot (dangerous) areas" with 8.90% has the least priority from interviews results but it had the last ranking in findings of Abu Mousa (2005).

Table 4-11: Risk factors priorities under political group

Item	Political factors	Priority from survey	Rank	Priority from interviews	Rank
Po1	Working at hot (dangerous) areas	0.157	3	0.089	4
Po2	New governmental acts or legislations	0.110	4	0.091	3
Po3	Unstable security circumstances (wars)	0.374	1	0.393	2
Po4	Closure	0.359	2	0.427	1
Total		**1**		**1**	

Almost all the political risks are considered very significant risks that is due to the unstable ongoing tense situation. However, respondents appeared that they do not care about new acts or legislations. The reason is that these acts have limited effects on construction issues.

Recently, the unstable political events in the Gaza Strip reflect the greatest unpredictable cost overburden that a contractor could face. So this factor has the first rank from questionnaire which but this factor had the fourth ranking in findings of Abu Mousa (2005).

Closure could cause unavailability of materials as well as inflation due to monopoly. Invasions could deconstruct the unaccomplished projects, which leads to disputes so it has the first rank in interviews results, and have the second rank concluded by Abu Mousa (2005).

4.2.8 Assessment of the construction group (Co)

Table 4-12 itemizes the group No.7, Construction criteria, and its recorded factors with their priority weights. It seems that the assessment of construction factors is agreed from questionnaire respondents and interviewees to be the same ranking.

The "Decrease in productivity" with 26.10% from questionnaire' results has the first priority as well as it has the first priority factor with 22.30% from interview' results, the "Lower work quality in presence of time constraints" factor with 22.10% also has the same priority percentage as well from interview' results if the construction criterion is chosen to be considered. The "Rush bidding" factor has the least priority factor from questionnaire with 11.90% and with 14.70% from interview's result.

Unlike (Abu Mousa, 2005) who concluded that undocumented change orders, lower work quality and misunderstanding drawings and specifications respectively were the highest ranking.

Table 4-12: Risk factors priorities under construction group

Item	Construction factors	Priority from survey	Rank	Priority from interviews	Rank
Co1	Rush bidding	0.119	5	0.147	5
Co2	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	0.215	3	0.214	3
Co3	Undocumented change orders	0.185	4	0.193	4
Co4	Lower work quality in presence of time constraints	0.221	2	0.222	2
Co5	Decrease in productivity	0.261	1	0.223	1
Total		**1**		**1**	

4.2.9 Assessment of the management group (Ma)

Table 4-13 itemizes the group No.8, Management criteria, and its recorded factors with their prioritize weights. The "Lack of experience" factor with 24.30% from questionnaire' results has the first priority as well as it has the first priority factor with 32.80% from interview' results. This is subjective output where the high experience in managing the risk the more effective and success construction will be.

The second ranking factor is "Information unavailability (include uncertainty)" with 24.30% priority from questionnaire results and 32.80% priority from interviews results. It is noticed that this factor had the least priority in the findings of (Enshassi et al., 2008).

The "Changes in management ways" factor with 9.30% and has the least ranking from questionnaire but it has 9.60% priority from interview' results to be the fifth ranking before the "Lack of software capabilities" which has the last rank, the sixth, with 8.50% priority which is related to the changing the management way as well.

Table 4-13: Risk factors priorities under management group

Item	Management	Priority from survey	Rank	Priority from interviews	Rank
Ma1	Ambiguous planning due to project complexity	0.166	4	0.135	4
Ma2	Changes in management ways	0.093	6	0.096	5
Ma3	Information unavailability (include uncertainty)	0.209	2	0.218	2
Ma4	Lack of experience	0.243	1	0.328	1
Ma5	Lack of software capabilities	0.117	5	0.085	6
Ma6	Undefined scope of working	0.172	3	0.139	3
Total		**1**		**1**	

4.3 Results of main risk groups assessment (part 3 of the first questionnaire)

As mentioned in chapter 3, the questionnaire included 35 risk factors, which have been categorized in eight main groups; these groups were physical group, design group, logistics group, financial group, legal group, construction group, political group and management group. The comparison is performed for each pair of groups in a recurrence way taking into account that this assessment for the main goal of risk assessment in construction building projects during the pre-bid phase from contractor point of view in Gaza Strip.

The global priorities for the groups (main criteria) are mentioned in Table 4-14, the results from the first questionnaire is clarified that the highest priority group is for the financial criterion with 22.80% then the political criterion with 17.30%. The logistics criterion has the least priority with percentage of 7.70%. The same results of the highest priority from interviews illuminate that the financial criterion with 24.30% has the majority between others then the political criterion with 21.10% also has the second priority like the questionnaire's result, the logistics criterion with 7.40% also has lowest priority as the

questionnaire's result. All the judgments of the respondents are consistent wherein all consistency indexes are less than 0.10.

Table 4-14: Global priorities for main groups

Item	Main Group	From Questionnaires' respondents		From interviews	
		Priority	Consistency Ratio	Priority	Consistency Ratio
Ph	Physical	0.080	0.00	0.057	0.00
De	Design	0.099	0.00	0.077	0.01
Lo	Logistics	0.077	0.01	0.074	0.01
Le	Legal	0.091	0.04	0.079	0.11
Fi	Financial	0.228	0.01	0.243	0.03
Po	Political	0.173	0.01	0.211	0.04
Co	Construction	0.125	0.01	0.132	0.01
Ma	Management	0.127	0.01	0.127	0.03
	Total	1	-	1	-

According to Abu Mousa (2005) more than 80% of the failures were caused by financial factors, that is why financial risks got the highest weights of the surveyed risks. According to Argenti (cited in Hallaq, 2003), small firms do not pay as much attention to financial ratios as do larger firms. Small firms have not an accounting department that publishes reports on a regular basis and therefore, financial ratios are difficult to monitor since they hire private accountants. Gaza strip small firms never put into consideration the employee's benefits and compensations, variation orders, controlling equipment cost and usage, material wastages and yearly evaluating profits as a priority, which may affect the financial situation of the company.

According to Al-Hallaq (2003) contractors could financially fail due to:

- Depending on banks and paying high.
- Lack of capital.
- Lack of experience in the line of work.
- Cash flow management.
- Low margin of profit due to competition.
- Lack of experience in contracts.
- Award contracts to lowest price.
- Closure.

4.4 Results of the open ended questions in the interviews

The main findings of the open-ended questions from the interviews regarding to risk management from contractor point of view are clarified and discussed in the following points:

4.4.1 Knowledge of risk management principles

Approximately, most of the respondent contractors know the risk management phases. Few of them believe that it is not essential to be well-known in the building projects which are the majority type of construction projects in Gaza Strip, and they will use experts if necessary.

4.4.2 Considering risk management principles in construction projects

Most of the interviewed contractors agreed that the principle of risk management is considered at all stages of construction projects by experience not upon knowledge background because applying risk management techniques is necessary, however; its application is weak and superficial.

4.4.3 Importance of risk management in construction projects

Most of the respondent decision makers agreed that risk management has a positive effect in construction industry if it is applied from early stages of the project and continued to the last stage; this will reduce all kinds of time and cost wastes, so it is very important.

4.4.4 Cooperation among parties

Most of the contractors agreed that there is a direct cooperation between them and the consultant in the field. However, some of those contractors described this cooperation as indirect cooperation. A minority of the respondent contractors stated that there is no cooperation except the meetings happened during the construction work especially when handling over the packages and the owner attends most of these meetings.

4.4.5 The preventive actions to reduce the risk

Unquestionably, there are serious efforts by contractors to handle the risks that may affect the construction industry, so they could reduce the negative impacts of the expected risks as possible as it could be done. Table 4-15 lists the most recommended actions from the interviewees.

Table 4-15: Recommended previntive actions from interviwees

Recommended actions	Interviewee 1	Interviewee 2	Interviewee 3	Interviewee 4	Interviewee 5	Interviewee 6	Interviewee 7	Interviewee 8	Interviewee 9	Interviewee 10
Depend on subjective judgment to produce a proper program.	✓		✓	✓		✓		✓	✓	✓
Obtaining continuous information that lead to reduce the risk	✓	✓	✓	✓		✓	✓	✓		✓
Refer to previous and ongoing similar projects for accurate program.		✓	✓	✓					✓	
Plan alternative methods as stand-by.	✓	✓		✓						✓
Close supervision for minimizing unsuccessful work	✓	✓	✓	✓	✓		✓		✓	✓
Coordinate closely with subcontractors.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Insure against the occurrence of the factor.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

These preventive actions are taken to be the factors of the second questionnaire. Abu Mosa (2005) conclude most of these factors as the utmost efficient actions to reduce the construction risks.

4.5 Results of the second questionnaire

The second questionnaire's aim is to find the best preventive actions used to reduce the risk in construction building projects in Gaza Strip based on the outcome findings of the first questionnaire and interviews occur in earlier time.

4.5.1 Results of alternatives assessment (third level of hierarchy)

Table 4-16 summarize the prioritized weights for the suggested alternatives.

