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Risk Management in Construction Projects from Contractors and Owners" perspectives

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بسم الله الرحمن الرحيم

﴿قل إن صلاتي ونسكي ومحياي ومماتي لله رب العالمين۞ لا

شريك له وبذلك أمرت وأنا أول المسلمين۞﴾ الأنعام (162-163)

To my father with all of my love

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Abstract

Construction is a risky industry and there is no other industry that requires proper application of business practices much as construction industry. The main objective of this research is to gain understanding of 44 risk factors that could be in front of building projects in Gaza Strip. The study aims also to investigate the effectiveness of risk preventive and mitigative methods. Moreover, the usage of risk analysis techniques is addressed.

The objectives of this research have been achieved through a comparative study of closed-ended questionnaires with interviews and a case study in Gaza Strip. The results of analyzing the 40 questionnaires that were directed to contractor respondents concluded that the most important risk factors are: financial failure of the contractor, working at hot (dangerous) areas, closure, defective design and delayed payments on contract. On the other hand, owner respondents concluded that the most important risk factors are: awarding the design to unqualified designer, defective design, occurrence of accidents, difficulty to access the site, and inaccurate quantities. The results show that there are many risk factors contractors and owners could not allocate them on the party that should bear these factors' consequences. The study findings show that the contractors and the owners suffer from lack of innovative methods to prevent or mitigate risks. Contractors and owners – according to results – do not utilize risk analysis techniques but depend widely on direct judgment in estimating time and cost.

The results of this study recommended that there is an essential need for more standardization and effective forms of contract, which address issues of clarity, fairness, roles and responsibilities, allocation of risks, dispute resolution and payment. Both owners and contractors are called for identification of possible risk factors that could be faced and to allocate them contractually. There is a need to keep a computerized historical data of finished projects to help in rights reservation and to be an information source for future comparison. A standard form of contracts which address issues of clarity, fairness, roles and responsibilities, allocation of risks, dispute resolution and payment should be adopted for all the projects in Gaza Strip instead of the consequential disorder that was a result of applying different types of contracts. More effort should be made to properly apply risk management in the construction industry.

ملخص البحث

إدارة المخاطر في مشاريع التشييد في قطاع غزة من وجهتي نظرشركات المقاولات والمؤسسات المالكة

تعتبر صناعة الإنشاءات من أكثر الصناعات خطورة، ولذلك فإنها من أكثرها تطلبًا لتطبيق القواعد الصحيحة لإدارة الأعمال. إن الهدف الرئيسي لهذا البحث هو فهم عوامل المخاطرة التي قد تواجهها مشاريع المباني في قطاع غزة، كما ويهدف البحث إلى قياس فاعلية الطرق المستخدمة في التعامل مع عوامل المخاطرة سواء بالحول دون وقوع هذه المخاطر أو بالتقليل من تبعاتها، كما أن الدراسة هدفت إلى دراسة طرق تحليل المخاطر المتبعة من قبل المالكين والمقاولين.

لقد تم استخدام أسلوب الاستبيان مع المقابلة الشخصية لجمع المعلومات المطلوبة من أربعين مشاركًا من شركات المقاولات ومثلهم من الهيئات المالكة، كما تم تقديم حالة دراسية عملية.

خلص البحث بعد تحليل 44 عامل من عوامل المخاطرة إلى أن أكثر العوامل خطورة من وجهة نظر شركات المقاولات هي: فشل المقاول ماليًا، وقرب المشروع من المناطق الخطرة، والحصار، والتصميم الخاطئ، وتأخر الدفعات. إلا أن أكثر العوامل خطورة من وجهة نظر الهيئات المالكية هي: العهود بالتصميم إلى مصمم غير كفؤ، والتصميم الخاطئ، ووقوع الحوادث في العمل، وإمكانية الوصول للموقع، وعدم دقة الكميات. أظهرت النتائج أن هناك عدد كبير من عوامل المخاطرة لم تستطع شركات المقاولات أو الهيئات المالكة تحديد الطرف الذي يمكن أن يتحمل هذه المخاطر، كما ظهر أن شركات المقاولات أو الهيئات المالكة لا تستخدم طرقًا خلاقة للتعامل مع المخاطر، ولازالت تعتمد على التقييم المباشر المبني على الخبرة بدلاً من الطرق الحديثة لتحليل المخاطر وتقدير المدة والتكلفة اللازمة للمشروع.

توصي الدراسة أن يتم تعديل طريقة ترسية العطاءات لتكون الترسية للعطاءات الأكثر دقة بدلاً من أقل الأسعار كما أن شركات المقاولات والهيئات المالكة مدعوة لتعريف عوامل المخاطرة وتسمية الطرف الذي سيتحملها تعاقديًا، كما أن هناك حاجة ماسة لحفظ معلومات محوسبة عن المشاريع المنفذة لاستغلالها في المقارنة المستقبلية، كما أنه يجب تبني نموذج عام للعقود الهندسية، كما أوصت الدراسة بالعمل الجاد لتطبيق إدارة المخاطر في صناعة الإنشاءات.

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Chapter 1

Introduction

This chapter includes some historical information about Palestinian economy and construction industry due to the relevance of such information to the subject of this thesis. Also, the chapter contains necessary definitions, importance of the research, objectives of the study and its boundaries.

1.1 The nature of the construction industry

The nature of the construction projects makes the industry unique in that the manufacturing facility or plant must move to the construction site (Hinze, 2001). There are many different descriptions of the construction industry, drawn from different specialist disciplines. This vagueness is compounded by the fact that the construction involves such a wide range of activity that the industry's external boundaries are also unclear (Murdoch and Hughes, 2000). For example, the term "construction" can include the erection, repair, and demolition of things and diverse as houses, offices, shapes, dams,…etc. Construction is difficult to comprehend fully because the relationships between the parts are not always clear and the boundaries of the industry may be characterized as:

- It is fragmented
- It is sensitive to economic cycles
- There are extraordinary diversity of professions, specialists and suppliers
- It is largely affected by external environments

There is no other industry that requires the proper application of business practices much as construction industry. The many variables and complex relationships that exist between variables that must be considered in the process of building a construction project necessitates sound business practices and decisions. The coordination and use of many types of labor skills, materials and equipment that are used to build a project require daily application of proper business practices (Adrian, 1975). The variable environment surrounding the construction project complicated decisions to be made concerning the use of labor, materials and equipment. In addition, governmental influence and labor practices have a bearing on business decisions that must be made (Adrian, 1975).

1.2 Management in Construction

On the whole, construction contractors have been slow in applying proper management methods to the conduct of their business (Clough and Sears, 1994). Management in construction industry have been characterized as being weak, insufficient, nebulous, backward and slow to react to changing conditions. Nevertheless, in the overall picture, the construction industry is at or near the top in the annual rate of business failures and resulting liabilities (Clough and Sears, 1994). Explanations are given for why the construction has been slow in applying management procedures that have proven effective in other industries. The reasons are (Raftery, 1997):

- Construction projects are unique
- Construction projects involve many skills largely non-repetitive in nature
- Projects are constructed under local conditions of weather, location, transportation and labor that are more or less beyond the contractor's control.
- Construction firms, in main, are small operations, with the management decisions being made by one or two persons (Clough and Sears, 1994)
- There are special problems in construction
- The future can not be forecasted
- Construction is a high-risk business.

1.3 The Size of the Construction Industry

There is no doubt that construction is a key activity in any economy, it influences and is influenced by the gross domestic product (GDP) of any nation (Cox & Townsend, 1998). Construction industry is defined as a risky industry with uncertainties that management has to deal with. A variety of external and internal factors influencing the construction process are main reasons of this situation (Sey & Dikbas, 1983). Forese et al (1997) stated that construction industry is characterized by having many players of multiple disciplines who are brought together at various stages throughout a single project. Construction projects are complex and time-consuming undertakings. The structure must be designed in accordance with applicable codes and standards, culminating in working drawings and specifications that describe the work in sufficient details for its accomplishment in the field (Clough, 1986). The construction projects have been divided into four main categories: residential construction, building construction, heavy engineering construction and industrial construction. The construction industry is a vital part of the U.S. economy. It provides jobs for 8 millions people and creating a 12% slice of the American's gross domestic product (Levy, 2000). In the U.K., the construction industry directly employs about 1.7 millions people and accounts for about 6% of GDP (NAO, 2001). Building construction produces structures ranging from small retail stores to urban redevelopment complexes, from grade schools to complete new universities, hospitals, commercial office towers, theaters, government buildings, recreation centers, light manufacturing plants and warehouses. Economically, this sector typically accounts for 35 to 40% of the construction market (Barrie & Paulson, 1992). Table (1.1) summarizes data concerning population, GDP and construction output in the UK, USA, Japan and Germany (Cox & Townsend, 1998).

Table 1.1. International comparisons for construction for construction output in 1998

Feature	UK	USA	Japan	Germany
Population (Million)	58	250	125	66
Total GDP (₤ Billion)	523	4216	2820	1075
Construction Output (₤ Billion)	45.5	312	509	114
% GDP on Construction	8.7	7.4	18.1	10.6
Construction investment per capita (₤)	789	1248	4073	1735

Source: US Department of Commerce (Cited in Cox & Townsend, 1998).

1.4 Construction industry in Palestine

Construction is a vital activity in the Palestinian economy. It contributes substantially in the Palestinian gross domestic product and employment (PCBS, 1999). According to World Bank (1998), in 1985 the construction industry contributed 17% of value added to GDP. Construction sector has played a crucial role in extending job opportunities for Palestinian labor force. Expansion of the construction activity has generated a lot of jobs for skilled, semi skilled and unskilled construction workers. The absolute number of domestic construction increased from 12.8 thousands in 1970 to 40.3 thousands in 1996. The share of this labor domestic employment has risen from 7.9% to 12% for the same period (PECDAR, 1997).

In 1996 private services (including trade, rental services and transportation) contributed 38 percent of value added to the Palestinian economy. This is followed by public and community services, which contributed 23% of value added. Next comes industry (manufacturing, quarrying, and the supply of utilities) which added 16 percent to value added in the year. Agriculture and fishing contributed 14% to value added and finally 9 percent of the value added came from activities in the construction sector (World Bank, 1998). Figure (1.1) illustrates GDP at factor cost-1996.

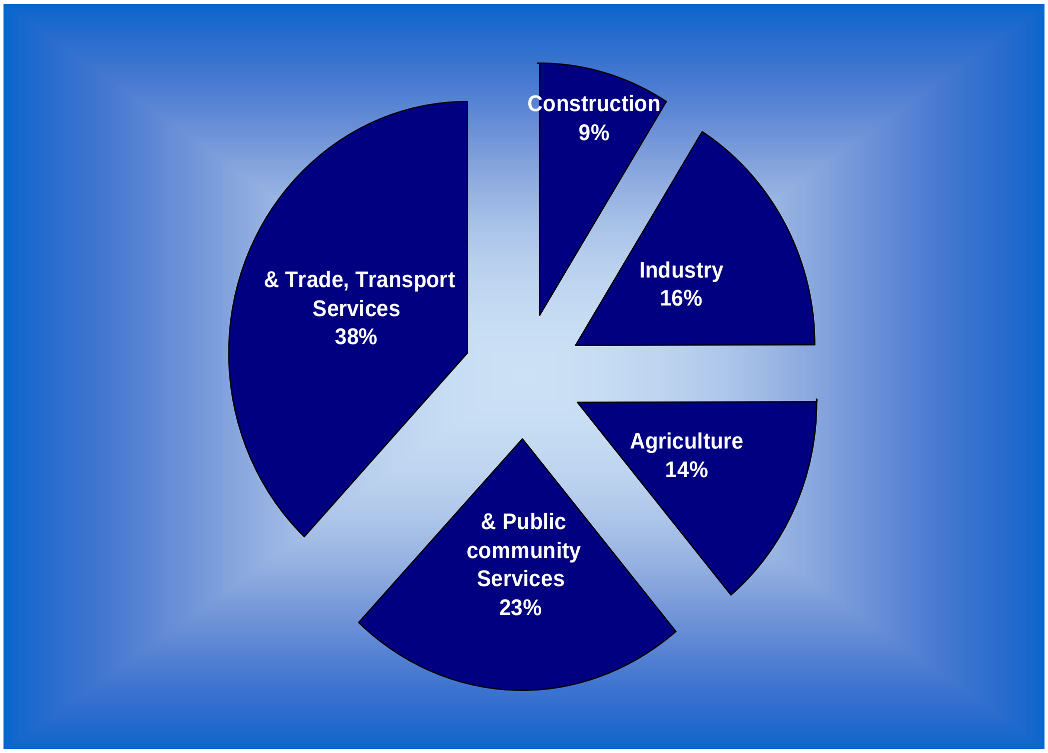


Figure 1.1. GDP at factor cost in Palestine (World Bank, 1998).

In the building industry, efficient organization on the building site has been difficult to apply due, in the main to the most unique conditions which the industry operates, particularly in relation to materials supply from Israel and relatively short periods during which it operates on any one site (Enshassi, 1997, cited in Madi, 2003).

1.5 The Palestinian Economy

Palestinian economy is almost totally dependent on the economy of Israel. This situation was created to serve the interests of the occupying power (PECDAR, 2001). More than 80 percent of exports are directed to Israel, from which 90 percent of imports originate. Palestine experiences a trade deficit with Israel because after thirty years of neglect, it lacks a broad, competitive industrial and agricultural base. This situation is further compound by Israeli restrictions on the volume, destination and sources of Palestinian trade (PECDAR, 2001).

During the past two decades, more than three quarters of private investment were in construction (PECDAR, 2001). The construction share in GDP for West Bank and Gaza Strip had reached unprecedented levels. This is illustrated in Table (1.2).

Table 1.2. The construction share in GDP for W. Bank & Gaza Strip (PECDAR, 2001)

Item/Years	G.D.P	Construction Share %
1972	276.2	9
1974	548.7	12
1976	650.5	16
1978	695.4	16
1980	1044	16
1982	1002	19
1984	998.8	18
1986	1536.7	16
1988	1789.9	16.7
1990	2220	21.6
1992	2486.6	22.4
1994	2975.23	26

1.6 Risks in Construction

The construction industry generally has a bad reputation for its work. The industry has a reputation for time and cost overruns (Raftery, 1997). This bad reputation is due to many reasons. One of them is that the construction industry is one of riskiest of all business types (Clough and Sears, 1994). There are many types of risk in the construction contracts; they are:

- Physical works
- Delay and disputes
- Direction and supervision
- Damage and injury to persons and property
- External factors
- Payment
- Law and arbitration

1.7 Typical Risks on a Construction Project

- Occurrence of accidents to operatives on site causing physical injury.
- Failure to complete within the stipulated design and construction time.
- Failure to obtain the expected outline planning, detailed planning or building code/regulation approvals within the time allowed in the design program.
- Unforeseen adverse ground conditions delaying the project.
- Unexpected rises for labor and materials.
- Force majeure.
- Failure to complete the project within the client's budget allowance.
- Loss of the contractor caused by the late production (Flanagan & Norman, 1993).

It is important to distinguish the sources of risk form their effects. Ultimately, all risk encountered on a project is related to one or more of the following (Flanagan & Norman, 1993):

- Failure to keep within the cost budget/forecast/estimate/tender.
- Failure to keep within the time stipulated for the approvals, design, construction and occupancy.
- Failure to meet the required technical standards for quality, functions, fitness for purpose, safety and environment preservation.

The effect of adverse events will be financial loss. The task of professional advisors, contractors and suppliers is to identify the discrete sources of risk which cause to failure occur, and to develop a risk management strategy that provides for the most appropriate organizations to carry that risk (Flanagan & Norman, 1993).

1.8 Risk and Uncertainty

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 (Jaafari, 2001). Risk also can be defined as a characteristic of a situation, action, or event in which a number of outcomes are possible, the particular one that will occur is uncertain, and at least one of the possibilities is undesirable (Yoe, 2000). Zayed and Chang (2002) defined risk as the presence of potential or actual constraints that could stand in the way of project performance, causing partial or complete failure either during construction or at time of use. Greene (2001) stated that there is no all encompassing definition of risk and provided his interpretation of what risk constituents:

Risk = Hazard × Exposure [1]

He defined hazard as *the way in which an event can cause harm* and exposure as *the extent to which likely recipient of harm can be influenced by the hazard*.

1.9 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 from initial investment appraisal to completion and into use is a complex process. Construction industry in Gaza Strip is suffering from the misunderstanding of risk management including risk identification, analysis and assessment, and that is why this research is important, where it will discover the risk factors in the construction industry in Gaza strip and determine the importance of each factors in terms of severity and allocation.

1.10 Research Aim

This research sets sights on introducing the risk management in building projects from the contractors and owners' perspectives and identifies key risk variables and their effects on the projects.

1.11 Purpose of the study

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, few researchers have participated in this topic addressing the construction industry in the local market. This study is to analyze risk factors affecting the construction industry in Gaza strip.

1.12 Objectives

The objectives of this study are:

1. Identifying key risk factors that could stand in front of construction processes by reviewing the literature and through the additions that could be made by the industry practitioners, i.e. contractors and owners.
2. Investigating the severity and the allocation of each identified risk factor according to the perspectives of contractors and owners.
3. Examining the risk management actions efficiency that are applied in the industry by each category (contractors and owners).
4. Studying a case of construction the New Pediatric Hospital to get in-depth information about the impacts of the identified risk factors on the project regarding the schedule and the cost.
5. Providing practical suggestions and recommendations pointing toward upgrading the risk management process in construction and improve the performance of contracting companies and owners in this field.

1.13 Research Boundaries

1. Due to time limitation, this research is concerned with building projects only and will not take into account that other categories of construction industry like heavy engineering construction (tunnels, bridges, dams, etc.), industrial projects (factories and workshops), and infrastructure projects (sewage and water supply).
2. Only contractors who are registered in the Palestinian Contractors Union will be addressed by the study.
3. Risk key-variables and the affected processes of projects by these variables will form the core of the study.
4. This research is limited to one type of contracts, which is Turn-Key contracts.

Chapter 2

Risk Management in Building Projects

2.1 Introduction

The construction industry has changed rapidly over the past 10 years; companies are faced with more risk and uncertainty than over before. Clients expect more, most importantly, they do not want surprises, and are more likely to engage in litigation when things go wrong. Risk management has become an important part of the management process for any project. Risk in construction has been the object of attention because of time and cost overruns associated with construction projects. This chapter reviews the literature concerning some of risks faced in the construction industry, some of analysis techniques and risk response practices.

2.2 Defining Risk and Uncertainty

Risk can be defined as an uncertain event or condition that, if it occurs, has a positive or a negative effect on a project objective. A risk has a cause and, if it occurs, a consequence (Office of project management process improvement, 2003). Jaffari (2001) defined risk 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. The Project Management Institute (1996) introduced a simple definition for risk as a discrete occurrence that may affect the project for better or worse. In order to emphasize the major objectives of survey on risk management actions, risk has been defined as the probability of occurrence of some uncertain, unpredictable and even undesirable events that would change the prospects for the profitability on a given investment (Kartam, 2001). Chicken and Posner (cited in Greene, 2001) provide their interpretation of what a risk constituents:

$$\text{Risk} = \text{Hazard} \times \text{Exposure}$$

They defined hazard as *"the way in which a thing or a situation can cause harm"*, and exposure as *"the extent to which the likely recipient of the harm can be influenced by the hazard"*. Harm is taken to imply injury, damage, loss of performance and finance, whilst exposure imbues the notions of frequency and probability. Risk is the triple characteristic of any project decision in the situation of uncertainty. It can be defined as a trinity of risk event *(A)*, risk probability *(P)* and function of risk losses *(u)*:

$$R = (A, P, u)$$

The risk event *(A)* is a random event which is connected with any project decision (Titarenko, 1997).