Table 4-16: Final prioritize preventive actions from second questionnaire

Item	Alternative	Priority weight	Rank
Alt 1	Depend on subjective judgment to produce a proper program	0.296	1
Alt 2	Produce proper schedule by getting updated project information	0.213	4
Alt 3	Refer to previous and ongoing similar projects for accurate program	0.273	2
Alt 4	Transfer or share risk to/with other parties	0.218	3

The alternative "Depend on subjective judgment to produce a proper program" has the best percentage 29.60%, as the best preventive action must be used toward any risk that may be undertaken. Contractors usually depend on subjective judgment to produce a proper program is the most effective risk preventive actions. Judgment or subjective probability uses the experience gained from similar projects undertaken in the past by the decision maker to decide on the likelihood of risk exposure and the outcomes. These findings are supported by (Abu Mousa, 2005, Kartam and Kartam, 2001).

Construction industry is subjected to dynamic conditions, so risk managers must improve their estimates. Even with near perfect estimates, decision making about risk is a difficult task. Thus depending only on experience and subjective judgment may not be enough so that the next alternative is "Refer to previous and ongoing similar projects for accurate program" which has 27.3% priority then "Produce proper schedule by getting updated project information" which has 21.3% priority.

Unlike "Produce proper schedule by getting updated project information" alternative that have 21.3% as prioritized weight to be the last option used. It is noticed that all alternatives are around 24.55% as a median value so the four alternatives are considered useful and effectively play a vital role as protective actions against the risks that may occur in construction building projects.

- ✓ It is indicated that almost the "Depend on subjective judgment to produce a proper program" is the best preventive way to deal with all types of risk, this finding is believed also by Abu Mousa (2005).

- ✓ It will be more realistic and practical way to deal with the risk when comparing the situation with ongoing or previous similar projects then producing proper schedule by

getting updated information which is the final option if no sharing or transferring risk is conduction to/with other parties. But Abu Mousa (2005) suggested to "Produce proper schedule by getting updated project information" before "Refer to previous and ongoing similar projects for accurate program".

4.5.2 Results of the sub-criteria factors assessment (second level of hierarchy)

The second level of analytical hierarchy contains the factors that related to each criteria/group in the first level.

4.5.2.1 Results for preventive action toward financial risks

Table 4-17 displays the prioritized weights for each alternative of preventive action toward all risk factors in the financial group and this is illustrated in the next points:

- The risk of "Delaying payments on contract" has the best preventive action, which is "Produce proper schedule by getting updated project information" and the last preventive action is "Refer to previous and ongoing similar projects for accurate program".

- Nevertheless, the best preventive action is "Refer to previous and ongoing similar projects for accurate program" for the risk of "Financial failure of the contractor" and the last decision for dealing with this financial risk is "Transfer or share risk to/with other parties".

- The risk of "Unmanaged cash flow" has the best preventive action, which is "Produce proper schedule by getting updated project information" nonetheless the last preventive action is "Transfer or share risk to/with other parties".

- The risk of "Increasing of materials prices" has the best preventive action which is "Depend on subjective judgment to produce a proper program" but "Produce proper schedule by getting updated project information" is the last decision as a preventive action toward this risk.

- As well as the risk of "Monopolizing of materials due to closure and other unexpected political conditions" has the best preventive action the same with the risk of "Increasing of materials prices" which is "Depend on subjective judgment to produce a proper program" then "Transfer or share risk to/with other parties " and the next

alternative is “Refer to previous and ongoing similar projects for accurate program” to “Produce proper schedule by getting updated project information” which is the last decision as a preventive action.

Table 4-17: Priorities for factors of financial group with respect to alternatives

Item	Alternatives / Factors	Depend on subjective judgment to produce a proper program	Produce proper schedule by getting updated project information	Refer to previous and ongoing similar projects for accurate program	Transfer or share risk to/with other parties	**Total**
Fin1	Delayed payments on contract	0.245	0.343	0.203	0.209	**1**
Fin2	Financial failure of the contractor	0.229	0.243	0.314	0.214	**1**
Fin3	Unmanaged cash flow	0.180	0.342	0.307	0.171	**1**
Fin4	Increasing of materials prices	0.385	0.178	0.249	0.188	**1**
Fin5	Monopolizing of materials due to closure and other unexpected political conditions	0.341	0.180	0.192	0.288	**1**

4.5.2.2 Results for preventive action toward political risks

Table 4-18 displays the prioritized weights for each alternative of preventive action toward all risk factors in the political group and this is illustrated in the next points:

- The risk of “Unstable security circumstances (wars)” has the most suitable preventive action which is “Depend on subjective judgment to produce a proper program” but “Produce proper schedule by getting updated project information” is the last decision as a preventive action toward it.

- “Closure” like the risk of “Unstable security circumstances (wars)”, the best alternative as preventive action is “Depend on subjective judgment to produce a proper

program" also "Produce proper schedule by getting updated project information" is the last decision as a preventive action toward it.

Generally, the political risks can not be prevented during the pre-bidding stage from the contactor side.

During these situations, all parties are agreed that if any political risk happened, the contractor will ask emergence meeting for assessment this risk as well as for finding the most suitable preventive action toward it. But, it is known that in Gaza Strip, the political situation is clear where the intended building project will be constructed under unstable condition and under closure. So it is stated in most of the funded projects' documents that (All parties agreed to work under pressure to complete the project implementation if any emergencies/crisis occurred).

Table 4-18: Priorities for factors of political group with respect to alternatives

Item	Alternatives / Factors	Depend on subjective judgment to produce a proper program	Produce proper schedule by getting updated project information	Refer to previous and ongoing similar projects for accurate program	Transfer or share risk to/with other parties	Total
Poli 1	Unstable security circumstances (wars)	0.435	0.116	0.167	0.282	**1**
Poli 2	Closure	0.359	0.134	0.195	0.312	**1**

Table 4-19 displays the prioritized weights for each alternative of preventive action toward all risk factors in the construction group and this is illustrated in the next points:

- The risk of "Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications" has the best preventive action which is "Refer to previous and ongoing similar projects for accurate program" and the last preventive action is "Produce proper schedule by getting updated project information".

- Nevertheless, the best preventive action is "Produce proper schedule by getting updated project information" for the risk of "Lower work quality in presence of time

constraints" and the last decision for dealing with this construction risk is "Transfer or share risk to/with other parties".

- The risk of "Decrease in productivity" can be prevented if producing proper schedule by getting updated project information is done because it is the most suitable way for monitoring and controlling the productivity rate of the construction of building projects. Then referring to previous and ongoing similar projects for accurate program nonetheless the last preventive action can be planned in the pre-bidding stage is "Transfer or share risk to/with other parties" to deal with decreasing the productivity.

Table 4-19: Priorities for factors of construction group with respect to alternatives

Item	Alternatives / Factors	Depend on subjective judgment to produce a proper program	Produce proper schedule by getting updated project informati on	Refer to previous and ongoing similar projects for accurate program	Transfer or share risk to/with other parties	**Total**
Con 1	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	0.287	0.177	0.353	0.183	**1**
Con 2	Lower work quality in presence of time constraints	0.213	0.362	0.285	0.140	**1**
Con 3	Decrease in productivity	0.238	0.325	0.29	0.147	**1**

Table 4-20 displays the prioritized weights for each alternative of preventive action toward all risk factors in the management group and this is illustrated in the next points:

- To deal with the "Information unavailability (include uncertainty)" risk, the optimum preventive action is referring to previous and ongoing similar projects for accurate program in order to check the trustworthiness of the information. If there is no similar projects the preventive action will depend on the subjective judgment to produce a proper program then produce proper schedule by getting updated project information according to the real cases in the construction site of the building project. The last

preventive action is to transfer or share this risk to/with other parties, as when contractor is intended to prepare for bidding of the construction building project, the well assured information will be his responsibility and sharing some duties or transferring it to/with another party won't be release the responsibility from his side especially in "Information unavailability" as a risk factor.

- The best preventive action toward the "Lack of experience" risk is "Refer to previous and ongoing similar projects for accurate program" as the same optimum action toward "Information unavailability", as well as the next preventive alternative is "Depend on the subjective judgment to produce a proper program". Nevertheless, Transfer or share risk to/with other parties is more suitable to be planned as preventive action unlike Information unavailability. "Produce proper schedule by getting updated project information" is the last decision for dealing with this "Lack of experience" as a management risk.

Table 4-20: Priorities for factors of management group with respect to alternatives

Item	Alternatives / Factors	Depend on subjective judgment to produce a proper program	Produce proper schedule by getting updated project information	Refer to previous and ongoing similar projects for accurate program	Transfer or share risk to/with other parties	**Total**
Man 1	Information unavailability (include uncertainty)	0.249	0.227	0.408	0.116	**1**
Man 2	Lack of experience	0.281	0.16	0.332	0.227	**1**

4.5.3 Results of the main criteria factors assessment (first level of hierarchy)

The outcome results for the main criteria/groups are summarized in Table 4-21, and discussed as followed:

- The best alternative must be considered in financial risks is "Depend on subjective judgment to produce a proper program" as the financial risks are so sensitive issue to decide the best alternative in preventing them in construction building projects, so it is realistic and optimum alternative when dealing with financial risks. Then "Refer to

previous and ongoing similar projects for accurate program" to "Produce proper schedule by getting updated project information" can be used to support risk prevention and "Transfer or share risk to/with other parties" will be the last decision.