Uncertainty is a situation in which a number of possibilities exist and which of them has occurred, or will occur, is unknown. Considering all risks are uncertain but not all uncertainty is risky (Yoe, 2000).

Risks and uncertainties characterize all activities in production, services and exchange. They affect all the fundamental variables that determine planning, implementation, monitoring, adjustment, behavior and explain choices, and bring about decisions (Okema, 2001). Any definition of risk is likely to carry an element of subjectivity, depending upon the nature of the risk and to what is applied.

Certainty exists only when one can specify exactly what will happen during the period that covered by the decision. This is not very common in the construction industry (Flanagan & Norman, 1993). Other writers see no difference between risk and uncertainty; Education and Learning Wales (2001) stated that risk and uncertainty can be defined as follows:

- Risk exists when a decision is expressed in terms of range of possible outcomes and when known probabilities can be attached to the outcomes.
- Uncertainty exists when there is more than one possible outcome of a course of action but the probability of each outcome is unknown.

In some situations, the risk does not necessarily refer to the chance of bad consequences. There may be the possibility of good consequences, and it is important that a definition of risk includes some reference to this point.

Writers such as Flanagan & Norman (1993) differentiated between risk and uncertainty. *Risk* has place in calculus of probability, and lends itself to quantitative expression. *Uncertainty*, by contrast, might be defined a situation in which there are no historic data or previous history related to the situation being considered by the decision maker. ADB, (2002) stated that in essence, risk is a quantity subject to empirical measurement, while uncertainty is of a non-quantifiable type. Thus, in a risk situation it is possible to indicate the likelihood of the realized value of a variable falling within stated limits—typically described by the fluctuations around the average of a probability calculus. On the other hand, in situations of uncertainty, the fluctuations of a variable are such that they cannot be described by a probability calculus.

The Royal Society (Greene, 2001) viewed risk as the probability *"that a particular adverse event occurs during a stated period of time, or results from a particular challenge."* The Royal Society also states that *"as a probability in the sense of statistical theory risk obeys all the formal laws combining probabilities"*. The problem with statistical theory is that it is only ever a guess, or an approximation of what is to occur.

Risk can be considered as a *"systematic way of dealing with hazards"*. If it is assumed that there is uncertainty associated with any prediction of hazard occurring, then there is only uncertainty because there is only ever a prediction of likely. Therefore for risk to exist there must be a hazard. The perception of hazards is entirely subjective. What one person find hazardous, his neighbor may not. This perception of hazard is centered around previous experience, cultural values and to some extent the aspect of specialist training in an area of field of expertise to which the hazard relates (Greene, 2001).

2.2.1 Dynamic and Static Risks

Dynamic risk is concerned with making opportunities; for instance it might concern developing a new and innovative product. Dynamic risk means that there will be potential gains as well as losses. Dynamic risk is risking the loss of something certain for gain of something uncertain (Flanagan & Norman, 1993) and (NAO, 2001).

Static risk related only to potential losses where people are concerned with minimizing losses by risk aversion (Flanagan & Norman, 1993). The unsystematic and arbitrary management of risks can endanger the success of the project since most risks are very dynamic throughout the project lifetime (Baloi & Price, 2003).

2.3 Causes of Risk as Threats

There exists no comprehensive study explaining the causes of risks among construction companies, moreover research covering the subject matter has tended to identify the symptoms rather than causes, a number of authors have attempted in their studies to ascertain the causes of threats in the construction industry, Kangari (cited in Rwelamila & Lobelo, 1997) ascribed the high threats to:

- A highly fragmented industry.
- Industry highly sensitive to economic cycles.
- Fierce competition as result of an over-capacitated market.
- Relative ease of entry.
- Management problems.
- Trading including:
    - Competitive quoting.
    - Outsize projects.
    - High gearing.
    - Resistance to change.
- Accounting, where inconsistencies occur in the financial data generated for management.
- Increase in project size.
- Unfamiliarity with new geographic area.
- Moving into new type of construction.
- Change in key personnel.

2.4 Sources of Risks

Checklist of risk drivers (Estate Management Manual, 2001):

- Commercial risk.
- Financial risk.
- Legal risks.
- Political risks.
- Social risks.
- Environmental risks.
- Communications risks.
- Geographical risks.
- Geotechnical risks.
- Construction risks.

- Technological risks.
- Operational risks.
- Demand/product risks.
- Management risks.

These sources of risk relate to project-specific and non-project-specific risks, as both these types of risk need to be considered when identifying the risks in a project or a process. The institution, assisted by the project team, need to define the boundaries of these sources and to break down these sources into detailed risk elements. This will allow a common understanding amongst those attempting to identify the risks in a project.

The division of risks into source elements can be difficult. It also creates the potential for increased personal subjectivity. It can also lead to the possibility of "double-counting" some risks by attributing the same risk to more than on source. This may, however, beneficial in understanding the relationships between risk sources and elements (Estate Management Manual, 2001). The obvious problem with categorizing risk, apart from the cultural perceptions noted by the royal society report, 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 Figure (2.1). It is proposed that the risks can be considered with respect to six categories: financial and economic, political and environment, design, site construction, physical and Environmental 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 (Enshassi & Mayer, 2001).

2.5 Risk Management Process

A number of variations of risk management process have been proposed. Boehm (cited in Raz & Michael, 2001) suggested a process consisting of two main phases: risk assessment, which includes identification, analysis and prioritization, and risk control which includes risk management planning, risk resolution and risk monitoring planning, tracking and corrective action. Chapman and Ward (cited in Tummala & Burchett, 1999) identified risk management approach as a multiphase `risk analysis' which covers identification, evaluation, control and management of risks. Simmons (1998) provided a definition for the risk management as the sum of all proactive management-directed activities, within a program that is intended to acceptably accommodate the possibly failures in elements of the program. "Acceptably" is as judged by the customer in the final analysis, but from a firm's perspective a failure is anything accomplished in less than a professional manner and/or with less than-adequate result. Al-Bahar cited in (Ahmed et al, 1999) defined the risk management as a formal orderly process for systematically identifying, analyzing, and responding to risk events throughout the life of a project to obtain the optimum or acceptable degree of risk elimination or control.

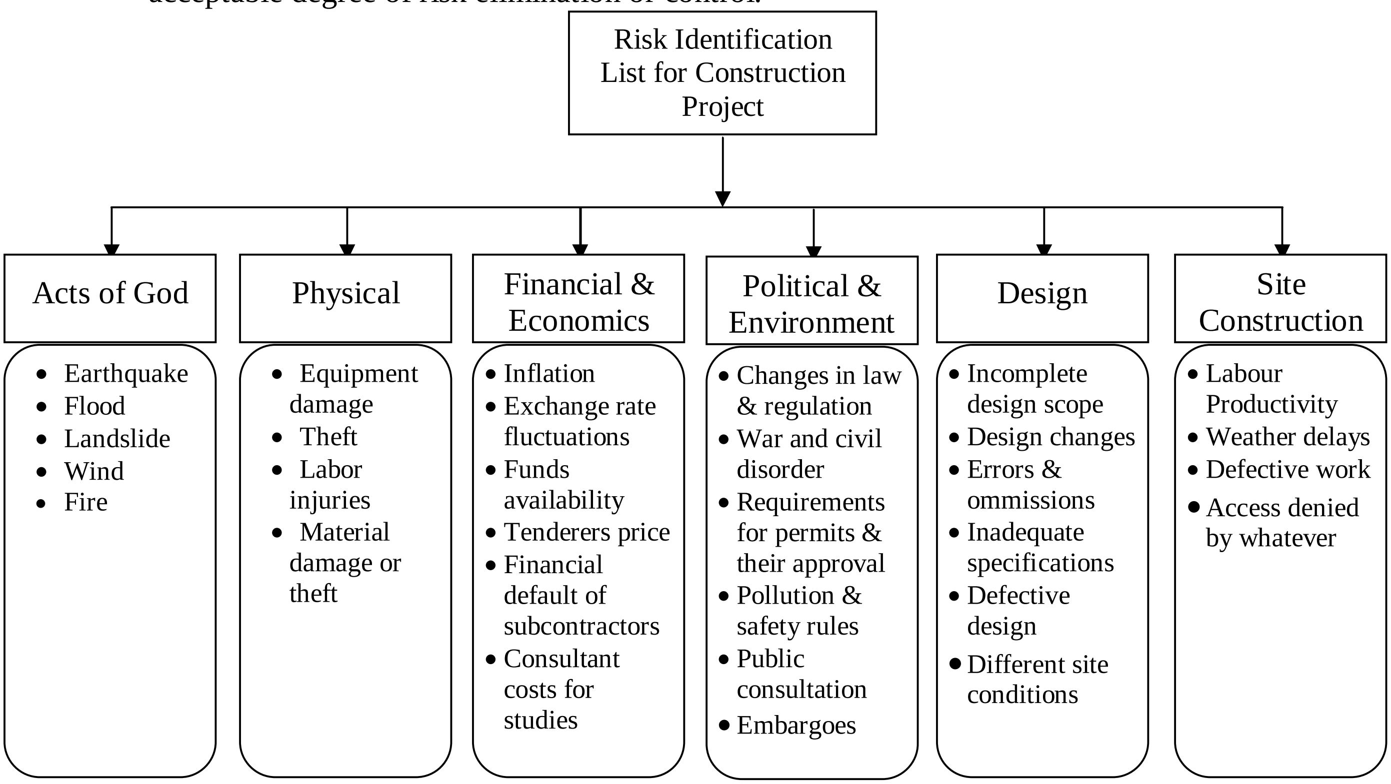


Figure 2.1. Risk Categorization List, adapted from (Enshassi & Mayer, 2001)

It is possibilities that are being accommodated. It is management's job to do the planning that will accommodate the possibilities. The customer is the final judge, but internal goals should be to a higher level than customer expectations. Risk management as a shared or centralized activity must accomplish the following tasks (Simmons,1998):

- Identity concerns.
- Identify risks & risk owners.
- Evaluate the risks as to likelihood and consequences.

- Assess the options for accommodating the risks.
- Prioritize the risk management efforts.
- Develop risk management plans.
- Authorize the implementation of the risk management plans.
- Track the risk management efforts and manage accordingly.

Chapman and Ward (1997) outlined a generic risk management process consisting of nine phases:

1. Define the key aspects of the project;
2. Focus on a strategic approach to risk management;
3. Identify where risks may arise;
4. Structure the information about risk assumption and relationships;
5. Assign ownership of risks and responses;
6. Estimate the extent of uncertainty;
7. Evaluate the relative magnitude of the various risks;
8. Plan response;
9. Manage by monitoring and controlling execution.

According to the Project Management Body of Knowledge (PMI,1996), risk management forms one of the so-called nine functions of project management (the other eight being integration, communications, human resources, time, cost, scope, quality and procurement management). The traditional view is that these functions should form the basis of planning and that each should be the focus of attention in each phase of the project. In the PMBOK, PMI (1996) presents four phases of the risk management process: identification, quantification, responses development and control. Risk Management covers the process of identification, assessment, allocation, and management of all project risks (APM, 2000). Healy cited in (Shen, 1997) suggested a systematic process including risk identification, risk analysis and risk response, where risk response has been further divided into the four actions: risk retention, risk reduction, risk transfer and risk avoidance. Risk management is also seen as a process that accompanies the project from its definition through its planning, execution and control phases up to its completion and closure (Raz & Michael, 2001). Risk management is not synonymous with insurance, nor does it embrace the management of all risks to which a project is exposed. In practice, the truth lies somewhere between the two extremes. A risk management system must be practical, realistic and must be cost effective. The depth to which you analyze risk obviously depends upon your circumstance. Only you can judge the importance to be placed on a structured risk analysis. Conventional education does little to foster an awareness of how unpredictable reality can be (Flanagan & Norman, 1993). Risk management measures the potential changes in value that will be experienced in a portfolio as a result of differences in the environment between now and some future point in time (Dembo & Freeman, 1998).

2.5.1 Construction risk management approach-Conceptual Model

This model placed risk management in the context of project decision making while considering the over-lapping contexts of behavioral responses, organization structure, and technology. The objectives of project and construction risk management should be clearly established within the context of project decision-making, and will be governed largely by the risk attitude of the project proponent. In discussing human judgments in decision-making, proposes a sociological and organizational context for risk analysis. The construction risk management conceptual model provides an effective systematic framework for quantitatively identifying, analyzing, and responding to risk in construction projects. With this model emphasis is placed on how to identify and manage risks before, rather than after, they materialize into losses or claims (Enshassi & Mayer, 2001).

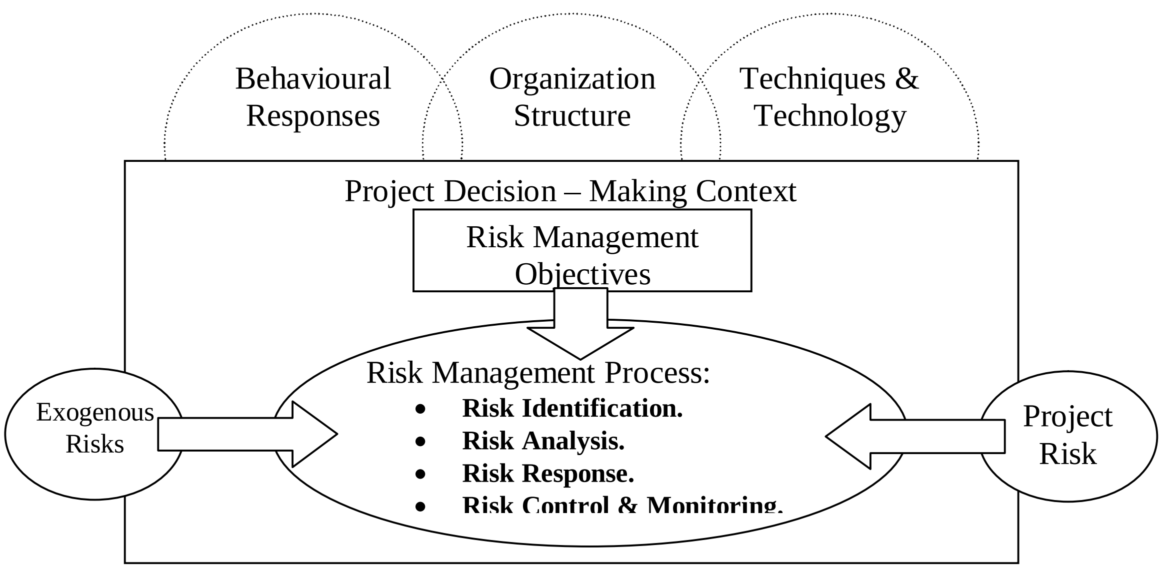


Figure 2.2. Conceptual Model of Construction Risk Management, (Enshassi & Mayer, 2001)

2.5.2 Risk Identification

This is the first stage in risk management and it entails capturing all the potential risks that could arise within the project. It is commonly acknowledged that of all the stages of risk management process, risk identification stage has the largest impact on the accuracy of any risk assessment (Chapman, 1998). To facilitate risk identification, risks can also be broadly categorized as controllable and uncontrollable risks (Flanagan and Norman, 1993). Further, controllable risks are those risks which a decision maker undertakes voluntarily and whose outcome is, in part, within our direct control; and uncontrollable risks as those risks which we cannot influence (Chege & Rwelamila, 2000). Risk identification consists of determining which risks are likely to affect the project and documenting the characteristics of each. Risk identification is not a one time event; it should be performed on a regular basis throughout the project (PMI, 1996). The identification of risks consists of a method used to generate risks, and guidance on what those risks should look like when written down (Isaac, 1995). Risk identification should address both internal and external risks. Internal risks are things that the project team can influence, such as staff assignments and cost estimates. External risks are things beyond the control or influence of the project team, such as government actions. In project context, risk identification is also concerned with opportunities (positive outcomes) as well as threats (negative outcomes) (PMI, 1996). At this stage, a broad view should be taken to ascertain without any constraint the risks that are likely to impede the project in meeting its cost target. A failure to recognize the existence of one or more potential risks may result in a disaster or foregoing an opportunity for gain resulting from proper corrective action (Enshassi & Mayer, 2001). When attempting to identify risk, it is rather like trying to map the world. Maps of the world tend to be centered on the location of the map maker. Much of the world is not visible from where you stand. Some territory which is familiar and obvious to you may not be obvious to everyone. Similarly, looking at a large project from the top, with multiple layers of planning, complex vertical and horizontal interactions, and sequencing problems, resembles looking into the world map through a fog. Management's ability to influence the outcome is limited to what they can see. The great temptation is to focus upon what should happen, rather than what could happen. A clear view of the event is the first equipment, focusing on the sources of risk and effect of the event (Flanagan & Norman, 1993). While extensive catalogues of risk can be devised, these are always likely to be incomplete and therefore inadequate. This may lead to decision-makers failing to consider the full spectrum of potential risks for a project. Developing categories of risk is one way of typifying risks so that this danger can be minimized (Enshassi & Mayer, 2001).

2.5.3 Risk Analysis

Risk analysis, a component of the risk management process, deals with the causes and effects of events which cause harm. The aim behind such analysis is a precise and objective calculation of risk. To the extent that this is possible, it allows the decision making process to be more certain (Estate Management Manual, 2002). The essence of risk analysis is that it attempts to capture all feasible options and to analyze the various outcomes of any decision. For building projects, clients are mainly interested in the most likely price, but projects do have cost over-runs and, too frequently, the 'what if' question is not asked (Flanagan & Norman, 1993).

Risk analysis involves assessing the identified risks. This first requires that the risks are quantified in terms of their effect on cost, time or revenue. They can be analyzed by measuring their effects on the economic parameters of the project or process. In terms of risk response, three general types of response can be identified (Estate Management Manual, 2002):

- Risk avoidance or reduction.
- Risk transfer.
- Risk retention.

The use of risk analysis gives an insight into what happens if the project does not proceed according to plan. When active minds are applied to the best available data in a structured and systematic way, there will be a clearer vision of the risks than would have been achieved by intuition alone (Flanagan & Norman, 1993).

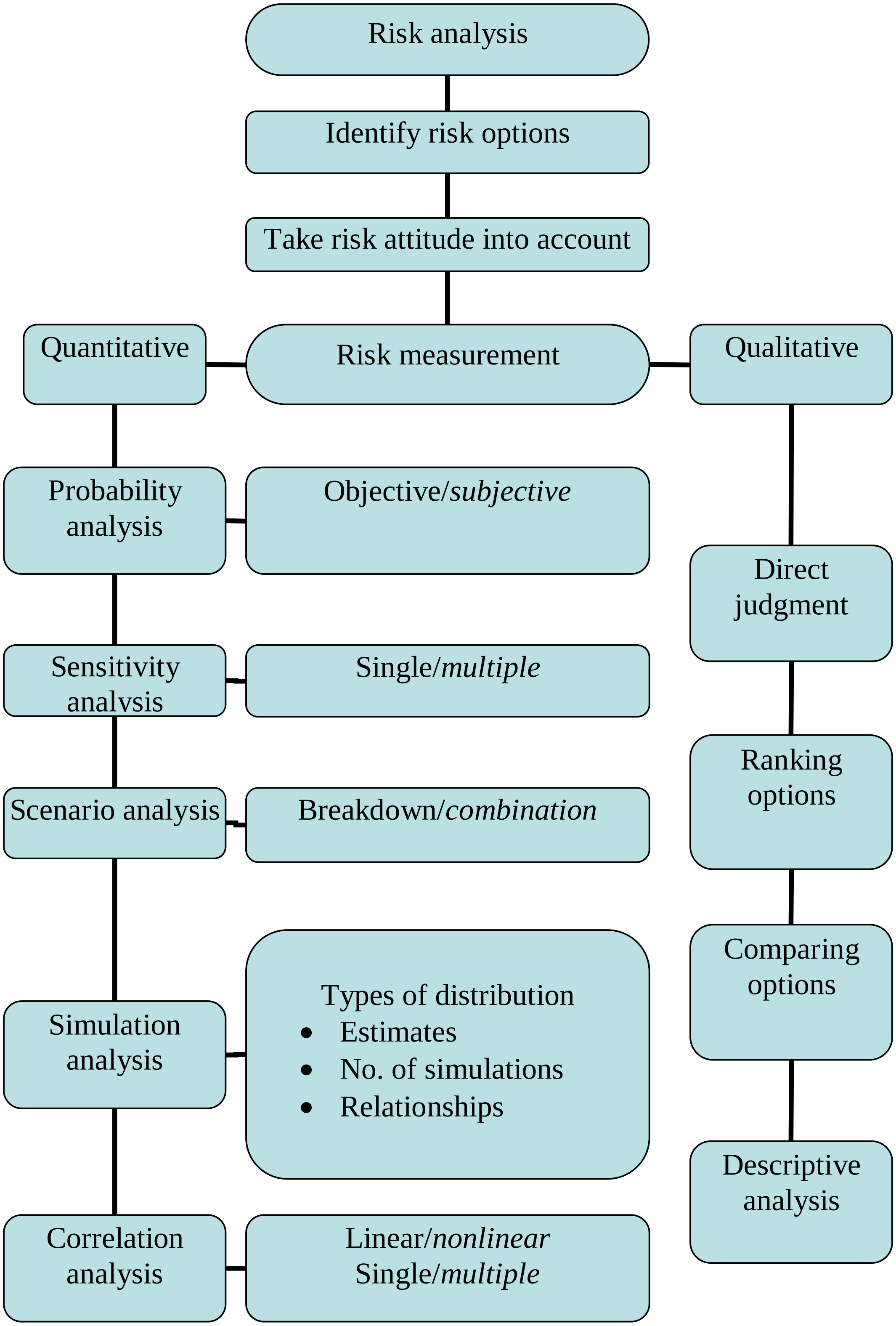


Figure 2.3. Risk Analysis Sequence (Flanagan & Norman, 1993)

Figure (2.3), detailed by Flanagan and Norman (1993), shows the sequence in risk analysis. The traditional approach to forecasting construction price or construction duration at the design stage of a project is to use the available data and produce a single point best estimate. The risk analysis approach explicitly recognizes uncertainty that surrounds the best estimate by generating a probability distribution based upon expert judgment. Therefore, the understanding about the effects of uncertainty upon the project will be improved. Risk analysis must not be viewed as a stand alone activity; any strategies developed must not be seen as cast in stone commandants. Rather, these should be seen as a component of all decisions made continually to respond to project dynamics (Jaafari, 2001). Risk analysis involves evaluating risks and risk interactions to assess the range of possible project outcomes. It is complicated by a number of factors including, but not limited to (PMI, 1996):

- Opportunities and threats can interact in unanticipated ways (e.g., schedule delays may force consideration of new strategy that reduces overall project duration).
- A single risk event can cause multiple effects, as when late delivery of a key material produces cost overruns, schedule delays, penalty payments, and a lower quality product.
- The mathematical techniques used can create a false impression of precision and reliability.

What is needed is an application of risk analysis to help project managers control cost that is relatively simple to apply, can be used throughout the life cycle of a construction project, accounts for the tendency of construction professionals to apply risk in linguistic terms, and apply their experience (Bender & Ayyub, 2001).

2.5.3.1 Methods of Risk Analysis

The analysis of risks can be *quantitative* or *qualitative* in nature depending on the amount of information available (APM, 2000). Qualitative analysis focuses on identification together with assessment of risk, and quantitative analysis focuses on the evaluation of risk (Chapman, 2001). Indeed there may be so little information about certain risks that no analysis is possible. Table (2.1) summarizes the various techniques used for risk analysis.

Table 2.1. Various risk analysis techniques, adapted from (Ward and Chapman, 1997)

Risk Analysis	
Qualitative	Quantitative
a. Direct judgment b. Ranking options c. Comparing options d. Descriptive analysis	e. Probability analysis f. Sensitivity analysis g. Scenario analysis h. Simulation analysis

A. Qualitative Risk Analysis

Lowe (2002) introduced a definition for the qualitative assessment of risk involves the identification of a hierarchy of risks, their scope, factors that cause them to occur and potential dependencies. The hierarchy is based on the probability of the event and the impact on the project. In qualitative risk analysis risk management acts as a means to registering the properties of each risk (Kuismanen et al, 2002). Qualitative risk analysis assesses the importance of the identified risks and develops prioritized lists of these risks for further analysis or direct mitigation. The management team assesses each identified risk for its probability of occurring and its impact on project objectives. Sometimes experts or functional units assess the risks in their respective fields and share these assessments with the team (Office of project management process improvement, 2003). Components of risk analysis were introduced by Kindinger and Darby (2000):

- List activities, tasks, or elements that make up the project.
- Identify applicable risk factors.
- Develop risk-ranking scale for each risk factor.
- Rank risk for each activity for each risk activity.
- Document the results and identify potential risk-reduction actions.

- **Qualitative risk ranking guidelines**

A method to systematically document the risk for each qualitative risk factor identified in Figure (2.4) is needed to perform a consistent evaluation of risk across the different project or program activities. To make this possible, qualitative definitions of risk factors are defined for three categories of risk (none/low, medium, and high). A simple example of a completed evaluation is shown in Figure (2.5).

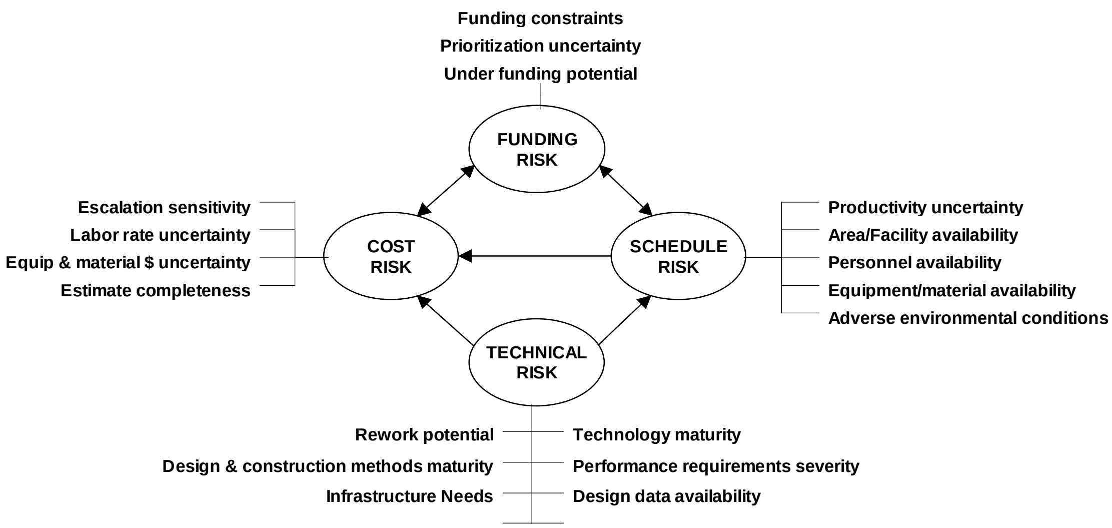
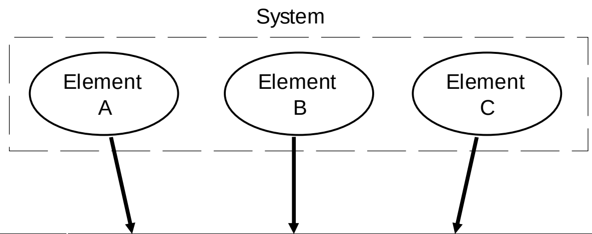


Figure 2.4. Qualitative Risk Factor Ranking Criteria, adopted from (Kindinger & Darby, 2000)



Risk Factor	A	B	C	Risk Factor Total
I	Low (1)	Low (1)	High (3)	5
II	Medium (2)	High (3)	Medium (2)	7
III	Low (1)	Low (1)	High (3)	5
Activity Total	4	5	8	

Figure 2.5. Risk Factor Evaluation, (Kindinger & Darby, 2000)

- **Uses of Qualitative Risk analysis Results**

Qualitative risk analysis results are used to aid the project management team in three important ways (Kindinger & Darby, 2000):

- The qualitative risk analysis factor rankings for each project activity provide a first-order prioritization of project risks before the application of risk reduction actions. This general ranking process is shown in Figure (2.5).

- The more meaningful, result from conducting a qualitative risk analysis is the identification of possible risk-reduction actions responding to the identified risk factors. Risk reduction recommendations are often straightforward to make when the risk issue is identified.
- The final use of the qualitative risk analysis is the development of input distributions for qualitative and quantitative risk modeling. The integrated qualitative and quantitative risk analysis is shown below in Figure (2.6).

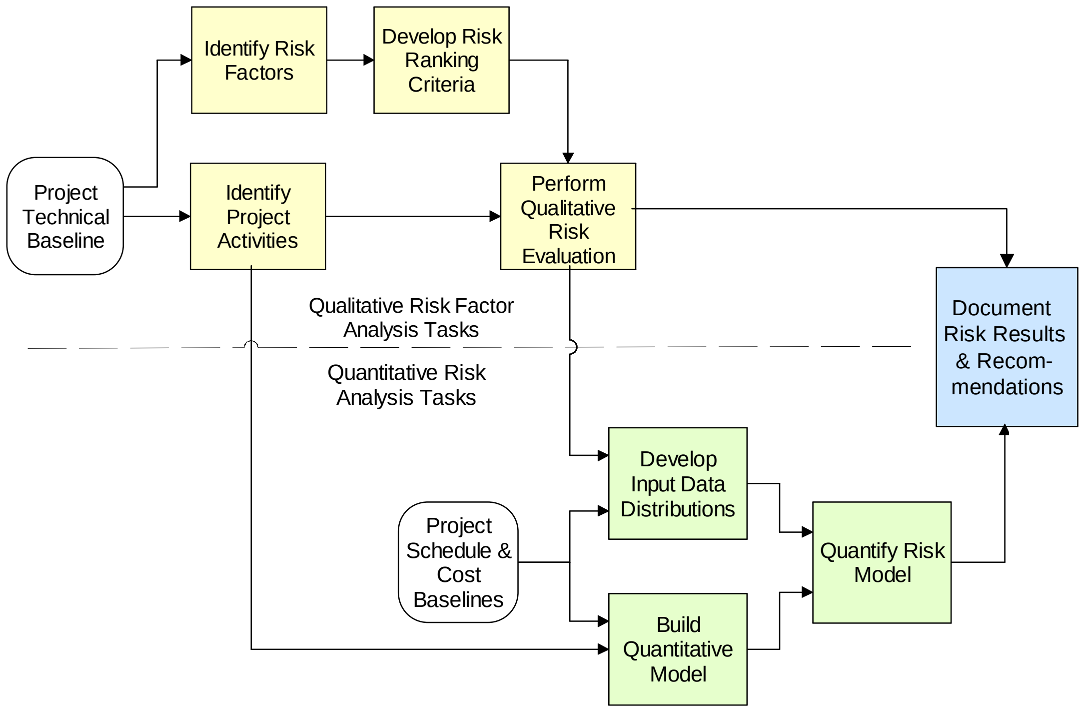


Figure 2.6. Integrated qualitative and quantitative risk analysis, (Kindinger & Darby, 2000)

B. Quantitative Risk Analysis

Quantitative risk analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. Quantitative analysis is based on a simultaneous evaluation of the impact of all identified and quantified risks. The result is a probability distribution of the project's cost and completion date based on the risks in the project (Office of Project Management Process Improvement, 2003). The quantitative methods rely on probability distribution of risks and may give more objective results than the qualitative methods, if sufficient current data is available. On the other hand, qualitative methods depend on the personal judgment and past experiences of the analyst and the results may vary from person to person. Hence the quantitative methods are preferred by most analysts

(Ahmed et al, 2001). Quantitative risk analysis considers the range of possible values for key variables, and the probability with which they may occur. Simultaneous and random variation within these ranges leads to a combined probability that the project will be unacceptable (Asian Development Bank, 2002). Quantitative risk analysis involves statistical techniques that are most easily used with specialized software (Office of Project Management Process Improvement, 2003). Quantitative risk analysis is to assign probabilities or likelihood to the various factors and a value for the impact then identify severity for each factor (Abu Rizk, 2002). When thorough quantitative risk analysis is necessary it can take two alternative approaches (Kuismanen, 2001):

1. risks can be quantified as individual entities while looking at the big picture. This way can include the cumulative effects (to certain accuracy) into each individual risk and thus make more accurate estimations of the net value of the risks.
2. Alternatively modeling the mathematical properties of the interrelations from the bottom up can be started and then calculate the net impact of each risk including the effects of interrelations.

In Figure 2.7 the basic steps of a quantitative risk analysis and a simplified relationship between risk analysis, risk assessment and risk management is presented (Abrahamsson, 2002).

- **Basic Steps of quantitative risk analysis**

As discussed previously, the aim of risk analysis is to determine how likely an adverse event is to occur and the consequences if it does occur. When quantitative risk analysis is to be done, it is attempted to describe risk in numerical terms. To do this, it should go through a number of steps (Kelly, 2003):

1. Define the consequence; define the required numerical estimate of risk.
2. Construct a pathway; consider of all sequential events that must occur for the adverse event to occur.
3. Build a model - Collect data; consider each step on the pathway and the corresponding variables for those steps.

4. Estimate the risk; once the model has been constructed and the data collected the risk can be estimated. Included in this estimation will be an analysis of the effects of changing model variables to reflect potential risk management strategies.
5. Undertake a sensitivity and scenario analysis; Undertaking a risk analysis requires more information than for sensitivity analysis.

- **Methods of Quantitative Risk Analysis**

Any specific risk analysis technique is going to require a strategy. It is best to begin by providing a way of thinking about risk analysis that is applicable to any specific tool might be used.

- *Probability Analysis* is a tool in investigating problems which do not have a single value solution, Monte Carlo Simulation is the most easily used form of probability analysis.
- *Monte Carlo Simulation* is presented as the technique of primary interest because it is the tool that is used most often.
- *Sensitivity Analysis* is a tool that has been used to great extent by most risk analysts at one time to another.
- *Breakeven Analysis* is an application of a sensitivity analysis. It can be used to measure the key variables which show a project to be attractive or unattractive.
- *Scenario Analysis* is a rather grand name for another derivative of sensitivity analysis technique which tests alternative scenarios; the aim is to consider various scenarios as options.

Sensitivity Analysis and Monte Carlo Simulation are discussed briefly:

- **Sensitivity Analysis**

Sensitivity analysis is a deterministic modeling technique which is used to test the impact of a change in the value of an independent variable on the dependent variable. Sensitivity analysis identifies the point at which a given variation in the expected value of a cost parameter changes a decision. Sensitivity analysis is performed by changing the values of independent risk variables to predict the economic criteria of the project (Merna & Stroch, 2000). Sensitivity analysis is an interactive process which tells you what effects changes in a cost will have on the life cycle cost (Flanagan & Norman, 1993). Sensitivity Analysis is the calculating procedure used for prediction of effect of changes of input data on output results of one model (Jovanovich, 1999). It dose not aim to quantify risk but rather to identify factors that are risk sensitive. Sensitivity analysis enables the analyst to test which components of the project have the greatest impact upon the results, thus narrowing down the main simplicity and ability to focus on particular estimates (Flanagan & Norman, 1993). The advantage of sensitivity analysis is that it can always be done to some extent. Specific scenarios of interest can be reasonably well described. Extreme outcomes, like the maximum or minimum possible costs, can often be estimated.

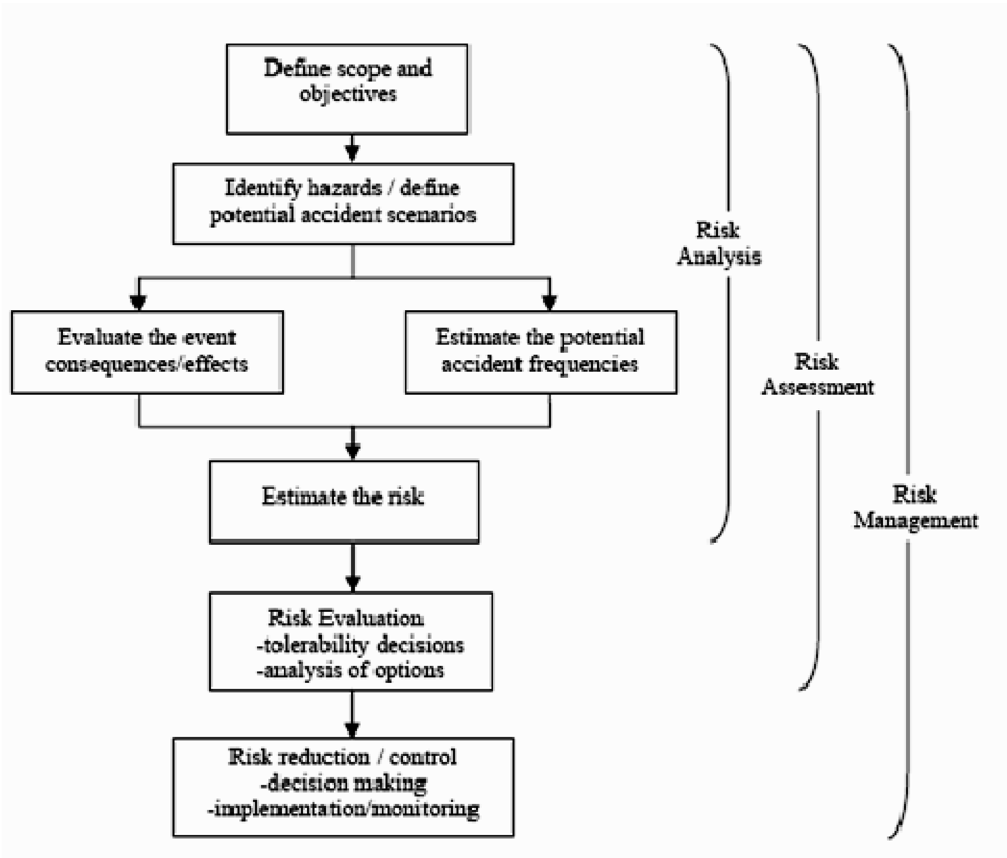


Figure 2.7. Simplified relationship between risk analysis, risk assessment and risk management. Adapted from Abrahamsson (2002).