- Also, the best alternative must be considered in political risks is like the financial risks which is "Depend on subjective judgment to produce a proper program" then "Transfer or share risk to/with other parties" as the political situation is unforeseeable risk and it will be no fair if the contractor handle these kinds of risks alone. If political risk can be handled so the next alternative will be "Refer to previous and ongoing similar projects for accurate program" to support risk prevention also to "Produce proper schedule by getting updated project information" is the least effective way to deal with political risks.

- The best alternative must be considered in construction risks is "Refer to previous and ongoing similar projects for accurate program" and this is the first step to "Produce proper schedule by getting updated project information". If these actions are not effective enough, so that the construction risks are unique or complex to deal with, "Depend on subjective judgment to produce a proper program" will be the most suitable way to deal with the construction risks and "Transfer or share risk to/with other parties" is the same last way to deal with these risks as the financial risks.

- Also, the best alternative must be considered in managerial risks is "Refer to previous and ongoing similar projects for accurate program" which is a strategically suitable way when dealing with managerial risks as producing accurate program is part of planning stage which is the most important phase in construction management, then "Depend on subjective judgment to produce a proper program" if there is no similar project is available. "Produce proper schedule by getting updated project information" can be used to support risk prevention after producing accurate program which is the previous alternative. Finally, "Transfer or share risk to/with other parties" as the same last way to deal with management risks as the financial and construction risks.

Table 4-21: Priorities for the main criteria/groups with respect to alternatives

Item	Group / Alternatives	Depend on subjective judgment to produce a proper program	Produce proper schedule by getting updated project information	Refer to previous and ongoing similar projects for accurate program	Transfer or share risk to/with other parties	Total
Fin	Financial	0.271	0.247	0.263	0.219	1
Poli	Political	0.396	0.125	0.181	0.298	1
Con	Construction	0.246	0.288	0.309	0.157	1
Man	Management	0.268	0.187	0.362	0.183	1

4.5.4 Consistency

Table 4-22 presents the consistency for all factors in first and second levels of hierarchy, it is clear that all the judgments of the respondents are consistent wherein all consistency indexes are less than 0.10.

Table 4-22: Consistency ratio in the second questionnaire

Item	Group/Factor	Consistency
Fin	**Financial**	**0.0060**
Fin 1	Delayed payments on contract	0.0325
Fin 2	Financial failure of the contractor	0.0270
Fin 3	Unmanaged cash flow	0.0057
Fin 4	Increasing of materials prices	0.0207
Fin 5	Monopolizing of materials due to closure and other unexpected political conditions	0.0039
Ploi	**Political**	**0**
Poli 1	Unstable security circumstances (wars)	0.0103
Poli 2	Closure	0.0035
Con	**Construction**	**0.0003**
Con 1	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	0.0416
Con 2	Lower work quality in presence of time constraints	0.0122
Con 3	Decrease in productivity	0.0171
Man	**Management**	**0**
Man 1	Information unavailability (include uncertainty)	0.0106
Man 2	Lack of experience	0.0194

4.5.5 Sensitivity analysis

When performing a sensitivity analysis it is possible to vary the priorities of the factors and observe how the priorities of the alternatives would change:

4.5.5.1 Performance sensitivity

The performance sensitivity analysis that displayed in Figure (4-1) shows how the alternatives were prioritized relative to other alternatives with respect to each factor/group as well as overall.

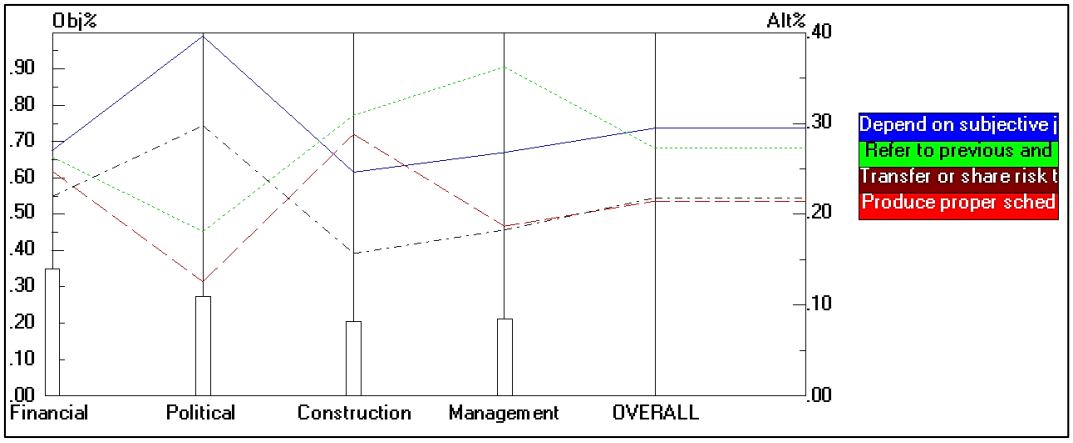

Figure 4-1: The performance sensitivity analysis

- To see how the best alternative performs compared to the second, third and fourth alternatives, read the overall priority from the intersection of the right y-axis and the overall priority for each alternative, "Depend on subjective judgment to produce a proper program" is approximately 29.60%, "Refer to previous and ongoing similar projects for accurate program" is approximately 27.3%, "Transfer or share risk to/with other parties" is approximately 21.8% and "Produce proper schedule by getting updated project information" is approximately 21.3%. Note that the priorities for the alternatives sum to one.

- To read each group's priority (based on the decision-makers' pair wise comparisons), the left y-axis should be used. For illustration "Financial" is about 34.1% while "Political" is about 26.3% and "Construction" is about 19.5% unlike "Management" which is about 20.1%.

- To read the alternative priorities with respect to each group, read from the right y-axis. For example, using "Depend on subjective judgment to produce a proper program"

for financial and political risks is an optimum selection that have priority of 69% and 100% respectively, while using "Refer to previous and ongoing similar projects for accurate program" is an optimum action for construction and management risks with priority of 70.5% and 90% which are very high percentage among other groups/criteria.

If a factor/group is thought that it might be more or less important than originally indicated, its priority can be increased or decreased and see the impact on other factors/groups as well as the final best alternatives and this is illustrated in Figures (4- (2, 3, 4, and 5)) as follows:

In Figure (4-2), when increasing the financial group to be the highest risk through dragging it to reach 50% of overall priority, the management group will be more effective than political and the construction group will have the last priority as before. Also the optimum preventive action toward the risks will be the same as before which is "Depend on subjective judgment to produce a proper program" then the "Refer to previous and ongoing similar projects for accurate program" but if the financial will increase this amount the "Produce proper schedule by getting updated project information" will be more effective than "Transfer or share risk to/with other parties".

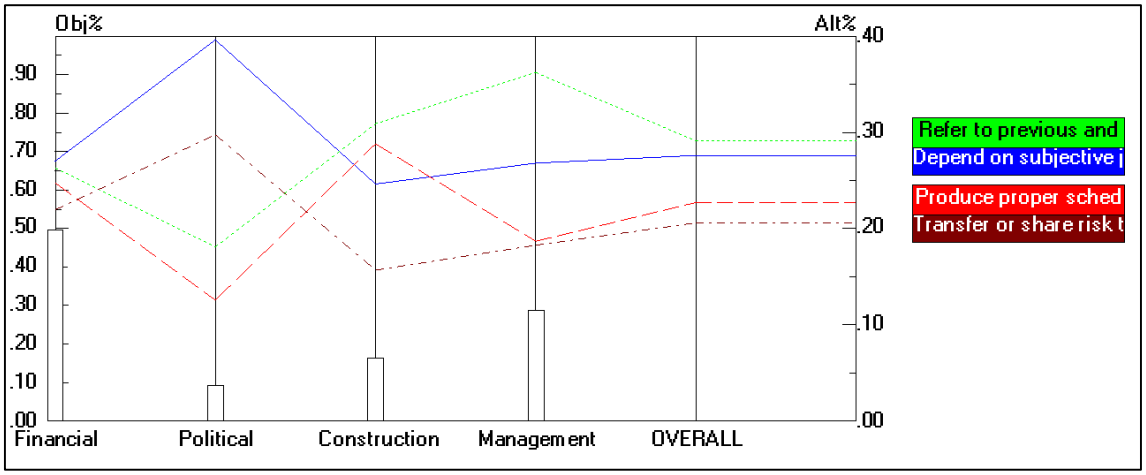

Figure 4-2: Performance sensitivity for increasing Financial to 50%

- In Figure (4-3), when increasing the political group to be the highest risk through dragging it to reach 50% of overall priority, the financial group will be more effective than management and the construction group will have the last priority as before. In addition, the optimum preventive action toward the risks will be the same as before which is "Depend on subjective judgment to produce a proper program" but the "Transfer or share risk to/with other parties" will be the second alternative then "Refer to previous and

ongoing similar projects for accurate program" will be more effective than "Produce proper schedule by getting updated project information".