The major disadvantage of sensitivity analysis is that the analyst usually has no idea how likely these various scenarios are. Many people equate possible with probable, which is not the case with sensitivity analysis (Yoe, 2000).

- **Monte Carlo Simulation**

Simulation is a probability-based technique where all uncertainties are assumed to follow the characteristics of random uncertainty. A random process is where the outcomes of any particular process are strictly a matter of chance (Flanagan, 2003). The Monte Carlo process is simply a technique for generating random values and transforming them into values of interest, the methods of generating random or pseudo random numbers are more sophisticated now and the mathematics of other distributions is more complex (Yoe, 2000). Different values of risk variables are combined in a Monte Carlo simulation. The frequency of occurrence of a particular value of any one of the variables is determined by defining the probability distribution to be applied across the given range of values. The results are shown as frequency and cumulative frequency diagrams. The allocation of probabilities of occurrence to each risk requires the definition of ranges for each risk (Merna & Stroch, 2000). Lukas (2004) presented risk analysis simulation steps:

1. Start with a project estimate done for each cost account.
2. Decide on the most likely cost, pessimistic costs, and optimistic costs.
3. Insert data into simulation software, then run the model.
4. Determine contingencies based on desired risk level.
5. Prioritize "risky" cost accounts for risk response planning.

This method of sampling (i.e. random sampling) will, lead to over- and under-sampling from various parts of the distribution. In practice, this means that in order to ensure that the input distribution is well represented by the samples drawn from it, a very large number of iterations must be made. In most risk analysis work, the main concern is that the model or sampling scheme we use should reproduce the distributions determined for the inputs (Abrahamsson, 2002). On the other hand, Lukas (2004) stated some of the simulation benefits:

- Improves estimate accuracy, it helps determine a contingency plan for an acceptable level of risk.
- Helps determine the bigger cost risks for risk response planning.

2.6 Risk Response Practices

PMI (1996) suggested three ways of responding to risk in projects, they are as follows:

- Avoidance: eliminating a specific threat, usually by eliminating the cause. The project management team can never eliminate all risks, but specific risk events can often be eliminated.
- Mitigation: reducing the expected monetary value at risk events by reducing the probability of occurrence (e.g., using new technology), reducing the risk event value (e.g., buying insurance), or both.
- Acceptance: accepting the consequences. Acceptance can be active by developing a contingency plan to execute should the risk event occur or passive by accepting a lower profit if some activities overrun.

Abu Rizk (2003) suggested some actions to be taken in response to residual risks. Actions can include:

- Reduce uncertainty by obtaining more information, this leads to re-evaluation of the likelihood and impact.
- Eliminate or avoid the risk factor through means such as a partial or complete re-design, a different strategy or method etc.
- Transfer the risk element by contracting out affect work.
- Insure against the occurrence of the factor.
- Abort the project if the risk is intolerable and no other means can be undertaken to mitigate its damages.

Ahmed et al (2001), Akintoyne and MacLeod (1997), Enshassi and Mayer (2001), and Education and Learning Whales (2001) argued that there are four distinct ways of responding to risks in a construction project, namely, risk avoidance, risk reduction, risk retention and risk transfer. Those ways are discussed in below briefly.

2.6.1 Risk Avoidance

Risk avoidance is sometimes referred to as risk elimination. Risk avoidance in construction is not generally recognized to be impractical as it may lead to projects not going ahead, a contractor not placing a bid or the owner not proceeding with project funding are two examples of totally eliminating the risks. There are a number of ways through which risks can be avoided, e.g. tendering a very high bid; placing conditions on the bid; pre-contract negotiations as to which party takes certain risks; and not biding on the high risk portion of the contract(Flanagan & Norman, 1993).

2.6.2 Risk Transfer

This is essentially trying to transfer the risk to another party. For a construction project, an insurance premium would not relieve all risks, although it gives some benefits as a potential loss is covered by fixed costs (Tummala & Burchett, 1999)

Risk transfer can take two basic forms:

- The property or activity responsible for the risk may be transferred, i.e. hire a subcontractor to work on a hazardous process;
- The property or activity may be retained, but the financial risk transferred, i.e. by methods such as insurance and surety.

2.6.3 Risk Retention

This is the method of reducing controlling risks by internal management (Zhi, 1995); handling risks by the company who is undertaking the project where risk avoidance is impossible, possible financial loss is small, probability of occurrence is negligible and transfer is uneconomic (Akintoyne & MacLeod,1997). The risks, foreseen or unforeseen, are controlled and financed by the company or contractor. There are two retention methods, *active* and *passive*;

a. **Active retention** (sometimes referred to as self-insurance) is a deliberate management strategy after a conscious evaluation of the possible losses and costs of alternative ways of handling risks.

b. **Passive retention** (sometimes called non-insurance), however, occurs through negligence, ignorance or absence of decision, e.g. a risk has not been identified and handling the consequences of that risk must be borne by the contractor performing the work.

2.6.4 Risk Reduction

This is a general term for reducing probability and/or consequences of an adverse risk event. In the extreme case, this can lead to eliminate entirely, as seen in “risk avoidance”. However, in reduction, it is not sufficient to consider only the resultant expected value, because, if potential impact is above certain level, the risk remains unacceptable. In this case, one of the other approaches will have to be adopted (Piney, 2002).

Chapter 3

Research Methodology

3.1 Introduction

The preceding chapter described in some detail the concepts and the practices of risk management in construction projects for full understanding of risk management concepts and practices. In this chapter, a description of data collection procedure adopted for this research is described. This chapter also provides the information about research strategy, research design, target population and sample size. It also discusses some of the practical problems encountered. A detailed methodology and tools used are described.

3.2 Research Strategy

Chambers English Dictionary defines research as (Fellows & Liu, 1997):

- a careful search
- investigation
- Systematic investigation towards increasing the sum of knowledge.

Research is diligent, systematic inquiry or investigation to validate old knowledge and generate new knowledge (Burns & Grove, 1987). Research dose not occur in a vacuum, research projects take place in context – of researcher's interests, expertise and experiences; of human contacts ; of the physical environment, etc (Fellows & Liu, 1997).

Research strategy can be defined as the way in which the research objectives can be questioned (Naoum, 1997).

There are two types of research strategies namely quantitative research and qualitative research (Naoum, 1997). Quantitative approaches seek to gather factual data and to study relationships between facts and how such facts and relationships accord with theories and the findings of any research executed previously (Fellows & Liu, 1997), where qualitative approaches seek to gain insights and to understand people's perception of "the world" whether as individuals or groups (Fellows & Liu, 1997). Qualitative research is "subjective" in nature, emphasizing meanings, experiences and so on (Naoum, 1997).

In this research, a quantitative approach is selected to determine the variables and factors that affect the risk management practices in building projects in Gaza Strip to find out if there is a systematic risk management practices through the contracting companies.

3.3 Research design

The term "research design" refers to the plan or organization of scientific investigation, designing of a research study involves the development of a plan or strategy that will guide the collection and analyses of data (Polit & Hungler, 1999). Burns & Grove (1997) defined the term design as "some consider research design to be the entire strategy for the study, from identifying the problem to find the plans for data collection. Other limit design to clearly define structural framework within which the study is implemented". The framework that the researcher creates is the design (Wood & Haber, 1998). Much research in the social sciences and management spheres involves asking and obtaining answers to questions through conducting surveys of people by questionnaires, interviews and case studies (Fellows & Liu, 1997).

In this research a closed-ended questionnaire with interview is used to collect data from respondents. In structured interview, questions are presented in the same order and with the same wording to all interviewees. The interviewers have full control on the questionnaire throughout the entire process of the interview (Naoum, 1998).

In structured interview, the interviewer administers a questionnaire, perhaps by asking the questions and recording the responses, with little scope for probing those responses by asking supplementary questions to obtain more details and to pursue new and interesting aspects (Fellows & Liu, 1997). Naoum (1998) summarizes the main advantages of structured interview as follows:

1. The answers can be more accurate.
2. The response rate is relatively high (approximately 60-70 percent), especially if interviewees are contacted directly.
3. The answers can be explored with finding out "Why" the particular answers are given.

Figure (3.1) shows the summarized methodology chart.

3.4 Research population

A population consists of the totality of the observation with which we are concerned (Walpole & Myers, 1998). In this research, the population is the total number of contractors (45 contracting companies) of the first class who have valid registration by the Contractors Union and the same number of owners.

3.5 Sample Size

Sampling defines the process of making the selections; sample defines the selected items (Burns & Grove, 1987). Wood and Haber (1997) defined the sampling as the process of selecting representative units of a population for the study in a research investigation. Scientists derive knowledge from samples; many problems in scientific research cannot be solved without employing sampling procedures (Wood & Haber, 1997).

Unfortunately, without a survey of the population, the representativeness of any sample is uncertain, but statistical theory can be used to indicate representativeness (Fellows & Liu, 1997). One of the most frequent questions asked "what size sample I use?" historically, the responses to this question at least 30 subjects. However, in most cases 30 subjects will be inadequate as a sample size (Burns & Grove, 1987).

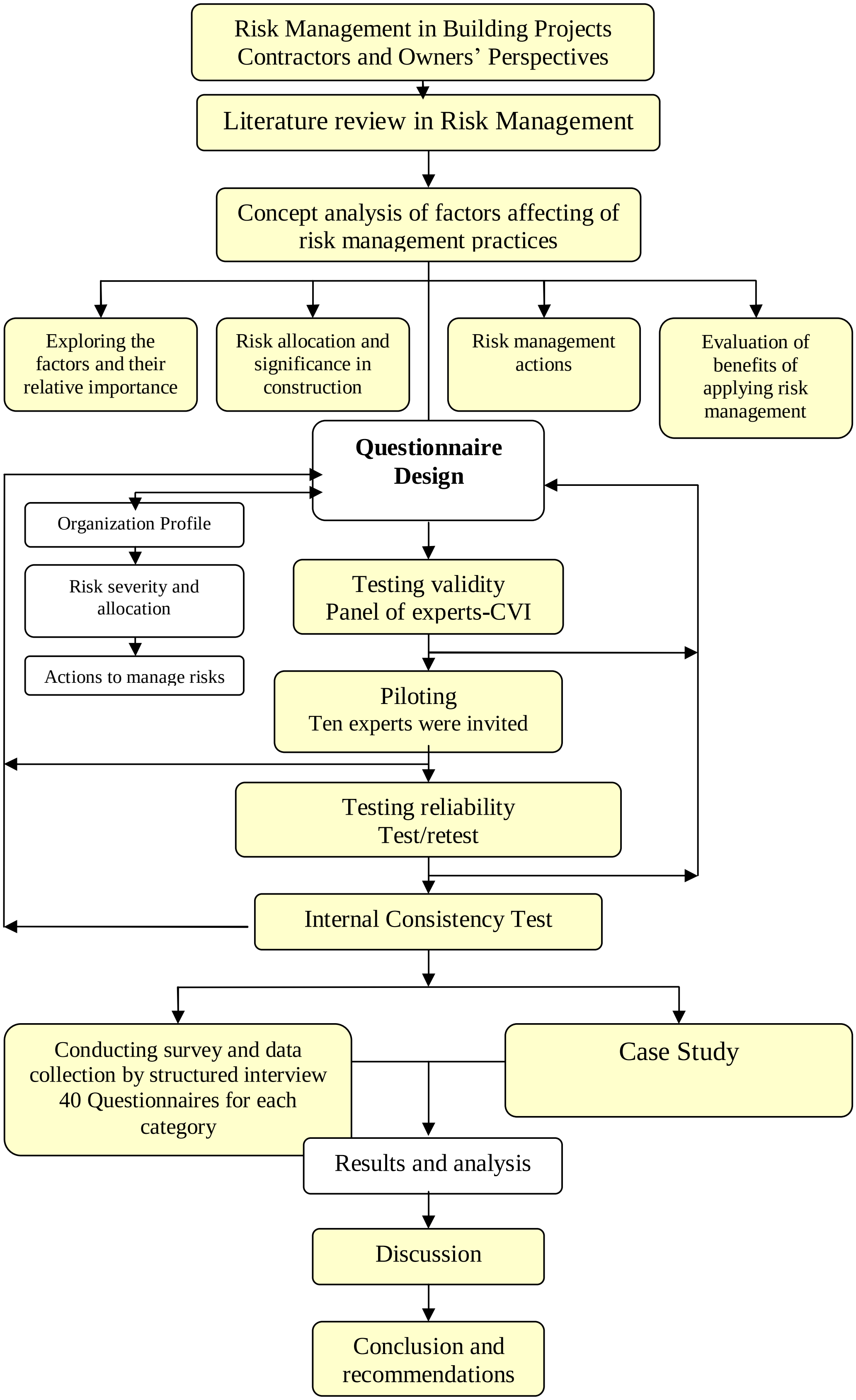


Figure 3.1. Methodology flow chart

A statistical calculation was used in order to calculate the sample size. The formula below was used to determine the sample size of unlimited population (Creative Research Systems, 2001):

$$SS = \frac{Z^2 \times P \times (1-P)}{C^2}$$

Where SS = Sample Size.

Z = Z Value (e.g. 1.96 for 95% confidence interval).

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

C = Confidence interval (0.05)

$$SS = \frac{1.96^2 \times 0.5 \times (1-0.5)}{0.05^2} = 384$$

Correction for finite population

$$SS_{New} = \frac{SS}{1 + \frac{SS-1}{pop}}$$

Where pop is the population = 45 first class contracting companies according to the PCU records.

$$SS_{New} = \frac{384}{1 + \frac{384-1}{45}} = 40.36 \approx 40$$

40 questionnaires are to be distributed to contracting firms; all of them are classified as first class companies. To carry out a comparison between contractors and owners' perspectives, the same number of questionnaires will be distributed to owners.

3.6 Sample method

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 & Liu, 1997).

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

3.7 Limitation of the research

1. Due to time limitation, this research is concerned with building projects only and will not take into account 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).
2. 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.
3. Also, contractors of first class and owners represent the population of this study. Second, third, fourth and fifth classes will be excluded.
4. This study is limited to the construction industry practitioners in Gaza Strip.

3.8 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).

3.9 Questionnaire design

The questionnaire survey was conducted to determine the opinion of contractors and owners regarding the risk factors. A four pages questionnaire accompanied with a covering letter were delivered to 40 contracting companies and 40 owner representatives (owners could be: ministries, municipalities, consultants, and so on).

The letter indicates the objectives of the research and explained to the participants that the results of the questionnaire would be used to improve the ability of contractors and owners to identify, analyze and estimate the risk factors impact on the construction phase of building projects.

A close-ended questionnaire was used for its advantages as it is easy to ask and quick to answer, they require no writing by either respondents or interviewer.

The questionnaire was composed of five sections to accomplish the aim of this research, as follows:

1. The organization profile (contractor and owner)
2. Risk factors that have been identified by literature, experts and by the researcher.
3. Risk preventive methods which could be used to avoid risk to take place.
4. Risk mitigative methods that could be used to mitigate risk impact or likelihood.
5. Risk analysis techniques that could be used to analyze and estimate risk factors impact.

The questionnaire was prepared in English language (Annex 1), but for the interest of the research and to have more accurate results the questionnaire were translated into Arabic (Annex 2), as most of the target population are not familiar with the English language.

To ensure obtaining complete and meaningful response to the questionnaire an interview was conducted with each respondent to explain the objective of the study and to get input towards the questionnaire design, especially towards identifying risk types and management actions for controlling these risks. Some of the questionnaires were filled throughout the interview. In addition, their analysis is straight forward (Naoum, 1998).

A draft questionnaire, with 36 risk factors (Annex 3), prepared from literature and distributed into nine groups – by adding two groups to the literature (Hillson, 2002); *political and construction* - to best fit the nature of the industry in Gaza Strip was discussed with the supervisor who requested adding more factors and test validity content by knowledge experts and local construction practitioners in Gaza Strip. Content validity was conducted by sending the draft questionnaire with covering letter to six experts to evaluate the content validity of questionnaire, to check readability, offensiveness of the language and to add more factors and information if needed (Annex 3). As a result, good comments regarding the shape and the factors were taken into consideration and 12 additional factors were added and 4 were omitted to reflect the nature of construction industry in Gaza Strip. These factors were amalgamated with the original factors and the required modifications have been introduced to the final questionnaire. A total of 44 factors were distributed into nine groups. To form the final questionnaire (Annex 1) which was printed by using two different colors in order to distinguish between the contractors and owners.

3.9.1 Construction risk allocation

There are different types of risks associated with the construction activities. These are physical, environmental, design, logistics, financial, legal, political, construction and management risks (Perry & Hayes, 1985, cited in Kartam, 2001). Table (3.1) illustrates different types of risk included in the questionnaire. To get input towards the questionnaire design, especially towards identifying risk types, rather than the related literature, an interview was conducted with five construction industry practitioners. Accordingly, all practitioners have participated in the questionnaire design, and as a result, the questionnaire was modified as stated before in section 3.9. Some of the literature's risk types such as floods, earthquakes, wind damages and pollution were not included in this study because of inapplicability.

3.9.2 Significance of risk and measurement scales

The degree of impact for each risk type was included in the questionnaire under the heading "Significance". The questionnaire was designed to examine practitioners' observations and judgments in determining the relative significance of each risk category. Although the degree of impact varies from project to project, the questionnaire is expected to elicit a general assessment of the significance of risk. Each respondent was required to rank each risk on a scale from 1 to 10 by considering its contributions to project delays. Scale 1 t10 is selected to obtain a greater level of suppleness in choosing statistical procedures (Wood & Haber, 1998). Rank 1 is assigned to a risk would give the lowest contributions to risk consequences while Rank 10 is allotted to a risk that would cause the highest contribution. In the same time ranks (1-3) means low importance risks, ranks (4-7) for medium risks and (8-10) for high risks.

Table 3.1. Risk variables (factors) included in the questionnaire

Construction Project Risk	*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)
		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
		Changes in management ways
		Information unavailability (include uncertainty)
		Poor communication between involved parties

In order to quantitatively demonstrate the relative significance of risks to a project, a weighting approach is adopted. The principle is that the risk with the highest contribution rank would be assigned the largest weight. The figures in brackets in Table (3.2) are weighted scores for each risk at different contribution rank. Each individual's weighted score is obtained by multiplying the number of respondents with the corresponding weight. The figures in the last column of the table give the total weighted scores for each risk. The rank range of 1 to 3 denotes risks that are not significant, 4 to 7 indicates significant risks and 8 to 10 shows very high significant risks

Table 3.2 – An example for contribution of risks to a project (risk significance).