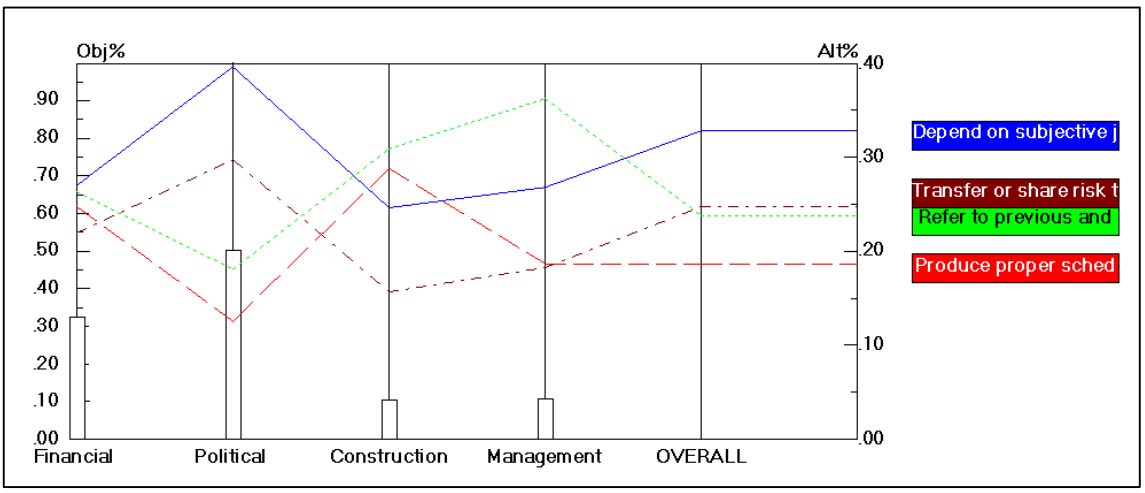

Figure 4-3: Performance sensitivity for increasing Political to 50%

- In Figure (4-4), when increasing the construction group to be the highest risk through dragging it to reach 50% of overall priority, the political group will be more effective than financial and the management group will have the last priority as before. Also the optimum preventive action toward the risks will be the same as before which is "Depend on subjective judgment to produce a proper program" then "Refer to previous and ongoing similar projects for accurate program" but the "Produce proper schedule by getting updated project information" will be the next alternative while "Transfer or share risk to/with other parties" will be the last option.

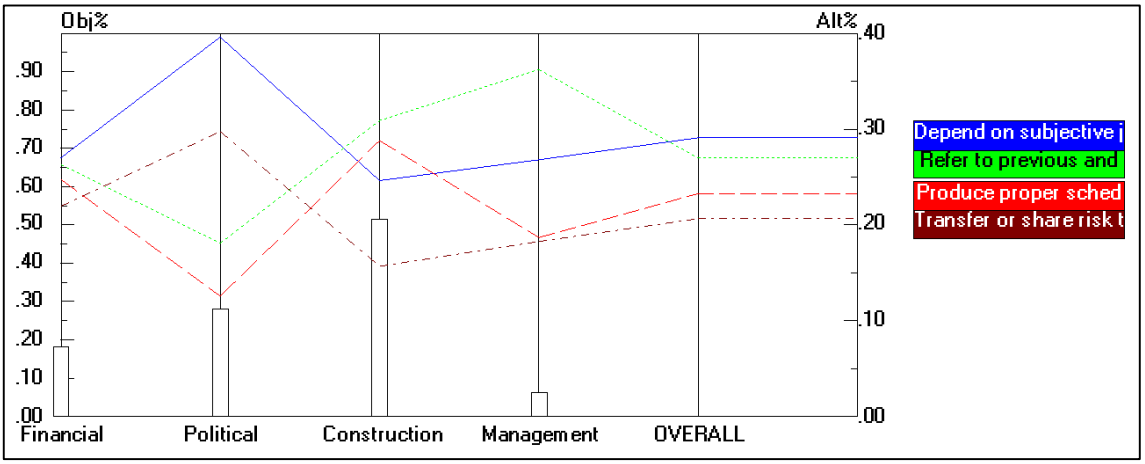

Figure 4-4: Performance sensitivity for increasing Construction to 50%

- In Figure (4-5), when increasing the management group as the highest risk to reach 50% of overall priority, the construction group will be more effective than political

and the financial group will have the last priority which is revolutionary as it is reflected to the optimum preventive action toward the risks that will be is “Refer to previous and ongoing similar projects for accurate program” but the “Depend on subjective judgment to produce a proper program” will be the second alternative then “Produce proper schedule by getting updated project information” will be more effective than “Transfer or share risk to/with other parties”.

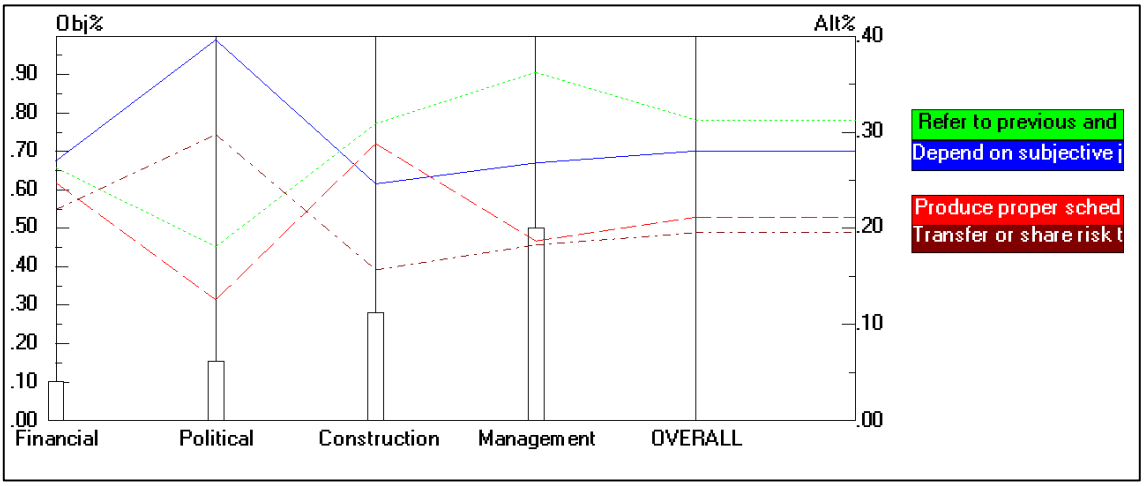

Figure 4-5: Performance sensitivity for increasing Management to 50%

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This chapter introduces the whole work that was carried out through conclusion and recommendations for the construction risk assessment in Gaza Strip. This chapter clarifies where research objectives are met over the final findings of this study, and some actions that may improve risk management practices are recommended, in addition to some future researches as results of findings are suggested.

5.1 Conclusion of the research aim and objectives

In attaining the aim of the research, four main objectives have been outlined and achieved through the findings of the analyzed collected data. The key findings are found as the following:

5.1.1 Key findings related to objective one

It is stated "To understand the risk issues in construction building projects in order to identify the risk factors and specifically classifying them based on a literature study".

✓ This objective is achieved during the literature and previous study reviews as well as during inclusive pretesting and piloting study that performed to the risk factors and risk preventive actions, in addition to unstructured and semi-structured interviews that conducted through the study phases. Findings shows that, eight main groups are efficient enough to be the main criteria of risk assessment in the construction of building projects. Another finding is determining the risk factors that categorized under these groups, by means of some of the risks can be predictable and easy to identify before they occur, while the others are unforeseeable and can cause unexpected time delays or additional costs, this conclusion is supported by the findings of Darnall and Preston (2010).

5.1.2 Key findings related to objective two

It is stated "To develop a decision support models based on AHP for the risks' factors in addition to risk preventive actions".

This objective is achieved through building two models, the first model is developed for assessing the risk factors that affect the construction project negatively, and the second model is developed for finding the optimum preventive action toward each risk factor.

5.1.3 Key findings related to objective three

It is stated "To prioritize the construction risk factors/groups to determine the most risky factors that have to be focused on".

This objective is achieved through applying the model number one and the results shows that the financial failure of the contractor has the highest priority weight to be considered in risk assessment then the unstable security circumstances (wars) and closure, which have the second priority. In addition, there are more than ten factors related to financial, political, construction and management groups that have the majority of priorities.

5.1.4 Key findings related to objective four

It is stated "To provide the optimum practical suggestions and recommendations through applying the developed models which targeting toward the optimum preventive actions in the risk management that aimed at recovering the performance of contracting companies in this field.".

This objective is achieved through applying the model number two. The results shows that it depends on the subjective judgment to produce a proper program in order to prevent the risk in building projects which is the optimum response. Then referring to previous and ongoing similar projects for accurate program is the second alternative to be considered. The next alternative is transferring or sharing risk to/with other parties and producing proper schedule by getting updated project information.

5.2 General Conclusions

✓ The respondents are generally mature in the construction industry. Most projects they executed are generally medium size ones. This may be a result of the political and economic situation in Gaza Strip which reflect on the construction field.

✓ In general, there is no risk management system used by contractors in Gaza Strip, this is concluded from the open-ended questions during the semi-structured interviews.

✓ Some of the risks can be predictable and easy to identify before they occur, while the others are unforeseeable and can result in unexpected time delays or additional costs, this conclusion is believed also by the findings of Darnall and Preston (2010).

✓ Political situation, in general, is the most important and expected risk factor in the last five years. As the closure and recent wars have the big effect on increasing material

prices, poor productivity and work delay as well as material shortages and material monopolizing.

✓ Depending on subjective judgment to produce a proper program then referring to similar projects to produce accurate program are the most effective preventive actions in pre-bidding stage then producing proper schedule by getting updated project information as well as transferring or sharing risks to or with other parties are the next alternatives.

5.3 Recommendations

✓ As this study showed that most contractors gave little attention to the risk management process, contractors are advised to take care of this point and be sure that the pricing team is risk sensitive and give enough effort to improve their capabilities.

✓ Contractors should recognize how to implement preventive actions techniques such as how collect and update the information of the real situation on the construction project in order to prepare proper program and schedule for the project that intended to be bided also how to share or transfer some risks by hiring specialized sub-contractors or asking for special insurance policies.

✓ The local construction industry parties are invited to have the AHP models and use them in order to improve the risk assessment of construction building projects in Gaza Strip and link it with the price estimating to develop the construction management process.

✓ When using AHP as an analytic tool, it is recommended to choose a focus group or convenient statistic sample to be the respondent target group, as it need a high qualifies experienced person to fill the AHP questionnaire.

5.4 Recommendations for further studies

✓ Researchers are invited to do in depth investigation of key risk factors, and preventive actions for other construction projects such as sewage, water supply and road projects.

✓ Studies advised to be conducted to find a convenient way to improve the developed models in this study to be one of a comprehensive construction tool in project management. It will be more useful if connecting to Building Information Modelling (BIM) programs especially for managing the material price increases and gaining the useful effective impact of changes in currency exchange rates as well as managing the construction projects ’resources.

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Appendix 1
(Questionnaire #1)
English version

Questionnaire survey about: Risk assessment in construction building projects using AHP

Research aim: Risk assessment by developing a multi-decision criteria support system using the Analytic Hierarchy Process (AHP) application in construction building projects in Gaza Strip. This model should provide users with an efficient mechanism that aids identifying risks and determine possible ways that may help avoid or minimize these risks.

Target group: first and second class contracting companies that registered in the Palestinian Contactors Union

This questionnaire consists of three parts;

Part 1: It is a general information about the respondent and about the contracting company which working for.

Part 2: It contains eight tables; each table designed to compare between several pairs of factors that categories under main groups

Part 3: It contain one table designed to compare the main groups as pairs.

Part 1: General information

Section 1: general information about the person who is filling this questionnaire. Please fill the right answer with (✓).

Gender			
Male		Female	

Qualification Level					
Bachelor degree		Master degree		Doctoral degree	

Specialization							
Civil		Architecture		Mechanical		Electrical	

Experience in contracting field					
Less than 5 years		5 to less than 10 years		10 years and more	

Section 2: contracting company general information. Please fill the right answer with (✓).

Experience of the contracting company in construction field							
Less than 5 years		5 to less than 15 years		15 to less than 25 years		25 years and more	
Average monitory amount for the executed projects in the company ($)							
Less than 250,000		250000 to less than 500,000		500,000 to less than million		Million and more	
Average period for one executed project in the company ($)							
Less than 6 months		6 to less than 12 months		12 months to less than 2 years		2 years and more	
Average percentage of the subcontractor share in one project							
Less than 25%		25 to less than 50 %		50 to less than 75%		75 to less than 100%	

Part 2: Comparing the risk factors according to their groups

At the beginning, select what is the more important factor than the other, and then select the level of importance through its numbering by ticking the grade

Compare between each pair of the physical risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																		
Occurrence of accidents because of poor safety procedures	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Supplies of defective materials
Occurrence of accidents because of poor safety procedures	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Equipment damage
Supplies of defective materials	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Equipment damage

Compare between each pair of the design risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																		
Defective design (incorrect)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No coordinated design departments (structural, mechanical, electrical, etc.)
Defective design (incorrect)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Preparing designs with urgent haste (Rush Design)
Defective design (incorrect)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Awarding the design to unqualified designers
No coordinated design departments (structural, mechanical, electrical, etc.)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Preparing designs with urgent haste (Rush Design)
No coordinated design departments (structural, mechanical, electrical, etc.)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Awarding the design to unqualified designers
Preparing designs with urgent haste (Rush Design)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Awarding the design to unqualified designers

Compare between each pair of the logistics risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																	
Unavailable labor, materials and equipment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Inaccurate project program
Unavailable labor, materials and equipment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Poor communications between the home and field offices (contractor side)
Inaccurate project program	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Poor communications between the home and field offices (contractor side)

Compare between each pair of the legal risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																	
Legal disputes during the construction phase among the parties of the contract	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Delayed disputes resolutions
Legal disputes during the construction phase among the parties of the contract	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No specialized arbitrators to help settle fast
Delayed disputes resolutions	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	No specialized arbitrators to help settle fast

Compare between each pair of the financial risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																	
Inflation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Delayed payments on contract
Inflation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Financial failure of the contractor
Inflation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Unmanaged cash flow
Inflation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Exchange rate fluctuation
Inflation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Increasing of materials prices
Inflation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monopolizing of materials due to closure and other unexpected political conditions
Delayed payments on contract	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Financial failure of the contractor
Delayed payments on contract	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Unmanaged cash flow
Delayed payments on contract	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Exchange rate fluctuation
Delayed payments on contract	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Increasing of materials prices
Delayed payments on contract	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monopolizing of materials due to closure and other unexpected political conditions
Financial failure of the contractor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Unmanaged cash flow
Financial failure of the contractor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Exchange rate fluctuation
Financial failure of the contractor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Increasing of materials prices

Compare between each pair of the financial risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																	
Financial failure of the contractor	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monopolizing of materials due to closure and other unexpected political conditions
Unmanaged cash flow	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Exchange rate fluctuation
Unmanaged cash flow	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Increasing of materials prices
Unmanaged cash flow	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monopolizing of materials due to closure and other unexpected political conditions
Exchange rate fluctuation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Increasing of materials prices
Exchange rate fluctuation	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monopolizing of materials due to closure and other unexpected political conditions
Increasing of materials prices	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monopolizing of materials due to closure and other unexpected political conditions

Compare between each pair of the political risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																	
Working at hot (dangerous) areas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	New governmental acts or legislations
Working at hot (dangerous) areas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Unstable security circumstances (wars)

Compare between each pair of the political risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																	
Working at hot (dangerous) areas	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	closure
New governmental acts or legislations	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Unstable security circumstances (wars)
New governmental acts or legislations	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	closure
Unstable security circumstances (wars)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	closure

Compare between each pair of the construction risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																	
Rush bidding	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications
Rush bidding	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Undocumented change orders
Rush bidding	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lower work quality in presence of time constraints
Rush bidding	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Decrease in productivity

Compare between each pair of the construction risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																		
Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Undocumented change orders
Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lower work quality in presence of time constraints
Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Decrease in productivity
Undocumented change orders	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lower work quality in presence of time constraints
Undocumented change orders	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Decrease in productivity
Lower work quality in presence of time constraints	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Decrease in productivity

Compare between each pair of the management risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																		
Ambiguous planning due to project complexity	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Changes in management ways
Ambiguous planning due to project complexity	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Information unavailability (include uncertainty)
Ambiguous planning due to project complexity	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lack of experience
Ambiguous planning due to project complexity	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lack of software capabilities
Ambiguous planning due to project complexity	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Undefined scope of work
Changes in management ways	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Information unavailability (include uncertainty)
Changes in management ways	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lack of experience
Changes in management ways	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lack of software capabilities
Changes in management ways	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Undefined scope of work
Information unavailability (include uncertainty)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lack of experience
Information unavailability (include uncertainty)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lack of software capabilities
Information unavailability (include uncertainty)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Undefined scope of work
Lack of experience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Lack of software capabilities
Lack of experience	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Undefined scope of work

Compare between each pair of the management risk factors **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																		
Lack of software capabilities	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Undefined scope of work

Part 2: Comparing the risk groups

Compare between each pair of the main risk groups. **1=Equal importance, 3= Moderate importance, 5= Strong importance, 7= Very strong importance, 9= Extreme importance, (2, 4, 6, 8= Intermediate values between adjacent scale values)**																		
Logistics	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Financial
Logistics	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political
Logistics	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Construction
Logistics	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management
Legal	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Financial
Legal	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political
Legal	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Construction
Legal	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management
Financial	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Political
Financial	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Construction
Financial	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management
Political	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Construction
Political	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management
Construction	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management

Appendix 2
(Questionnaire #1)
Arabic version

استبانة حول: تطبيق عملية التحليل الهرمي (AHP) في تقييم المخاطر لمشاريع التشييد

الهدف الرئيسي من البحث: تقييم عوامل المخاطر في مشاريع التشييد في قطاع غزة، وانعكاسها على تسعير العطاءات وذلك باستخدام طريقة التحليل الهرمي لهذه العوامل بحيث يتم مقارنة كل عامل حسب الفئة التي ينتمي إليها بالعوامل الأخرى من نفس الفئة، وبذلك تكون عملية المقارنة بين العوامل مرتبطة ببعضها البعض وليست مستقلة كما في التحليل الاحصائي المتعارف عليه.