Types of risks	Contribution rank										Total weighted scores
	1	2	3	4	5	6	7	8	9	10	
Defective materials	2 (2)	0 (0)	3 (9)	1 (4)	8 (40)	5 (30)	4 (28)	4 (32)	2 (18)	2 (20)	**183**
Inaccurate quantities	2 (2)	0 (0)	0 (0)	1 (4)	1 (5)	1 (6)	9 (63)	4 (32)	7 (63)	6 (60)	**235**

3.9.3 Risk management actions

Managing risks means minimizing, controlling, and sharing of risks, and not merely passing them off onto another party (Fisk, 1992, cited in Katram, 2001). The methods of managing risks are retention, transfer, mitigation, and prevention of risks or any combination thereof.

There are two kinds of management actions: preventive action and mitigative action. Preventive actions are used to avoid and reduce risks at the early stage of project construction, yet they may lead to submitting and excessive high bid for a project. Where the study is concerned with the construction phase; the survey addressed mitigative actions are remedial steps aimed at minimizing the effects of risks through the construction phase. The survey presents six mitigative actions. These actions were generated based on related research work on construction risk management.

3.9.3.1 Preventive actions

Table (3.3) illustrates the seven preventive methods that proposed to respondents to measure the effectiveness for each. Preventive actions are used to avoid and reduce risks at the early stage of project construction, yet they may lead to submitting an excessive high bid for a project. The relative degree of effectiveness between the methods will be quantitatively demonstrated as shown previously.

Table 3.3 – Relative effectiveness of preventive methods

Preventive method	**Effectiveness of preventive methods**						**Total weighted scores**
	Very high	High	Moderate	Low	Very low	In applicable	
	5	**4**	**3**	**2**	**1**	**0**	
Depend on subjective judgment to produce a proper program.	15 (75)	8 (32)	…	…	…	…	…
Produce a proper schedule by getting updated project information	…	…	…	…	…	…	…
Refer to previous and ongoing similar projects for accurate program	…	…	…	…	…	…	…
Consciously adjust for bias risk premium to time estimation	…	…	…	…	…	…	…
Plan alternative methods as stand-by.	…	…	…	…	…	…	…
Utilize quantitative risk analyses techniques for accurate time estimate.	…	…	…	…	…	…	…
Transfer or share risk to/with other parties	…	…	…	…	…	…	…

3.9.3.2 Mitigative actions

Whilst some project delay risks can be reduced though various preventive actions at early stages, the delay of progress still occurs in many projects during the construction process. A recent industry study has indicated that over 80% of projects exceed their scheduled time even with the employment of software techniques for project development (Katram, 1992). When delay happens, contractors can adopt various mitigative actions to minimize the effects of the delay. Table (3.4) represents the six mitigative methods being proposed to the respondents to measure the effectiveness for each of the methods. The relative degree of effectiveness between the methods will be quantitatively demonstrated as shown previously.

Table 3.4 – Relative effectiveness of mitigative methods

Remedial method	Effectiveness of remedial methods						Total weighted scores
	Very high	High	Moderate	Low	Very low	In applicable	
	5	**4**	**3**	**2**	**1**	**0**	
Increase manpower and/or equipment	15 (75)	8 (32)	…	…	…	…	…
Increase the working hours	…	…	…	…	…	…	…
Change the construction method	…	…	…	…	…	…	…
Change the sequence of work by overlapping activities	…	…	…	…	…	…	…
Coordinate closely with subcontractors	…	…	…	…	…	…	…
Close supervision to subordinates for minimizing abortive work	…	…	…	…	…	…	…

3.9.4 Risk analysis techniques

Table (3.5) below shows the risks analysis techniques. Respondents were asked to determine the relative use of those techniques. Six methods were included to highlight the construction industry practitioners concerns about risk analysis and its approaches, and to compare between contractors' usage of these procedures and owners'. The same weighing policy is used to measure the weighted score for each technique listed.

Table 3.5 – Relative effectiveness of risk analysis techniques

Risk analysis techniques	**Use of risk analysis techniques**						**Total weighted scores**
	Very high	High	Moderate	Low	Very low	In applicable	
	5	**4**	**3**	**2**	**1**	**0**	
Direct judgment using experience and personal skills	15 (75)	8 (32)	…	…	…	…	…
Comparing analysis (compare similar projects through similar conditions)	…	…	…	…	…	…	…
Probability analysis (analyze historical data)	…	…	…	…	…	…	…
Expert Systems (including software packages, decision support systems, computer-based analysis techniques such as @Risk	…	…	…	…	…	…	…
Sensitivity analysis	…	…	…	…	…	…	…
Simulation analysis using simulator computer packages	…	…	…	…	…	…	…

3.10 Validity of Research

Validity refers to the degree to which an instrument measures what it is supposed to be measuring (Pilot and Hungler, 1985). 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 (Wood and Haber, 1998). Validity has a number of different aspects and assessment approaches (Polit and Hangler, 1985). Below, several routes to evaluating an instrument's validity are listed:

- Content validity
- Criterion-related validity
- Construct validity

Questionnaire was reviewed by two groups of experts. The first was requested to identify whether the questions agreed with the scope of the items and the extent to which these items reflect the concept of the research problem. The other was requested to identify that the instrument used is valid statistically and that the questionnaire was designed well enough to provide relations and tests between variables. The two groups of experts do agree that the questionnaire was valid and suitable enough to measure the concept of interest with some amendments, the most important of which are:

- 12 additional risk factors were added to the questionnaire and 4 were omitted due to recurrence and ambiguity, (see Annex 3 and Annex 1).
- 7 preventive methods were added, (see Annex 3 and Annex 1).

3.11 Reliability of Research

Reliability of an instrument is the degree of consistency with which it measures the attribute it is supposed to be measuring (Polit & Hunger, 1985). The less variation an instrument 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. The test is repeated to the same sample of people on two occasions and then the scores obtained were compared by computing a reliability coefficient (Polit & Hunger, 1985). For the most purposes reliability coefficients above 0.7 are considered satisfactory. Period of two weeks to a month is recommended between two tests (Burns & Grove, 1987). Ten questionnaires were re-distributed among contractors and owners. The reliability coefficient was (0.90) in the contractors case and (0.87) in owners' which indicates a high level of reliability and the correlation was significant at 0.01 level.

3.12 Data collection

Data collection was based on personal interview for filing questions. The personal interview, which is a face-to-face process, in which the respondents were asked questions with a brief explanation for the ideas and contents of questionnaire, was conducted. The number of respondents who agreed to cooperate was 63 out of 80 which represent 79 % of the over all sample. On the contractors side the ratio was 78%, and on the owners' was 80%.

3.13 Data analysis

Analysis is an interactive process by which answers to be examined to see whether these results support the hypothesis underlying each question (Backstorm and Cesar, 1981 cited in Hallaq, 2003). Quantitative statistical analysis for questionnaire was done by using

Statistical Package for Social Sciences (SPSS). The analysis of data is done to rank the severity of causes of contractor's failure in Gaza Strip. Ranking was followed by comparison of mean values within groups and for the overall sub-factors. The opinion of contractors regarding the severity of each cause was checked by analysis of variance (ANOVA).

The following statistical analysis steps were done:

- Coding and defining each variable
- Summarizing the data on recording scheme
- Entering data to a work sheet
- Cleaning data
- Mean and rank of each cause
- Comparing of mean values for each main group and overall sub-factors
- ANOVA test was done to test the difference of answers of contractors regarding to variables
- Partial correlation test was done to compare the mean values of different groups
- Multi-comparison test was also done when there is a significant difference

Chapter 4

Results and Discussion

4.1 Introduction

The aim of this study is to determine the risk factors in construction industry, allocation of these factors, methods used to deal with risks and the techniques adopted in analyzing these risks. The results of the study are illustrated in this chapter. Mainly, the severity of risk factors, allocation of each, methods of dealing with risks and techniques of analysis. Then, a comparison will be held between contractors and owners' perspectives regarding the severity and allocation of each risk factor. Also, in this chapter the results and findings of this research are discussed in detail.

4.2 Risk factors – *Contractors' perspective*

As mentioned in chapter 3, the questionnaire included 44 risk factors, which have been categorized in nine main groups, these groups were: physical group, environmental group, design group, logistics group, financial group, legal group, construction group, political group and management group. The factors of each group will be demonstrated in the terms of severity and allocation according to the participants answers.

4.2.1 Physical group (Group 1)

4.2.1.1 Severity

Results verified that the supply of defect materials is the most important risk in the physical group (Table 4.1), occurrence of accidents was the second from importance and the third was the variation in labor and equipment productivity. These results indicate the concerns of contractors about suitability of materials and safety measures; this result is supported by the results of Ahmed, et al. (1999) and the findings of National Audit Office (2001) which considered the risks of defect materials and safety measures as very important risks.

4.2.1.2 Allocation

The criterion for a risk to appropriated to a particular category (owner, contractor, shared, insurance or ignored), was that it should get at least (60%) response rate to achieve the mainstream of the rates. Those that failed to get such response rate in favor of any category were listed as undecided. As shown in Figure (4.1), (39%) of contractors tried to shift the consequences of accidents to other parties such as insurance, (42%) of contractors appeared to be ready to bear these consequences and (19%) of them seemed to share these consequences with owners. That means that contractors are undecided about the allocation of safety risks as well as Hong Kong contractors (Ahmed et al, 1999) and unlike Kuwait contractor who accepted to bear the safety risks (Kartam, 2001). In fact contractors are better able to control such risks by supervising the application of safety precautions inside the construction sites. Moreover, the existence of insurance premiums for accidents and injuries can mitigate some of this risk consequences. Contractors should consciously pay more effort to mitigate the accidents costs and other consequences by applying effective training and increasing awareness of safety precautions. The majority of contractors (97%) accepted the risks of supplying defect materials and variation in productivity (71%). In fact, not only did contractors designate them as their responsibilities, but most researchers also support this position (Oglesby cited in Kartam, 2001). Also, contractors of Hong Kong confirmed this allocation (Ahmed et al, 1999).

Table 4.1. Physical group risks ranking

No.	Physical Group Risks	Weight	Severity (1-10)
2	Supplies of defective materials	239	7.7
1	Occurrence of accidents because of poor safety procedures	221	7.1
3	Varied labor and equipment productivity	188	6.1

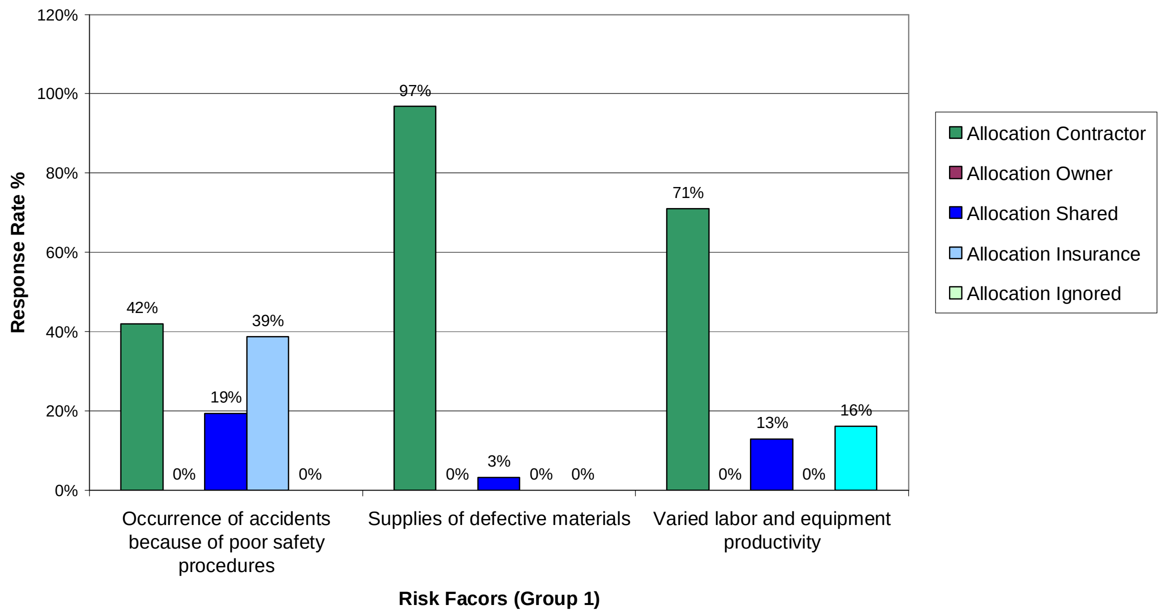


Figure 4.1. Physical group risks allocation, contractors' perspective

4.2.2 Environmental group (Group 2)

4.2.2.1 Severity

As seen in Table (4.2), contractors considered site accessibility as a main cause of delay; in addition they considered the risk of adverse weather conditions to be a medium risk. These risk categories increase the probability of uncertain, unpredictable and even undesirable factors in the construction site. However, the risks of adverse weather conditions and site accessibility did not appear with high significant risks among the surveyed risks. Environmental factors (catastrophes) occurred hardly ever , that is why the weight of the risk of Environmental factors was relatively low. These results are supported with the outcomes of (Kartam, 2001).

4.2.2.2 Allocation

Figure (4.2) demonstrates that contractors were not decided on the allocation of risk of Environmental factors . Moreover, a great share of contractors (39%) decided to ignore its risk. On the other hand Smith & Gavin (cited in Ahmed et al, 1999) suggest that it should be a shared risk, such events are not predictable. Risk of site access was considered as a shared risk (share the risk between the owner and the contractor) by the majority of contractors (71%), as a matter of fact, site access risk need to be borne by the owner who should evaluate the needs during the planning phase (Smith & Gavin, cited in Ahmed el al, 1999), but due to the ongoing tense situation, contractors and owners have to coordinate their efforts to get a best handling of such risks. 52% of contractors supposed to share the risks of adverse weather conditions, (13%) supposed contractors to bear this risk; in other words they were not decided on this risk's allocation, in fact, and through the review of some types of contracts that are used in Gaza Strip, most owners of the construction projects in the Gaza Strip are legally protected from liability of this risk via assigning some exculpatory clauses in their contracts, but it is known that weather conditions are out of control and such risk should be shared to get better handling and to reduce conflicts probabilities.

Table 4.2. Environmental group risks ranking

No.	Environmental Group Risks	Weight	Severity (1-10)
5	Difficulty to access the site (very far, settlements)	207	6.7
6	Adverse weather conditions	173	5.6
4	Environmental factors	160	5.2

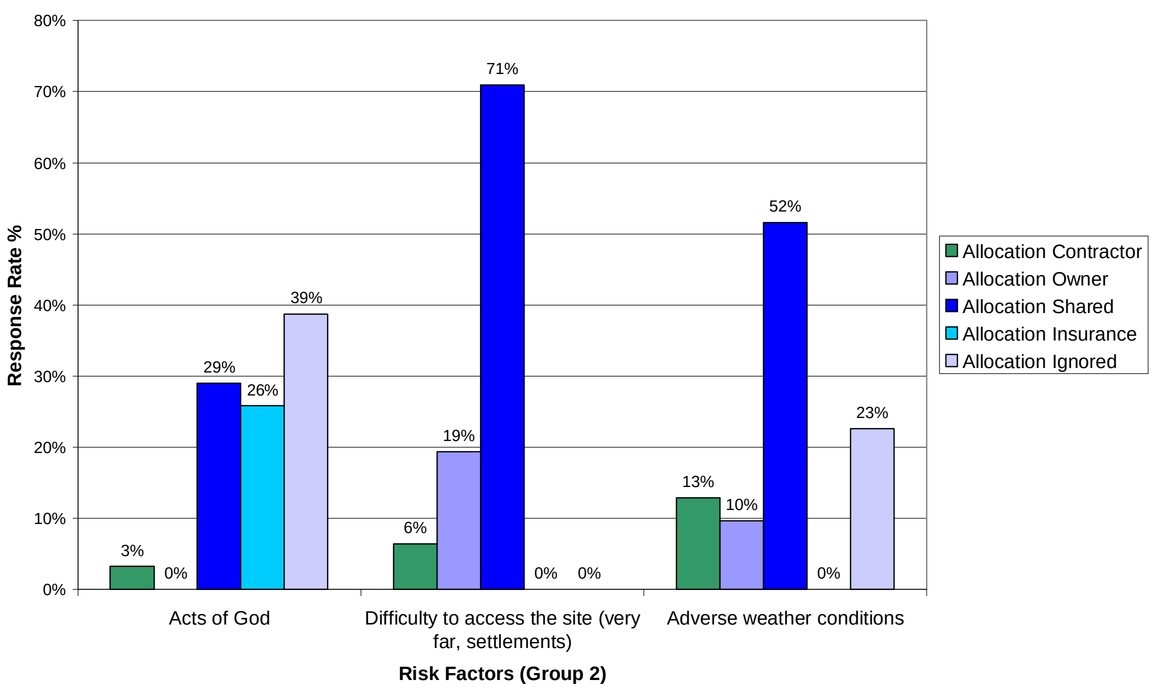


Figure 4.2. Environmental group risks allocation, contractors perspective

4.2.3 Design group (Group 3)

4.2.3.1 Severity

Design group factors included one of the most important surveyed risks. As illustrated in Table (4.3), defective design with (8.5) severity and lack of awarding the design to unqualified designer with (7.8) severity are the most important factors. These results also show that contractors suffer from insufficient or incorrect design information. This result was obtained from ranking the defective design risk category as one of the five most significant risks to project delays. These results complied with the results of Kartam (2001), (Lemos et al, 2004) and (Shen, 1997). It has to be noted that contractors concerned about defective design issues because they could be responsible about any critical issues could happen due to incorrect design. Respondents assigned the risks of un-coordinated design and lack of coordination in design as high significance risks, on the other hand these risks can be overcome by paying true attention and coordinate correctly between design disciplines. Other design risk factors considered medium risks by contractors.

Table 4.3. Design group risks ranking

No.	Design Group Risks	Weight	Severity (1-10)
7	Defective design (incorrect)	264	8.5
12	Awarding the design to unqualified designers	243	7.8
8	Not coordinated design (structural, mechanical, electrical, etc.)	225	7.3
10	Lack of consistency between bill of quantities, drawings and specifications	211	6.8
9	Inaccurate quantities	195	6.3
11	Rush design	192	6.2

4.2.3.2 Allocation

Figure (4.3) illustrates that greater part of contractors allocate design risks onto owners. Contractors had considered that owners should bear the risks of:

- Defective design (84%)
- Not coordinated design (87%)
- Inaccurate quantities (48%)
- Lack of consistency between bill of quantities, drawings and specifications (58%)
- Rush design (68%)
- Awarding design to unqualified designers (81%)

Major allocation percents were heading towards owners who are in a better position to supply sufficient and accurate drawings on the design and services. These findings complied with results of (Ahmed et al., 1999) and (Kartam, 2001) who stated that the owner could best manage deficiencies in specifications and drawings by appointing a capable consultant and providing sufficient design budget.