الفئة المستهدفة: شركات المقاولات درجة أولى أبنية والذين يعملون في قطاع غزة.

الاستبانة :هو جزء من دراسة تقييم لعناصر المخاطر في مشاريع التشييد باستخدام طريقة التحليل الهرمي وذلك استكمالا لمتطلبات الحصول على درجة الماجستير في إدارة المشاريع الهندسية، قسم الهندسة المدنية، الجامعة الإسلامية.

ماهية الاستبانة: الاستبانة مقسم إلى ثلاثة أجزاء كما يلي:

I. **الجزء الأول:** عبارة عن أسئلة خاصة بالمهندس الذي سيقوم بتعبئة الاستبانة، وأسئلة عامة عن شركة المقاولات التي يعمل بها والإجابة من خيارات متعددة.
II. **الجزء الثاني:** يضم ثمانية جداول مقارنة بين العوامل الفرعية لتقييم المخاطر التي قد يتعرض لها المشروع والتي تؤثر على قرار الشركة/المقاول في تحديد نسبة المخاطر في التسعير للمناقصات الخاصة بمشاريع إنشاء المباني. هذا الجزء يتطلب من مجيب الاستبانة أن يقارن كل عاملين على التوالي وتعيين درجة أهمية العامل الذي تم اختياره من حيث الأهمية عن الآخر في إدارة المخاطر في مشاريع المباني الإنشائية وذلك باتباع التدريج الموضوع من 1 إلى 9.
III. **الجزء الثالث:** يضم جداول مقارنة بين العوامل الرئيسية للعوامل السابقة وهي : العوامل الفيزيائية، العوامل الخاصة بالتصميم، العوامل الخاصة بالعوامل اللوجستية، العوامل المالية، العوامل القانونية، عوامل عمليات الإنشاء، العوامل السياسية والعوامل الإدارية. ويتم المقارنة بها بمثل منهجية المقارنة في الجدول الخاص بالجزء الثاني.

مثال عن كيفية التقييم:

قارن بين العناصر التالية بالنسبة للعامل الفيزيائي للمخاطر: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة			
توريد مواد تالفة (غير صالحة للاستخدام)	**2 3 4 5 6 7 8 9**	**1**	2 3 4 5 6 7 8 9 وقوع الحوادث بسبب ضعف إجراءات السلامة
وجود أضرار في المعدات	**2** **3 4 5 6 7 8 9**	**1**	2 3 4 5 6 7 8 9 وقوع الحوادث بسبب ضعف إجراءات السلامة

- ✓ بداية اختر العامل الذي يفوق أهمية عن الآخر، مثلا لو كان العامل (وقوع الحوادث بسبب ضعف إجراءات السلامة(أكثر اهمية بمقدار 5 أضعاف عن العامل الآخر(توريد مواد تالفة)، أي بدرجة كبيرة عنه.
- ✓ عندها يتم اختيار الرقم **5** من الترقيم المحاذي للعامل الذي تم اختياره كما هو موضح بالمثال الأول في الجدول السابق.
- ✓ أما في المثال الثاني العامل (وجود أضرار في المعدات) أكثر اهمية بمقدار الضعف عن العامل الآخر {وقوع الحوادث بسبب ضعف إجراءات السلامة)، أي بدرجة أقل من البسيطة تكاد تتساوي العامل الآخر ولكنها أعلى منه بدرجة.
- ✓ عندها يتم اختيار الرقم **2** من الترقيم المحاذي للعامل الذي تم اختياره كما هو موضح بالمثال الثاني.

الشكر الجزيل لكل من يساهم في هذا العمل البحثي ، وشكرا على الاهتمام بدقة الاجابات.

الباحثة : م. هديل محمد سعيد البرقوني.
المشرف: د. خالد عبد الرؤوف الحلاق .

الجزء الأول: بيانات خاصة بالمهندس الذي يقوم بتعبئة الاستبانة يتبعها بيانات عامة عن الشركة التي يعمل بها المهندس، الرجاء وضع علامة (✓) في المكان المناسب

الاسم (اختياري):.....

الجنس:			
1) ذكر		2) أنثى	
المؤهل العلمي			
1) بكالوريوس	2) ماجستير	3) دكتوراه	
التخصص			
1) مهندس معماري	2) مهندس مدني	3) مهندس كهربائي	4) مهندس ميكانيكي
عدد سنوات الخبرة			
1) أقل من 5 سنوات	2) من 5 إلى أقل من 10 سنوات	3) 10سنوات فأكثر	

بيانات عامة عن الشركة ، الرجاء وضع علامة (✓) في المكان المناسب

عدد السنوات في مجال المقاولات							
1) اقل من 5 سنوات		2) من 5 إلى أقل من 15 سنة		3) من 15 إلى أقل من 25 سنة		4) 25 سنة فأكثر	

متوسط قيمة المشاريع المنفذة: ($)							
1) أقل من 250 ألف		2) من 250 إلى أقل من 500 ألف		3) من 500 ألف إلى أقل من مليون		4) مليون فأكثر	

متوسط المدة الزمنية للمشروع الواحد							
1) أقل من 6 أشهر		2) من 6 إلى أقل من 12 شهر		3) من 12 شهر إلى أقل من سنتين		4) سنتين فأكثر	

النسبة المئوية الممنوحة لمقاولي الباطن في المشروع الواحد							
1) أقل من 25%		2) من 25 إلى أقل من 50 %		3) من 50 إلى أقل من 75%		4) من 75 إلى أقل من 100 %	

الجزء الثاني: مقارنة عوامل المخاطر الفرعية (من حيث الأهمية) بالنسبة للعامل الرئيسي لكل جدول

1. قارن بين كل عاملين، حيث أن كل عامل يحاذيه ترقيم خاص به
2. بداية اختر ما هو العامل الأكثر أهمية عن الآخر، ثم حدد درجة الأهمية من خلال الترقيم الخاص به وذلك بوضع علامة على الدرجة

قارن بين العناصر التالية بالنسبة للعامل الفيزيائي للمخاطر: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																			
وقوع الحوادث بسبب ضعف إجراءات السلامة	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	توريد مواد تالفة (غير صالحة للاستخدام)
وقوع الحوادث بسبب ضعف إجراءات السلامة	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	وجود أضرار في المعدات
توريد مواد تالفة (غير صالحة للاستخدام)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	وجود أضرار في المعدات

قارن بين العناصر التالية بالنسبة لعامل التصميم (في حال كان التصميم من مسئولة المقاول): **الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة**																		
خلل في التصميم	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم التنسيق بين أقسام التصميم المختلفة
خلل في التصميم	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التسرع في تجهيز التصاميم
خلل في التصميم	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	ترسية عملية التصميم لمصمم غير كفؤ
عدم التنسيق بين أقسام التصميم المختلفة	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التسرع في تجهيز التصاميم
عدم التنسيق بين أقسام التصميم المختلفة	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	ترسية عملية التصميم لمصمم غير كفؤ
التسرع في تجهيز التصاميم	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	ترسية عملية التصميم لمصمم غير كفؤ

قارن بين العناصر التالية بالنسبة ل اللوجستيات: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																		
عدم توفر العمالة، المواد والمعدات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم دقة البرنامج المخصص للمشروع
عدم توفر العمالة، المواد والمعدات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	ضعف الاتصال والتواصل بين المكتب الرئيسي للمقاول ومكتب التنفيذ في الموقع

قارن بين العناصر التالية بالنسبة ل اللوجستيات: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																				
عدم دقة البرنامج المخصص للمشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	ضعف الاتصال والتواصل بين المكتب الرئيسي للمقاول ومكتب التنفيذ في الموقع

قارن بين العناصر التالية بالنسبة للعامل القانوني: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																				
وقوع نزاعات قضائية خلال عملية الإنشاء بين أطراف التعاقد	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تأخر تسوية النزاعات القضائية
وقوع نزاعات قضائية خلال عملية الإنشاء بين أطراف التعاقد	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم وجود حكام متخصصين في المشاريع الهندسية لتسريع الوصول لتسوية
تأخر تسوية النزاعات القضائية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم وجود حكام متخصصين في المشاريع الهندسية لتسريع الوصول لتسوية