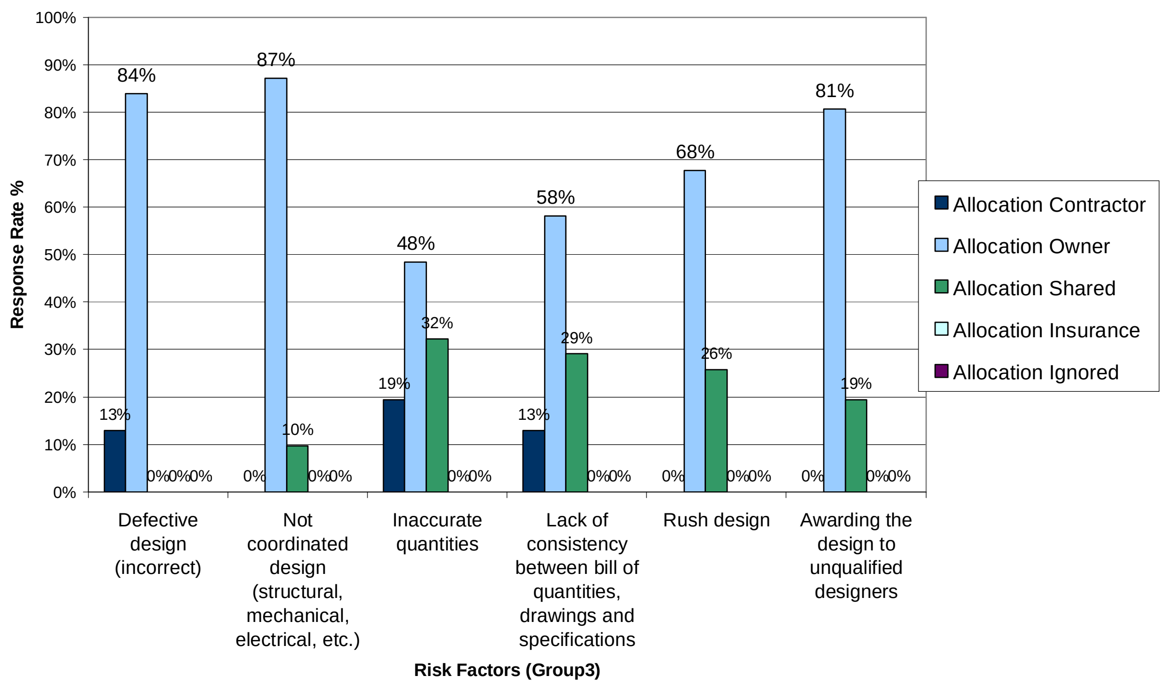


Figure 4.3. Design group factor allocation, contractor's perspective

4.2.4 Logistics group (Group 4)

4.2.4.1 Severity

Table (4.4) shows the weights of logistic group factors. Contractors believed that the risks of unavailability of labor and materials and poor communication among contractor's teams are highly significant risks. It is obvious that the mentioned issues are serious risks that could be faced. The risk of contractors competence is a risk that contractors worried about, it is hard for contracting firms with high managerial costs to compete with firms with lower managerial costs. The unavailability of labor and materials is some how 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 by working out and applying management standards to control such problems. Undefined scope of work and inaccurate project program approximately have the same severity, they have medium weights which pointed to the misunderstanding of these matters among contractors. These risks need to be fully comprehended. Such comprehension could ease and manage the work properly.

Table 4.4. Logistics group risks ranking

No.	Logistics Group Risks	Weight	Severity (1-10)
13	Unavailable labor, materials and equipment	222	7.2
17	Poor communications between the home and field offices (contractor side)	222	7.2
15	High competition in bids	201	6.5
14	Undefined scope of working	182	5.9
16	Inaccurate project program	179	5.8

4.2.4.2 Allocation

Figure (4.4) indicates that contractors appear to be ready to accept the risks of:

- Unavailability of labor, materials and equipment
- Poor communication among contractor’s teams

It is the contractor’s duty to provide labor, materials and equipment to execute the work, in the same time, contracting firms should teach its teams how to communicate and exchange information. On the other hand, contractors were undecided on the allocation of other factors of the logistics group. It should be the liability of owner who could manage the risk of contractor competence by enforcing rigorous criteria for the selection of contractor, this was supported by (Ahmed, et al 1999). Hence, risk of contractor competence should be allocated onto owners, but actually, current sluggish economic growth and highly competitive market in Gaza Strip have forced contractors to reduce or even ignore their profit so as to remain competitive. With respect to other two factors, almost (50%) of contractors viewed them as shared risk. It is believed that owners should clearly define the scope of work and set up a proper program to abide by during construction, but this dose not eliminate the contractors responsibility even if was partial. Both contractor and owner should be able to provide the staff and abilities to get a proper project program.

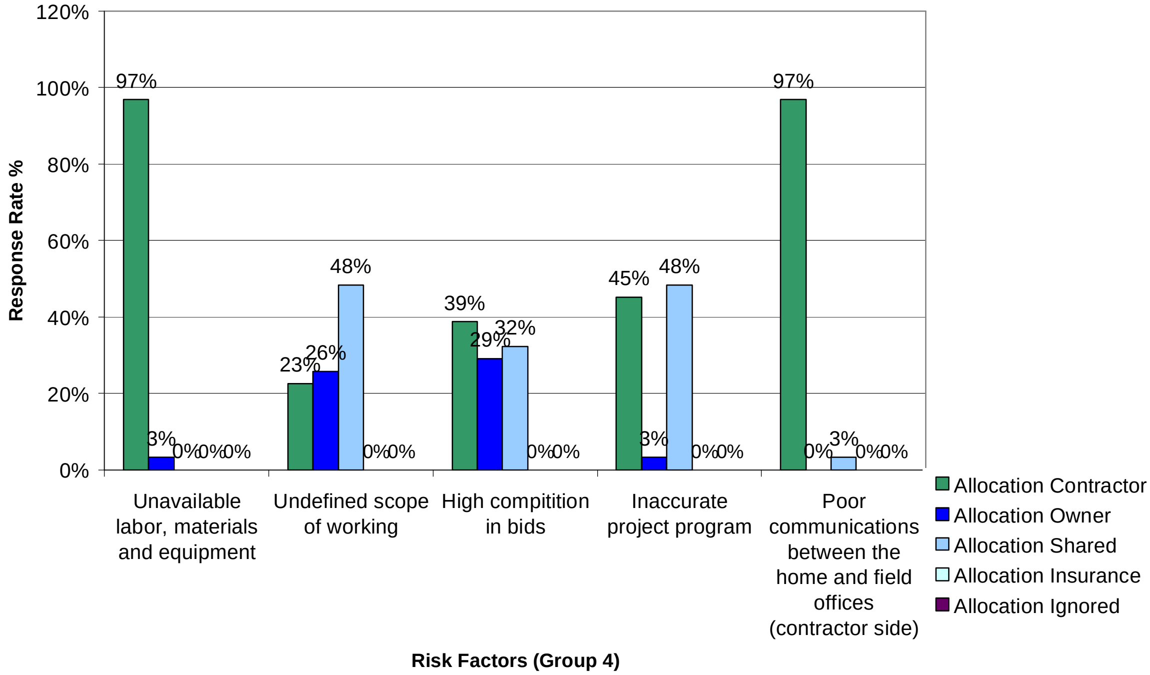


Figure 4.4. Logistics group risks allocation, contractors' perspective

4.2.5 Financial group (Group 5)

4.2.5.1 Severity

As seen in table (4.5), financial risks got the highest scores of surveyed risk factors given by contractor's respondents. Contractors considered the financial failure of contractor is the most sever risk in the financial group. According to 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.

More than 80% of the failures were caused by financial factors, that is why financial risks got the highest weights of the surveyed risks, Table (4.5). According to Argenti (cited in

Hallaq, 2003), small firms don't 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.

Table 4.5. Financial group risks ranking

No.	Financial Group Risks	Weight	Severity (1-10)
20	Financial failure of the contractor	279	9.0
19	Delayed payments on contract	260	8.4
21	Unmanaged cash flow	256	8.3
23	Monopolizing of materials due to closure and other unexpected political conditions	243	7.8
18	Inflation	240	7.7
22	Exchange rate fluctuation	232	7.5

4.2.5.2 Allocation

Figure (4.5) shows that contractors appear to be ready to bear the risks of:

- Financial failure of contractor (71%)
- Unmanaged cash flow (90%)

Majority of contractors (81%) allocated the delayed payments risk to the owners. This risk category is one of the most debated ones. These results are supported by (Kartam, 2001). Moreover Kangari (cited in Kartam, 2001) stated that in the law, this item can be claimed as part of loss and expense (Kangari, cited in Kartam, 2001).

Contractor's respondents were undecided on who should take inflation risk, but (45%) of the contractor respondents considered it as a contractor's issue because the contracts here in Gaza Strip contain clauses to allocate such risks onto the contractors. Even, the pre-bid meeting minutes could contain such clauses. Contractors are considering this risk category as an oscillating risk category, where its threat increases when inflation increases, and vice versa. Contractors were undecided about exchange rate fluctuation and monopoly risks.

Inflation and exchange rate fluctuation risks should be best shared between the owner and the contractor by including contract clauses that define the required parameters and conditions for sharing. These are risks where each party may be able to manage better under different conditions and could be specified in contracts as suggested above.

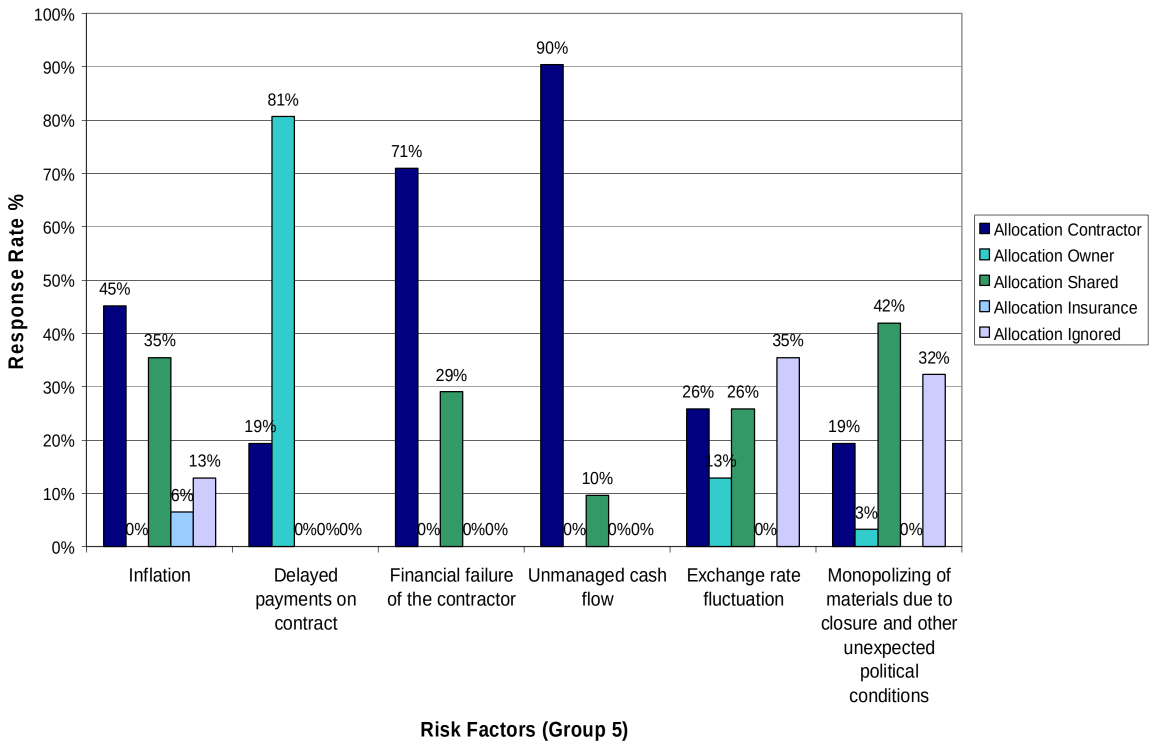


Figure 4.5. Financial group risks allocation, contractors' perspective

4.2.6 Legal group (Group 6)

4.2.6.1 Severity

Table (4.6) shows that legal disputes, delayed disputes resolution and lack of specialized arbitrators had the highest weights in the legal group, which indicates the importance of dispute resolutions and the disputes' consequences. Difficulty to settle disputes between project parties. Ambiguity of work legislations and difficulty to get permits came in the tail respectively. However the low weight indicates that contractors are not suffering of these risks, unlike Hong Kong contractors who do care about getting permits and consider it one of the most important risks (Ahmed et al, 1999).

Table 4.6. Legal group risks ranking

No.	Legal Group Risks	Weight	Severity (1-10)
26	Legal disputes during the construction phase among the parties of the contract	228	7.4
27	Delayed disputes resolutions	228	7.4
28	No specialized arbitrators to help settle fast	222	7.2
25	Ambiguity of work legislations	171	5.5
24	Difficulty to get permits	166	5.4

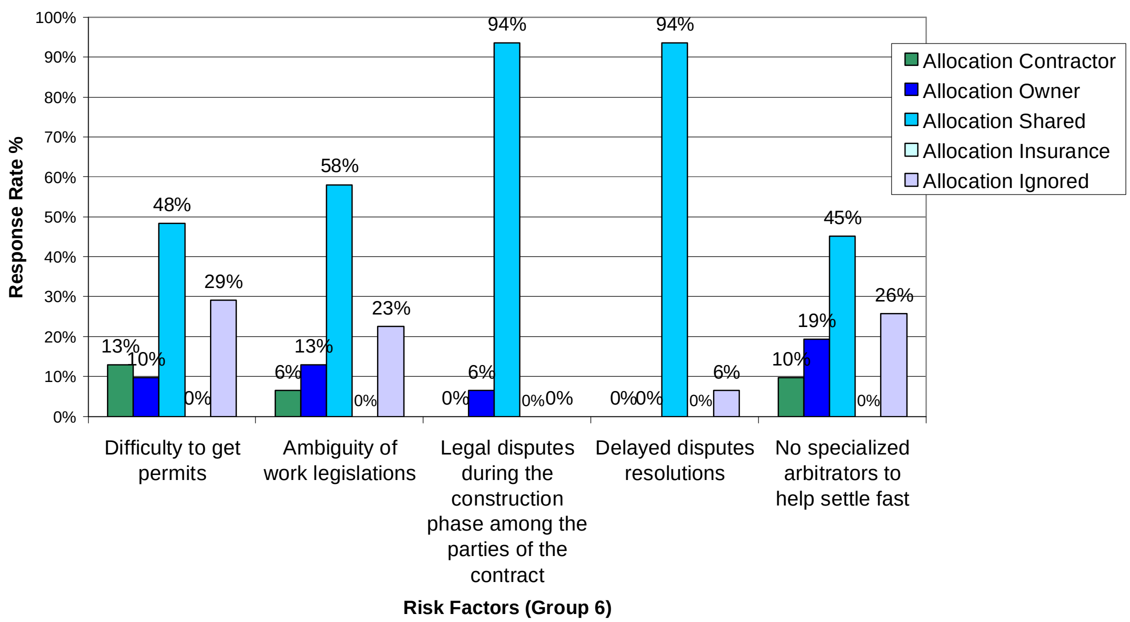


Figure 4.6. Legal group risks allocation, contractors' perspective

4.2.6.2 Allocation

Figure (4.6) illustrates the allocation of legal group factors according to contractors respondents. It is obvious that the greatest part of contractor respondents deal with legal risks as shared risks. 48% of respondents considered the risk of difficulty to get permits a shared risk, on the other hand almost the third of respondents (29%) ignored this risk. 58% of respondents dealt with ambiguity of work legislations as shared too. The greatest part of respondents (94%) preferred to share legal disputes and delayed resolution with owners. Disputes could originate due to mistake or misunderstanding by either party. Hence, these risks should really be shared risks.

4.2.7 Construction group (Group 7)

4.2.7.1 Severity

In table (4.7) risks associated with construction were divided into two groups according to weights. The high importance group contained the risks of undocumented change orders, lower work quality and misunderstanding drawings and specifications respectively. Ahmed et al. (1999) supported theses results. Considering the risk of undocumented change orders as a high importance risk reflects a trend in which contractors are concerned with obtaining payment for a change in the work, since the cost impact of change orders can not be claimed later. Contractors disturbed with the lower work quality, which means that contractors do their best to not have an abortive works, to maintain a good reputation and to avoid more costs repeating the abortive works. Other important risk is the risk of misunderstanding of drawings and specifications, this risk can cause significant work delays, that is why contractors exhibit an awareness towards this risk. Design changes, difference between actual and contract quantities and rush bidding were in the 4th, 5th and 6th places with medium severities, this reflects the little attention paid by contractors to these issues.

Table 4.7. Construction group risks ranking

No.	Construction Group Risks	Weight	Severity (1-10)
31	Undocumented change orders	236	7.6
32	Lower work quality in presence of time constraints	228	7.4
30	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	225	7.3
33	Design changes	187	6.0
34	Actual quantities differ from the contract quantities	169	5.5
29	Rush bidding	152	4.9

4.2.7.2 Allocation

Figure (4.7) shows the allocation of construction risks. Contractors accepted the risk of undocumented change orders (68%); contractors understand that the documentation of change order is their job. Majority of contractor respondents (68%) allocate the risks of rush bidding, design changes and difference between actual and contract quantities on the owner. Allocating design changes risk category to the owner reflects a trend in which contractors are not very much concerned with changes in the work. Respondents were undecided about lower quality of work in presence of time constraints. It is thought that this risk category should be allocated to the contractor, since contractors are in a better position to control this risk (Kartam, 2001).

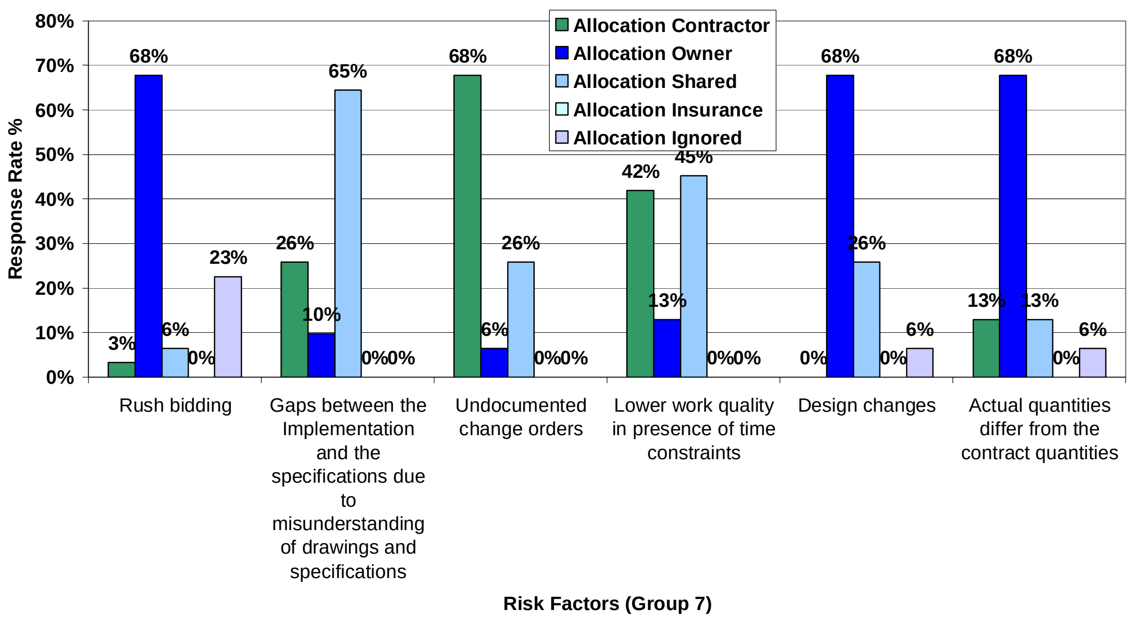


Figure 4.7. Construction group risks allocation, contractors' perspective

4.2.8 Political group (Group 8)

4.2.8.1 Severity

Table (4.8) demonstrates the ranking of political group risks. 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. Working at hot areas risk is considered a very high risk, contractors can not be enforced to work at such areas. Closure could cause unavailability of materials as well as inflation due to monopoly. Invasions could deconstruct the unaccomplished projects, which leads to disputes.