قارن بين العناصر التالية بالنسبة للعامل المالي: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																				
التضخم (انهيار القوة الشرائية للعملة)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تأخر الدفعات عن المواعيد المتعاقد عليها
التضخم (انهيار القوة الشرائية للعملة)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الانهيار المالي للمقاول
التضخم (انهيار القوة الشرائية للعملة)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم إدارة التدفقات النقدية (المالية)
التضخم (انهيار القوة الشرائية للعملة)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التغير في معدل صرف العملات
التضخم (انهيار القوة الشرائية للعملة)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الزيادة في أسعارالمواد
التضخم (انهيار القوة الشرائية للعملة)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	احتكار المواد من قبل الموردين بسبب إغلاق المعابر
تأخر الدفعات عن المواعيد المتعاقد عليها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الانهيار المالي للمقاول
تأخر الدفعات عن المواعيد المتعاقد عليها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم إدارة التدفقات النقدية (المالية)
تأخر الدفعات عن المواعيد المتعاقد عليها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التغير في معدل صرف العملات
تأخر الدفعات عن المواعيد المتعاقد عليها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الزيادة في أسعارالمواد
تأخر الدفعات عن المواعيد المتعاقد عليها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	احتكار المواد من قبل الموردين بسبب إغلاق المعابر

قارن بين العناصر التالية بالنسبة للعامل المالي: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																				
الانهيار المالي للمقاول	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم إدارة التدفقات النقدية (المالية)		
الانهيار المالي للمقاول	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التغير في معدل صرف العملات		
الانهيار المالي للمقاول	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الزيادة في أسعار المواد		
الانهيار المالي للمقاول	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	احتكار المواد من قبل الموردين بسبب إغلاق المعابر		
عدم إدارة التدفقات النقدية (المالية)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التغير في معدل صرف العملات		
عدم إدارة التدفقات النقدية (المالية)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الزيادة في أسعار المواد		
عدم إدارة التدفقات النقدية (المالية)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	احتكار المواد من قبل الموردين بسبب إغلاق المعابر		
التغير في معدل صرف العملات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الزيادة في أسعار المواد		
التغير في معدل صرف العملات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	احتكار المواد من قبل الموردين بسبب إغلاق المعابر		
الزيادة في أسعار المواد	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	احتكار المواد من قبل الموردين بسبب إغلاق المعابر		

قارن بين العناصر التالية بالنسبة للعامل السياسي: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																				
العمل في مناطق خطرة (مثال: مناطق حدودية)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التشريعات والتصرفات الجديدة للحكومة		
العمل في مناطق خطرة (مثال: مناطق حدودية)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الظروف الأمنية الغير مستقرة (مثال: الحروب)		
العمل في مناطق خطرة (مثال: مناطق حدودية)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	إغلاق المعابر (الحصار)		
التشريعات والتصرفات الجديدة للحكومة	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الظروف الأمنية الغير مستقرة (مثال: الحروب)		
التشريعات والتصرفات الجديدة للحكومة	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	إغلاق المعابر (الحصار)		
الظروف الأمنية الغير مستقرة (مثال: الحروب)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	إغلاق المعابر (الحصار)		

قارن بين العناصر التالية بالنسبة لعامل التشييد: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																					
التسرع في التقديم للعطاء (بدون مراجعة أو تدقيق)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	الفجوة بين ما يتم تنفيذه وبين المخططات والمواصفات المتعاقد عليها ، بسبب سوء فهم وثائق العطاء
التسرع في التقديم للعطاء (بدون مراجعة أو تدقيق)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم توثيق الأوامر التغيرية
التسرع في التقديم للعطاء (بدون مراجعة أو تدقيق)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تدهور جودة العمل في ظل التقيد بالوقت
التسرع في التقديم للعطاء (بدون مراجعة أو تدقيق)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تدهور معدل الانتاجية سواء للعمال او المعدات
الفجوة بين ما يتم تنفيذه وبين المخططات والمواصفات المتعاقد عليها ، بسبب سوء فهم وثائق العطاء	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم توثيق الأوامر التغيرية
الفجوة بين ما يتم تنفيذه وبين المخططات والمواصفات المتعاقد عليها ، بسبب سوء فهم وثائق العطاء	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تدهور جودة العمل في ظل التقيد بالوقت
الفجوة بين ما يتم تنفيذه وبين المخططات والمواصفات المتعاقد عليها ، بسبب سوء فهم وثائق العطاء	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تدهور معدل الانتاجية سواء للعمال او المعدات
عدم توثيق الأوامر التغيرية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تدهور جودة العمل في ظل التقيد بالوقت
عدم توثيق الأوامر التغيرية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تدهور معدل الانتاجية سواء للعمال او المعدات
تدهور جودة العمل في ظل التقيد بالوقت	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	تدهور معدل الانتاجية سواء للعمال او المعدات

قارن بين العناصر التالية بالنسبة للعامل الإداري: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																					
التخطيط الغير واضح (وجود إلتباسات) بسبب تعقيد المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	التغيير في طرق إدراة المشروع
التخطيط الغير واضح (وجود إلتباسات) بسبب تعقيد المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم توفر المعلومات بالإضافة لعدم دقتها

قارن بين العناصر التالية بالنسبة للعامل الإداري: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																				
التخطيط الغير واضح (وجود إلتباسات) بسبب تعقيد المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	قلة الخبرة لدى طاقم المقاول		
التخطيط الغير واضح (وجود إلتباسات) بسبب تعقيد المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	قلة الامكانيات البرمجية (عدم توفر برامج إداية او تقنية)		
التخطيط الغير واضح (وجود إلتباسات) بسبب تعقيد المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	نطاق العمل غير معروف		
التغيير في طرق إدراة المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عدم توفر المعلومات بالإضافة لعدم دقتها		
التغيير في طرق إدراة المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	قلة الخبرة لدى طاقم المقاول		
التغيير في طرق إدراة المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	قلة الامكانيات البرمجية (عدم توفر برامج إداية او تقنية)		
التغيير في طرق إدراة المشروع	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	نطاق العمل غير معروف		
عدم توفر المعلومات بالإضافة لعدم دقتها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	قلة الخبرة لدى طاقم المقاول		
عدم توفر المعلومات بالإضافة لعدم دقتها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	قلة الامكانيات البرمجية (عدم توفر برامج إداية او تقنية)		
عدم توفر المعلومات بالإضافة لعدم دقتها	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	نطاق العمل غير معروف		
قلة الخبرة لدى طاقم المقاول	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	قلة الامكانيات البرمجية (عدم توفر برامج إداية او تقنية)		
قلة الخبرة لدى طاقم المقاول	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	نطاق العمل غير معروف		
قلة الامكانيات البرمجية (عدم توفر برامج إداية او تقنية)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	نطاق العمل غير معروف		

الجزء الثالث: مقارنة عامة لعوامل المخاطر الرئيسية (من حيث الأهمية) التي تؤثر على قرار المقاول في تسعير العطاء

1. قارن بين كل عاملين، حيث أن كل عامل يحاذيه ترقيم خاص به
2. بداية اختر ما هو العامل الأكثر أهمية عن الآخر، ثم حدد درجة الأهمية من خلال الترقيم الخاص به وذلك بوضع علامة على الدرجة
3. الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة
4. الدرجات 2، 4، 6، 8 هي درجات وسطية

قارن بين عوامل تقييم المخاطر الرئيسية التالية بالنسبة لأهميتها في إدارة المخاطر: **الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة**																			
العوامل الفيزيائية(مثال: تلف المعدات والمواد ووقوع الحوادث)	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عوامل المخاطر المتعلقة بتصميم المخططات	
العوامل الفيزيائية(مثال: تلف المعدات والمواد ووقوع (الحوادث	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل اللوجستية	
العوامل الفيزيائية(مثال: تلف المعدات والمواد ووقوع (الحوادث	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل القانونية	
العوامل الفيزيائية(مثال: تلف المعدات والمواد ووقوع (الحوادث	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل المالية	
العوامل الفيزيائية(مثال: تلف المعدات والمواد ووقوع (الحوادث	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل السياسية	
العوامل الفيزيائية(مثال: تلف المعدات والمواد ووقوع (الحوادث	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عوامل التشييد (مثال: تدهور الانتاجية، تدهور (الجودة	
العوامل الفيزيائية(مثال: تلف المعدات والمواد ووقوع (الحوادث	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل الإدارية	
عوامل المخاطر المتعلقة بتصميم المخططات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل اللوجستية	
عوامل المخاطر المتعلقة بتصميم المخططات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل القانونية	
عوامل المخاطر المتعلقة بتصميم المخططات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل المالية	
عوامل المخاطر المتعلقة بتصميم المخططات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل السياسية	
عوامل المخاطر المتعلقة بتصميم المخططات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عوامل التشييد (مثال: تدهور الانتاجية، تدهور (الجودة	
عوامل المخاطر المتعلقة بتصميم المخططات	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل الإدارية	
العوامل اللوجستية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل القانونية	
العوامل اللوجستية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل المالية	
العوامل اللوجستية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل السياسية	

قارن بين عوامل تقييم المخاطر الرئيسية التالية بالنسبة لأهميتها في إدارة المخاطر: الدرجة (1) = مساوي الأهمية ، (3)= أهمية بسيطة، (5)= أهمية كبيرة، (7)= أهمية كبيرة جدا، (9)= أهمية مطلقة																			
العوامل اللوجستية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عوامل التشييد (مثال: تدهور الانتاجية، تدهور الجودة)
العوامل اللوجستية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل الإدارية
العوامل القانونية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل المالية
العوامل القانونية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل السياسية
العوامل القانونية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عوامل التشييد (مثال: تدهور الانتاجية، تدهور الجودة)
العوامل القانونية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل الإدارية
العوامل المالية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل السياسية
العوامل المالية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عوامل التشييد (مثال: تدهور الانتاجية، تدهور الجودة)
العوامل المالية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل الإدارية
العوامل السياسية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	عوامل التشييد (مثال: تدهور الانتاجية، تدهور الجودة)
العوامل السياسية	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل الإدارية
(عوامل التشييد (مثال: تدهور الانتاجية، تدهور الجودة	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	العوامل الإدارية

Appendix 3
(Questionnaire #2)
English version

Questionnaire survey about: Risk assessment in construction building projects using AHP

Research aim: Risk assessment by developing a multi-decision criteria support system using the Analytic Hierarchy Process (AHP) application in construction building projects in Gaza Strip. This model should provide users with an efficient mechanism that aids identifying risks and determine possible ways that may help avoid or minimize these risks.

Target group: first and second class contracting companies that registered in the Palestinian Contactors Union

This questionnaire contain twelve tables each table headed with a risk factor which is needed a preventive way to be determined.

For each table, select what is the more effective action than the other, and then select the level of effectiveness through its numbering by ticking the grade

What is the best preventive action toward the "Delayed payments on contract" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Delayed payments on contract" risk?																		
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Financial failure of the contractor" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Unmanaged cash flow" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information

What is the best preventive action toward the "Unmanaged cash flow" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Increasing of materials prices" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program

What is the best preventive action toward the "Increasing of materials prices" risk?																		
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Monopolizing of materials due to closure and other unexpected political conditions" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Unstable security circumstances (wars)" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Closure" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Closure" risk?																		
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Lower work quality in presence of time constraints" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Decrease in productivity" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Decrease in productivity" risk?																		
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Information unavailability (include uncertainty)" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

What is the best preventive action toward the "Lack of experience" risk?																		
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Produce proper schedule by getting updated project information
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Depend on subjective judgment to produce a proper program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Refer to previous and ongoing similar projects for accurate program
Produce proper schedule by getting updated project information	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties
Refer to previous and ongoing similar projects for accurate program	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Transfer or share risk to/with other parties

Appendix 4
(Questionnaire #2)
Arabic version

استبانة حول: تطبيق عملية التحليل الهرمي (AHP) في تقييم المخاطر لمشاريع التشييد

الهدف الرئيسي من البحث: تقييم عوامل المخاطر في مشاريع التشييد في قطاع غزة، وانعكاسها على تسعير العطاءات وذلك باستخدام طريقة التحليل الهرمي لهذه العوامل بحيث يتم مقارنة كل عامل حسب الفئة التي ينتمي إليها بالعوامل الأخرى من نفس الفئة، وبذلك تكون عملية المقارنة بين العوامل مرتبطة ببعضها البعض وليست مستقلة كما في التحليل الإحصائي المتعارف عليه.

مثال عن كيفية التقييم:

ما هي الطريقة الأفضل في تجنب الآثار المترتبة على خطر إغلاق المعابر (الحصار) ؟																	
إعداد الجدول الزمني المناسب عن طريق الحصول على تحديث للمعلومات المتعلقة بالمشروع باستمرار	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**نقل أو تقاسم المخاطر إلى/ مع الأطراف الأخرى**

1. **اختر الطريقة الأفضل من بين الخيارين المتاحين (هنا تم اختيار الاقتراح الثاني على اليسار).**
2. **ثم قيّم مدى أفضلية هذا الاختيار عن الآخر من خلال الترقيم (هنا تم اختيار الرقم 5؛ أي أن الاقتراح الثاني أكثر فعالية بما يعادل 5 أضعاف بالنسبة للاقتراح الأول وذلك في تجنب المخاطر المتعلقة بإغلاق المعابر).**

الشكر الجزيل لكل من يساهم في هذا العمل البحثي ، وشكرا على الاهتمام بدقة الإجابات.

الباحثة : م. هديل محمد سعيد البرقوني.
المشرف: د. خالد عبد الرؤوف الحلاق .
الجامعة الإسلامية.

الرجاء اتباع الطريقة التالية في عملية التقييم

1. **اختر الطريقة الأفضل من بين الخيارين المتاحين.**
2. **ثم قيّم مدى أفضلية هذا الاختيار عن الآخر من خلال الترقيم المطروح.**
3. **الدرجة (1) = مساوي الأفضلية، (3)= أفضلية بسيطة، (5)= أفضلية كبيرة، (7)= أفضلية كبيرة جدا، (9)= أفضلية مطلقة**

ما هي الطريقة الأفضل كإجراء احترازي لخطر تأخر الدفعات المتعاقد عليها			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** **إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة**
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** **الرجوع إلى المشاريع السابقة المشابهة أو الجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها**
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** **نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى**
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** **الرجوع إلى المشاريع السابقة المشابهة أو الجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها**
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** **نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى**
الرجوع إلى المشاريع السابقة المشابهة أو الجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** **نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى**

ما هي الطريقة الأفضل كإجراء احترازي لخطر الانهيار المالي للمقاول			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** **إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة**

ما هي الطريقة الأفضل كإجراء احترازي لخطر الانهيار المالي للمقاول			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أو الجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطرعدم إدارة التدفقات المالية (cash flow)			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطرعدم إدارة التدفقات المالية (cash flow)			
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى

ما هي الطريقة الأفضل كإجراء احترازي لخطر زيادة أسعار المواد			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9** نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى

ما هي الطريقة الأفضل كإجراء احترازي لخطر احتكار الموردين للمواد بسبب الحصار			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة 1 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 1 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 1 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 1 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 1 2 3 4 5 6 7 8 9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 1 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطر عدم استقرار الأوضاع الأمنية (الحروب)			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة 1 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 1 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 1 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطر عدم استقرار الأوضاع الأمنية (الحروب)			
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطر إغلاق المعابر (الحصار)			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطر عدم تطابق التنفيذ مع المواصفات والمخططات		
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطر تدني مستوى الجودة بسبب ضيق الوقت		
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9

إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	2 3 4 5 6 7 8 9	
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	2 3 4 5 6 7 8 9	
نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى	2 3 4 5 6 7 8 9	
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	2 3 4 5 6 7 8 9	
نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى	2 3 4 5 6 7 8 9	
نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى	2 3 4 5 6 7 8 9	

إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	2 3 4 5 6 7 8 9	
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	2 3 4 5 6 7 8 9	
نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى	2 3 4 5 6 7 8 9	

ما هي الطريقة الأفضل كإجراء احترازي لخطر تدني مستوى الجودة بسبب ضيق الوقت			
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطر انخفاض مستوى الانتاجية			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها 2 3 4 5 6 7 8 9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2 3 4 5 6 7 8 9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى 2 3 4 5 6 7 8 9

ما هي الطريقة الأفضل كإجراء احترازي لخطر عدم توفر المعلومات بالاضافة لعدم دقتها																		
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2	3	4	5	6	7	8	9	إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2	3	4	5	6	7	8	9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2	3	4	5	6	7	8	9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2	3	4	5	6	7	8	9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2	3	4	5	6	7	8	9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى	1	2	3	4	5	6	7	8	9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2	3	4	5	6	7	8	9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2	3	4	5	6	7	8	9
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2	3	4	5	6	7	8	9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى	1	2	3	4	5	6	7	8	9
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2	3	4	5	6	7	8	9	نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى	1	2	3	4	5	6	7	8	9

ما هي الطريقة الأفضل كإجراء احترازي لخطر عدم توفر الخبرة لدى طاقم المقاول																		
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2	3	4	5	6	7	8	9	إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1	2	3	4	5	6	7	8	9
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1	2	3	4	5	6	7	8	9	الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1	2	3	4	5	6	7	8	9

ما هي الطريقة الأفضل كإجراء احترازي لخطر عدم توفر الخبرة لدى طاقم المقاول			
الاعتماد على الحكم الموضوعي حسب الحالة وذلك لوضع برنامج مناسب للمشروع	1 2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9 نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى**
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1 2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9 الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها**
إعداد الجدول الزمني المناسب بدقة عالية عن طريق الحصول على معلومات المشروع المحدثة	1 2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9 نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى**
الرجوع إلى المشاريع السابقة المشابهة أوالجاري العمل بها والتي تتميز بدقة برنامج العمل الخاص بها	1 2 3 4 5 6 7 8 9	**1**	**2 3 4 5 6 7 8 9 نقل أو تقاسم المخاطر ل/ مع الأطراف الأخرى**