Table 4.8. Political group risks ranking

No.	Political Group Risks	Weight	Severity (1-10)
36	Working at hot (dangerous) areas (close to IDF positions)	279	9.0
39	Closure	277	8.9
35	Segmentation of Gaza Strip	258	8.3
38	Unstable security circumstances (Invasions)	258	8.3
37	New governmental acts or legislations	151	4.9

4.2.8.2 Allocation

In figure (4.8) allocation of political risks is viewed. Clearly, respondents are willing to share most of risks with owners. Segmentation, working at hot areas, closure and unstable security circumstances were considered shared risks with (71%), (68%), (68%) and (61%) respectively. It is thought that all risks that can not be controlled should be shared risks. 55% of respondents decided to share the new legislations risk – in spite of its low importance - with owner and (35%) to ignore. This indicates the low effects of such category.

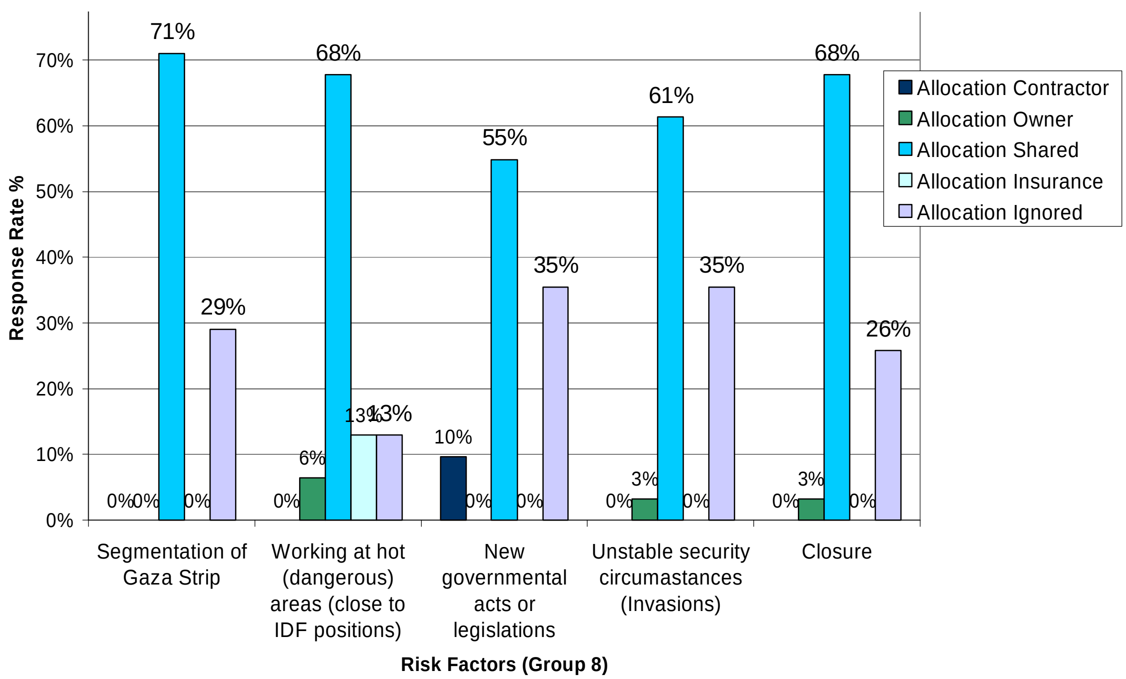


Figure 4.8. Political group risks allocation, contractors' perspective

4.2.9 Management group (Group 9)

4.2.9.1 Severity

Management group factors ranks are listed in Table (4.9). Poor communication between parties ranked first with (8.3) severity, the second was resource management with (7.3) severity, project complexity with (6.9) severity was third and the fourth was changes in management ways with severity of (6.4). These figures indicate the importance of management topics for contractors and indicates the existence of these risks, which need more and more applying management rules. Uncertainty ranked fifth with (6.2) severity. It is thought that management of projects need more and more training to properly manage projects specially the large ones.

Table 4.9. Management group risks ranking

No.	Management Group Risks	Weight	Severity (1-10)
44	Poor communication between involved parties	258	8.3
41	Resource management	226	7.3
40	Ambiguous planning due to project complexity	215	6.9
42	Changes in management ways	199	6.4
43	Information unavailability (include uncertainty)	191	6.2

4.2.9.2 Allocation

Figure (4.9) illustrates the respondents' allocation of management risks. Contractors seemed to be ready to accept the resource management and change in management ways risks with (68%) and (61%) respectively. It is predictable for contractor to deal with these risks. Contractor respondents decided to share ambiguous planning, uncertainty and poor communication risks with (61%), (65%) and (71%) respectively. These three issues should be really shared risks, it is the contractor's and owner's duty to put a clear plan for the project execution, to clarify any ambiguous information and to maintain a good communication manners in favor of project accomplishment.

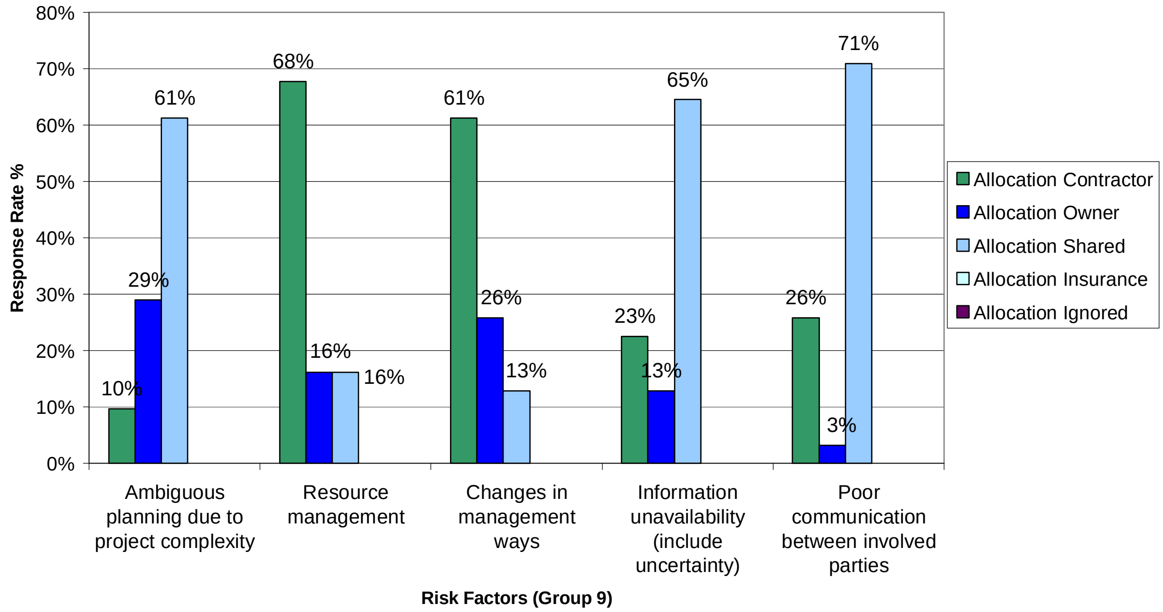


Figure 4.9. Management group risks allocation, contractors' perspective

4.3 Overall risk significance and allocation, contractors' perspective

4.3.1 Significance

Table (4.10) shows all risk factors included in the questionnaire ranked in descending order according to their weight from the contractors' perspective. The most and least important risk categories for Gaza Strip Contractors are shown in Table (4.11) which was developed based on the data in Table (4.10). The result shows that Gaza Strip contractors considered Financial failure of the contractor and Working at hot (dangerous) areas to be the most important construction risks giving them a score of (279), as shown in Table (4.11). They were followed by Closure, with a score of (277). The scores of the five most important risks range between (260) and (279). The least important risk, from the contractors' perspective is the risk of new governmental acts, with a score of (151) followed by the risk of Rush bidding with a score of (152). The scores range between (155) and (169). The results show that contractors considered (57%) of the risk factors as highly important risks and (43%) of them as medium risks.

Table 4.10. Risk factors ranking

No.	Risk Factors	Weight	Severity (1-10)
20	Financial failure of the contractor	279	9.0
36	Working at hot (dangerous) areas (close to IDF positions)	279	9.0
39	Closure	277	8.9
7	Defective design (incorrect)	264	8.5
19	Delayed payments on contract	260	8.4

35	Segmentation of Gaza Strip	258	8.3
38	Unstable security circumstances (Invasions)	258	8.3
44	Poor communication between involved parties	258	8.3
21	Unmanaged cash flow	256	8.3
12	Awarding the design to unqualified designers	243	7.8
23	Monopolizing of materials due to closure and other unexpected political conditions	243	7.8
18	Inflation	240	7.7
2	Supplies of defective materials	239	7.7
31	Undocumented change orders	236	7.6
22	Exchange rate fluctuation	232	7.5
26	Legal disputes during the construction phase among the parties of the contract	228	7.4
27	Delayed disputes resolutions	228	7.4
32	Lower work quality in presence of time constraints	228	7.4
41	Resource management	226	7.3
8	Not coordinated design (structural, mechanical, electrical, etc.)	225	7.3
30	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	225	7.3
13	Unavailable labor, materials and equipment	222	7.2
17	Poor communications between the home and field offices (contractor side)	222	7.2
28	No specialized arbitrators to help settle fast	222	7.2
1	Occurrence of accidents because of poor safety procedures	221	7.1
40	Ambiguous planning due to project complexity	215	6.9
10	Lack of consistency between bill of quantities, drawings and specifications	211	6.8
5	Difficulty to access the site (very far, settlements)	207	6.7
15	High competition in bids	201	6.5
42	Changes in management ways	199	6.4
9	Inaccurate quantities	195	6.3
11	Rush design	192	6.2
43	Information unavailability (include uncertainty)	191	6.2
3	Varied labor and equipment productivity	188	6.1
33	Design changes	187	6.0
14	Undefined scope of working	182	5.9
16	Inaccurate project program	179	5.8
6	Adverse weather conditions	173	5.6
25	Ambiguity of work legislations	171	5.5
34	Actual quantities differ from the contract quantities	169	5.5
24	Difficulty to get permits	166	5.4
4	Environmental factors	160	5.2
29	Rush bidding	152	4.9
37	New governmental acts or legislations	151	4.9

Table 4.11. Most and least important risk categories as perceived by Contractors

Importance	**Risk**
High	Financial failure of the contractor
	Working at hot (dangerous) areas (close to IDF positions)
(Most	Closure
important	Defective design (incorrect)
ranked first)	Delayed payments on contract
Low	New governmental acts or legislations
	Rush bidding
(least	Environmental factors

important	Difficulty to get permits
ranked first)	Actual quantities differ from the contract quantities

4.3.2 Allocation

The criterion for a risk to be appropriated to a particular category (contractor, owner, shared, insurance, or ignored), was that it should get at least a (60%) response rate. Those that failed to get such response rate in favor of any category were listed as undecided. Allocation of risk factors included in the questionnaire, according to the contractors respondents, is appeared in Table (4.12). Contractors have allocated nine risks onto themselves, that means contractors accept (20%) of the risk factors, they have allocated eight risks onto owners, which signifies that (18%) of the risk factors the owner should handle, according to the contractors. The contractors also considered eleven risks as shared risks, i.e. (25%) of the risk factors should be shared. On the other hand, they were undecided about sixteen risks, that means the contractors failed to allocate (37%) of the risk factors. These results indicate that contracts' clauses applied in Gaza Strip ignore the majority of these risk factors.

Table 4.12. Risk allocation, Contractors' perspective

Allocation	Risk Description
Contractor	Supplies of defective materials
	Varied labor and equipment productivity
	Unavailable labor, materials and equipment
	Poor communications between the home and field offices (contractor side)
	Financial failure of the contractor
	Unmanaged cash flow
	Undocumented change orders
	Resource management
	Changes in management ways
Owner	Defective design (incorrect)
	Not coordinated design (structural, mechanical, electrical, etc.)
	Rush design
	Awarding the design to unqualified designers
	Delayed payments on contract
	Rush bidding
	Design changes
	Actual quantities differ from the contract quantities
Shared	Difficulty to access the site (very far, settlements)
	Legal disputes during the construction phase among the parties of the contract
	Delayed disputes resolutions
	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications
	Segmentation of Gaza Strip
	Working at hot (dangerous) areas (close to IDF positions)
	Unstable security circumstances (Invasions)
	Closure
	Ambiguous planning due to project complexity
	Information unavailability (include uncertainty)
	Poor communication between involved parties
Undecided	Occurrence of accidents because of poor safety procedures
	Environmental factors
	Adverse weather conditions
	Inaccurate quantities
	Lack of consistency between bill of quantities, drawings and specifications
	Undefined scope of working
	High competition in bids
	Inaccurate project program
	Inflation
	Exchange rate fluctuation
	Monopolizing of materials due to closure and other unexpected political conditions
	Difficulty to get permits
	Ambiguity of work legislations
	No specialized arbitrators to help settle fast
	Lower work quality in presence of time constraints
	New governmental acts or legislations

4.4 Risk factors – *Owners' perspective*

In the following sections, risk factors severity and allocation will be discussed in detail from owners' perspective. The work done for the contractor respondents will be repeated for owner's.

4.4.1 Physical group (Group 1)

4.4.1.1 Severity

Table 4.13. Physical group risks ranking

No.	Physical Group Risks	Weight	Severity (1-10)
1	Occurrence of accidents because of poor safety procedures	258	8.1
2	Supplies of defective materials	201	6.3
3	Varied labor and equipment productivity	165	5.2

Occurrence of accidents was ranked first by owner's respondents with (258) weight as shown in table (4.13). The weight given to this risk by owners was higher than contractors' evaluation (221), which indicates that owners are more aware about safety measures than contractors. Owners paid less attention to defect material supplies than contractors, but they were less concerned about variation in productivity; this result is supported by the results of Ahmed, et al. (1999) and those of National Audit Office (2001) which considered the risks of defect materials and safety measures as very important risks.

4.4.1.2 Allocation

Figure (4.10) shows that owner's respondents decided to allocate all the physical group risks to contractors. The majority of respondents allocate occurrence of accidents, defect material supplies and productivity variation to contractors by (72%), (69%) and (84%) of respondents respectively. These deductions comply with the results of Ahmed, et al. (1999) in Hong Kong. It is believed that the contractor is in a better position to control these issues.

4.4.2 Environmental group (Group 2)

4.4.2.1 Severity

As shown in table (4.14), owner's respondents concerned about site accessibility which was ranked first with (258) weight. The second was Environmental factors risk with (178) weight and adverse weather conditions risk came third with (165) weight. Unlike contractors, owners did not concern about weather conditions very much, but they were worried about site accessibility.

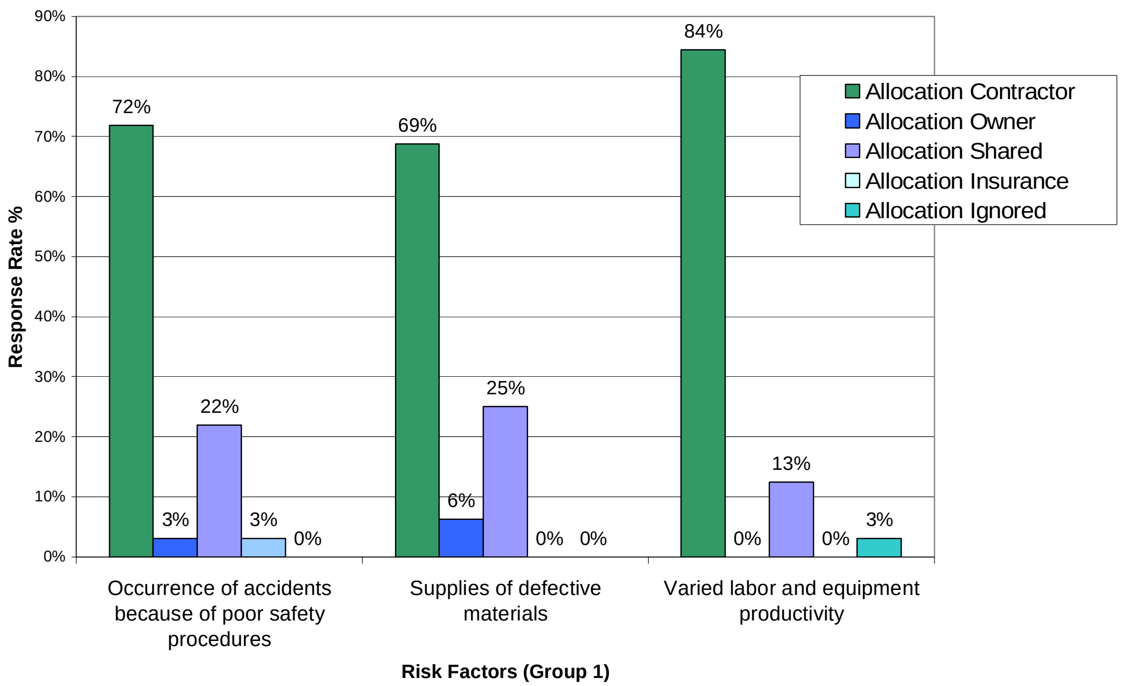


Figure 4.10. Physical group risks allocation, owners' perspective

Table 4.14. Environmental group risks ranking

No.	Environmental Group Risks	Weight	Severity (1-10)
5	Difficulty to access the site (very far, settlements)	253	7.9
4	Environmental factors	178	5.6
6	Adverse weather conditions	165	5.2

4.4.2.2 Allocation

Figure (4.11) illustrates the allocation of environmental risks according to owners' perspective. The respondents nearly allocated the site accessibility risk as shared risk (59%). 34% of respondents considered this risk as contractor's issue, this share of respondents has a trend to allocate risks onto contractor although these risks are out of control risks. Respondents were undecided about the risks of Environmental factors and adverse weather conditions, which is normal point of view as these risks are out of control.

Contractors and owners should share such risks. Kartam (2001) and Ahmed, et al. (1999) supported these results.

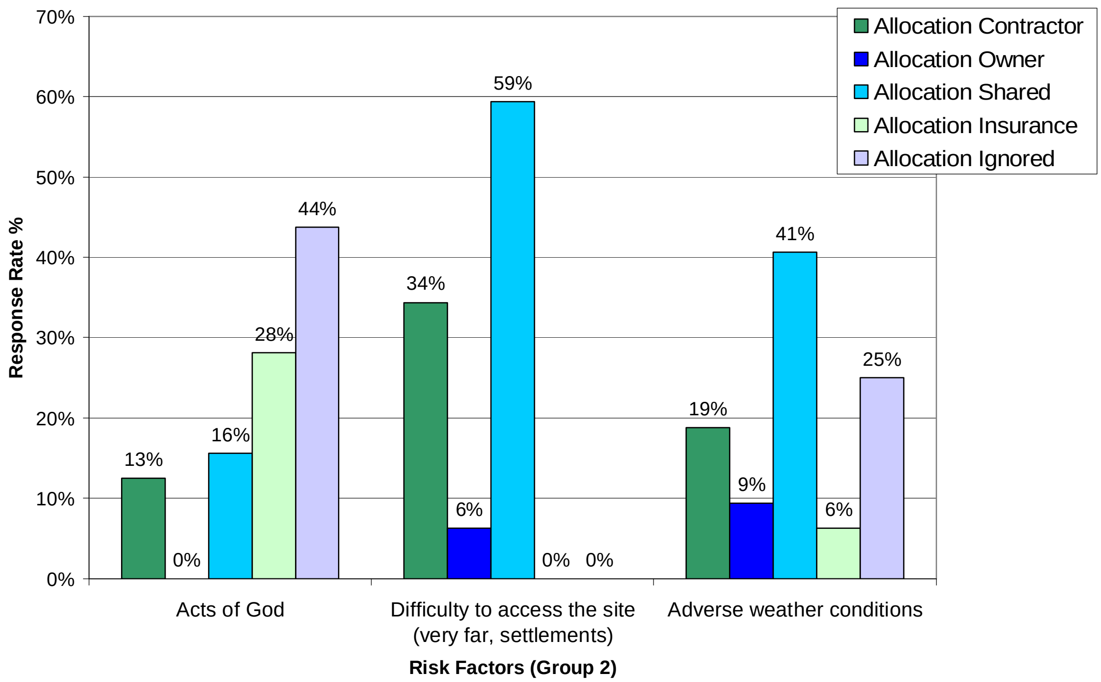


Figure 4.11. Environmental group risks allocations, owners' perspective

4.4.3 Design group (Group 3)

4.4.3.1 Severity

Table (4.15) below demonstrates weights and ranks of design group factors. As well as contractors, Owner's respondents considered design risks high risks. Owners are concerned about the quality of design. It has to be noted that owners concerned about defective design issues because they could be the trigger for many disputes and undesirable consequences. This risk if not treated properly it could lead to undesirable consequences specially in construction. These findings are strengthened by the results of Ahmed, et al (1999), (Lemos et al, 2004) and (Shen, 1997). The illegitimate result is to assign the risk of the rush design as a medium risk of the owners. It is a serious problem for owners to have this point of view.

Table 4.15. Design group risks ranking

No.	Design Group Risks	Weight	Severity (1-10)
12	Awarding the design to unqualified designers	296	9.3
7	Defective design (incorrect)	260	8.1
9	Inaccurate quantities	246	7.7
10	Lack of consistency between bill of quantities, drawings and specifications	224	7.0
11	Rush design	211	6.6
8	Not coordinated design (structural, mechanical, electrical, etc.)	205	6.4

4.4.3.2 Allocation

Figure (4.12) allocates design risks from owners' perspective. It is clear that owners accepted to bear the risks of:

- Incorrect design
- Rush design
- Awarding to unqualified designers.

Still, it could be observed from figure (4.12) that the risks of not coordinated design, inaccurate quantities, lack of consistency between quantities, specifications and drawings have received (59), (34) and (41%) responses respectively. They fell short of the chosen criterion (60% responses) for deciding its allocation. Unlike Hong Kong owners who allocated the design risk on themselves (Ahmed, et al. 1999). This further justifies the need for innovative contract procurement methods such as management contracting which are more capable of allocating the risks to the parties that could best handle them.

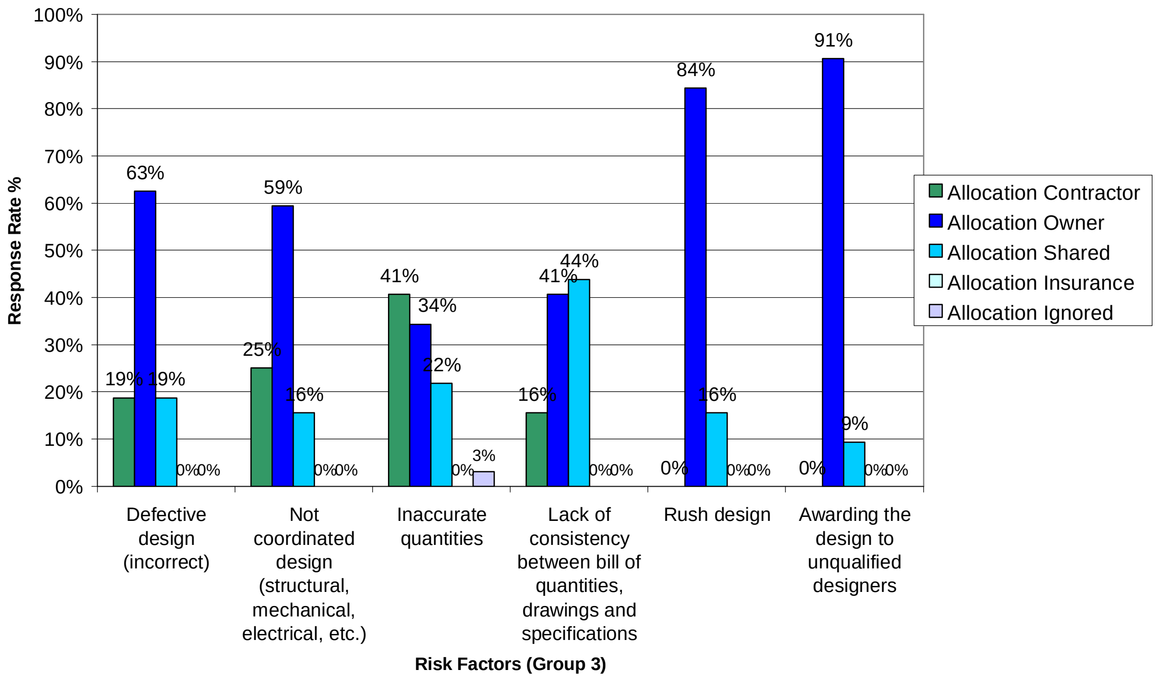


Figure 4.12. Design group risks allocation, owners' perspective

4.4.4 Logistics group (Group 4)

4.4.4.1 Severity

The figures shown in Table (4.16) illustrates the weights and ranks of the logistics group risks. It can be observed that both contractors and owners had the same ranks for the first two risks. Both of them concerned about contractor competence and availability of labor and materials. For the first risk mentioned, it was argued the owners' policies are the direct causes of this risk. The weights given to this group factors are relatively high, this indicates the importance of these risks at owner's respondents. The respondents were concerned about poor communication of contractor's side, this risk makes obstacles in the way of accomplishment, and it can observed in large firms.

Table 4.16. Logistics group risks allocation

No.	Logistics Group Risks	Weight	Severity (1-10)
15	High competition in bids	213	6.7
13	Unavailable labor, materials and equipment	211	6.6
16	Inaccurate project program	200	6.3
17	Poor communications between the home and field offices (contractor side)	187	5.8
14	Undefined scope of working	149	4.7

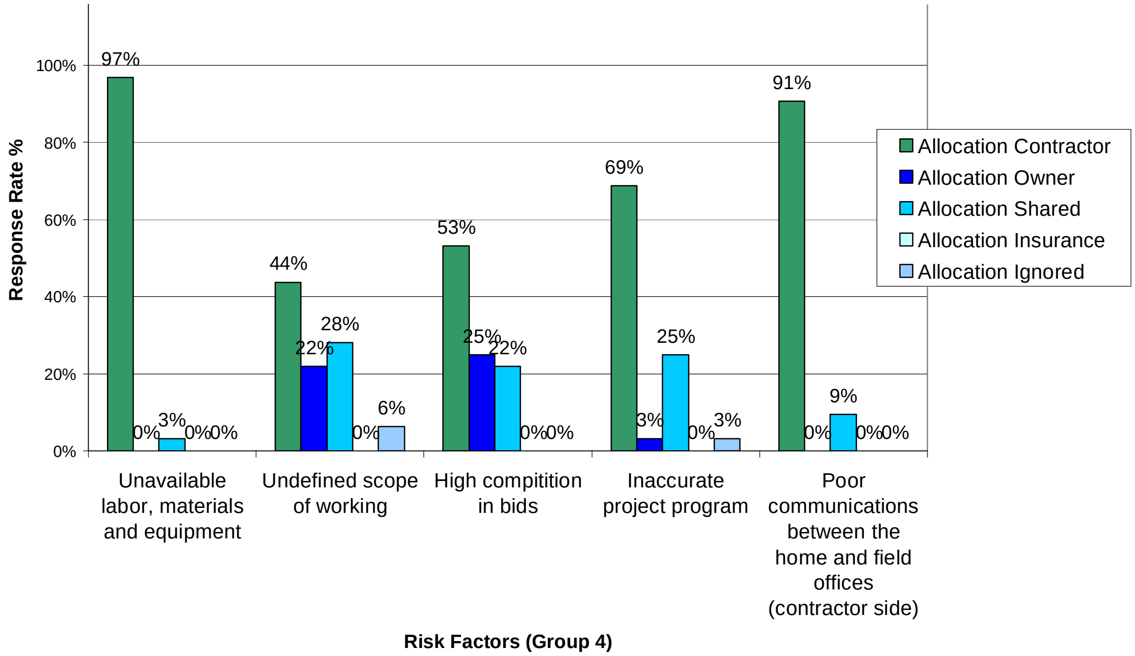


Figure 4.13. Logistics group risks allocation, owners' perspective

4.4.4.2 Allocation

Owners had considered that contractors should bear the risks of:

- Labor and materials unavailability (97% responses)
- Inaccurate project program (69% responses)
- Poor communication between contractors' teams (91% responses)

It should be the contractor's responsibility to make sure that labor and materials are available to execute the works. Unlike owners, it is believed that it should be a shared responsibility to put an accurate program to properly manage the projects tasks. Contractors should be able to control the communication process among their teams. Respondents were undecided about the risks of undefined scope of work and contractors competence. The risk of contractors' competence has to be the liability of the owner who could manage it by enforcing rigorous criteria for the selection of the contractor.

4.4.5 Financial group (Group 5)

4.4.5.1 Severity

Financial risks could be faced in construction projects are weighted and ranked in Table (4.17). Owner's respondents considered contractor's financial failure the most important financial risk with (215) weight. Next came the risk of inflation (191), monopoly and unmanaged cash flow risks were the third and the fourth respectively with (176) and (171) weights, although unmanaged cash flow is a direct cause of contractor's financial failure in Gaza Strip. The fifth was the risk of delayed payments on contract. Owner's respondents' evaluation differed completely from contractor's. Owners worried about failure but they did not about delayed payments and exchange rate fluctuation. In other words, owners concerned about not stopping the works.

Table 4.17. Financial group risks ranking

No.	Financial Group Risks	Weight	Severity (1-10)
20	Financial failure of the contractor	215	6.7
18	Inflation	191	6.0
23	Monopolizing of materials due to closure and other unexpected political conditions	176	5.5
21	Unmanaged cash flow	171	5.3
19	Delayed payments on contract	157	4.9
22	Exchange rate fluctuation	138	4.3

4.4.5.2 Allocation

Results of the survey show that both owners and contractors decided to allocate the risk of delayed payment on contracts on the owners with the same repose rate (81%). Owners considered that the contractor should be responsible about its failure and about managing its cash flow. Unfortunately, owners appeared even not to share risks of inflation, exchange rate fluctuation or monopoly, while these risks should best be shared between owners and contractors by including contract clauses that define the required parameters and conditions for sharing. These are risks where each party may be able to manage it better under different circumstances and could be specified in the contract as suggested above.

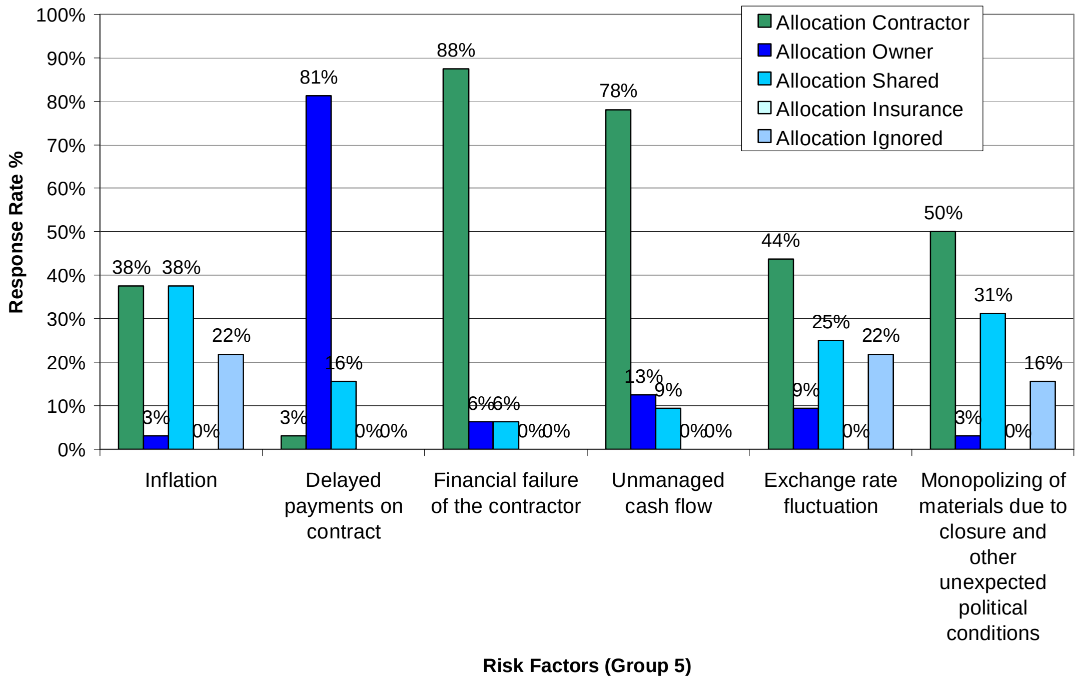


Figure 4.14. Financial group risks allocation, owners' perspective

4.4.6 Legal group (Group 6)

4.4.6.1 Severity

Table 4.18. Legal group risks ranking

No.	Legal Group Risks	Weight	Severity (1-10)
27	Delayed disputes resolutions	205	6.4
28	No specialized arbitrators to help settle fast	192	6.0
26	Legal disputes during the construction phase among the parties of the contract	164	5.1
25	Ambiguity of work legislations	143	4.5
24	Difficulty to get permits	127	4.0

Results shown in Table (4.18) illustrate the weights and ranks of legal group risks. Respondents considered the risk of delayed dispute resolution one of the highest risks. Actually, owners have a less realistic view to the legal risks than contractors. Owners are less concerned about legal issues than contractors, that could raise more disputes and increase the delay in resolving these disputes. The owners in other places like Hong Kong and Kuwait pay more attention for legal issues (Ahmed, et al, 1999) and (Kartam, 2001).

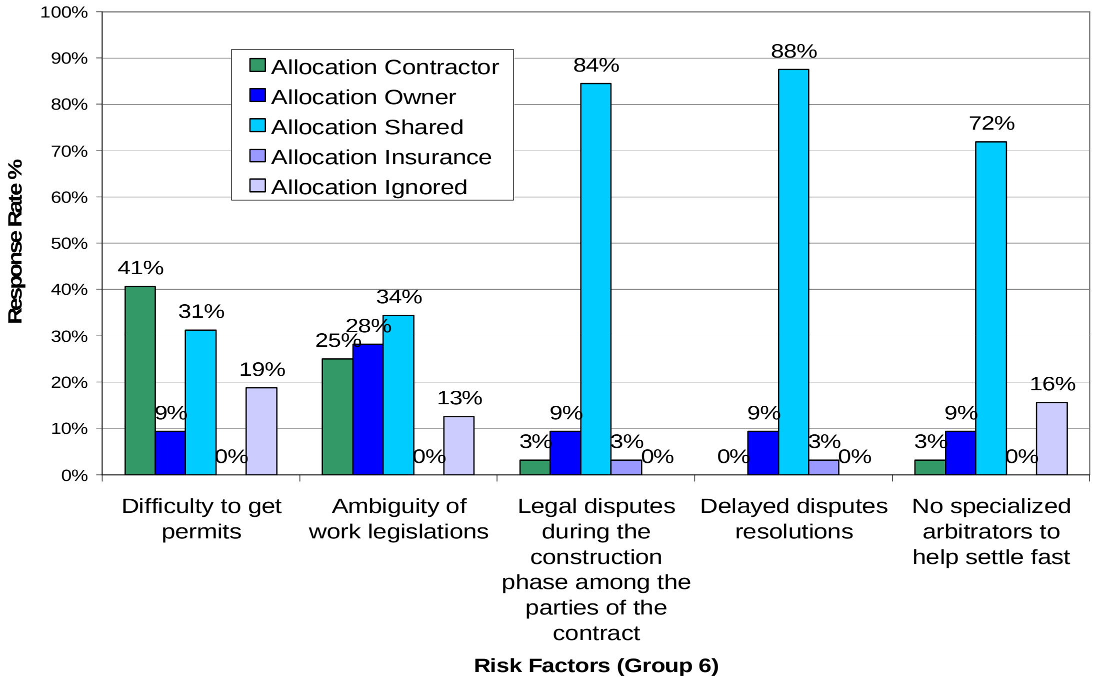


Figure 4.15. Legal group risks allocation, owners' perspective

4.4.6.2 Allocation

Owner's respondents were not decided about the risks of difficulty to get permits and the ambiguity of work legislation Figure (4.15). However, owners preferred to share the following risks with contractors:

- Legal disputes during construction phase (84%)
- Delayed disputes resolutions (88%)
- Arbitrators absence (72%)

4.4.7 Construction group (Group 7)

4.4.7.1 Severity

Table (4.19) demonstrates the weights and ranks given by owner's respondents to construction risks. As shown in the table, respondents assigned high importance to risks that contractors considered them as low-effects risks. Risk of rush bidding for example, contractors ranked it last. In other words, contractors and owners have a completely different point of views about construction risks. The researcher is more likely to consider contractors' point of view for because contractors are in direct contact with these risks; they have a more sensible point of view than owners.

Table 4.19. Construction group risks ranking

No.	Construction Group Risks	Weight	Severity (1-10)
29	Rush bidding	198	6.2
32	Lower work quality in presence of time constraints	186	5.8
30	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	178	5.6
34	Actual quantities differ from the contract quantities	166	5.2
33	Design changes	150	4.7
31	Undocumented change orders	140	4.4

4.4.7.2 Allocation

Results in Figure (4.16) show that owners allocate onto themselves the risks of :

- Rush bidding (75%)
- Design changes (66%)

It is the owners' responsibility to manage bidding process and to control design changes. They allocated onto the contractors the risk of low quality due to time constraints. Contractors have to pay all possible effort to accomplish the job according to specifications and standards even if time constraints exist. Respondents were uncertain of the risks of:

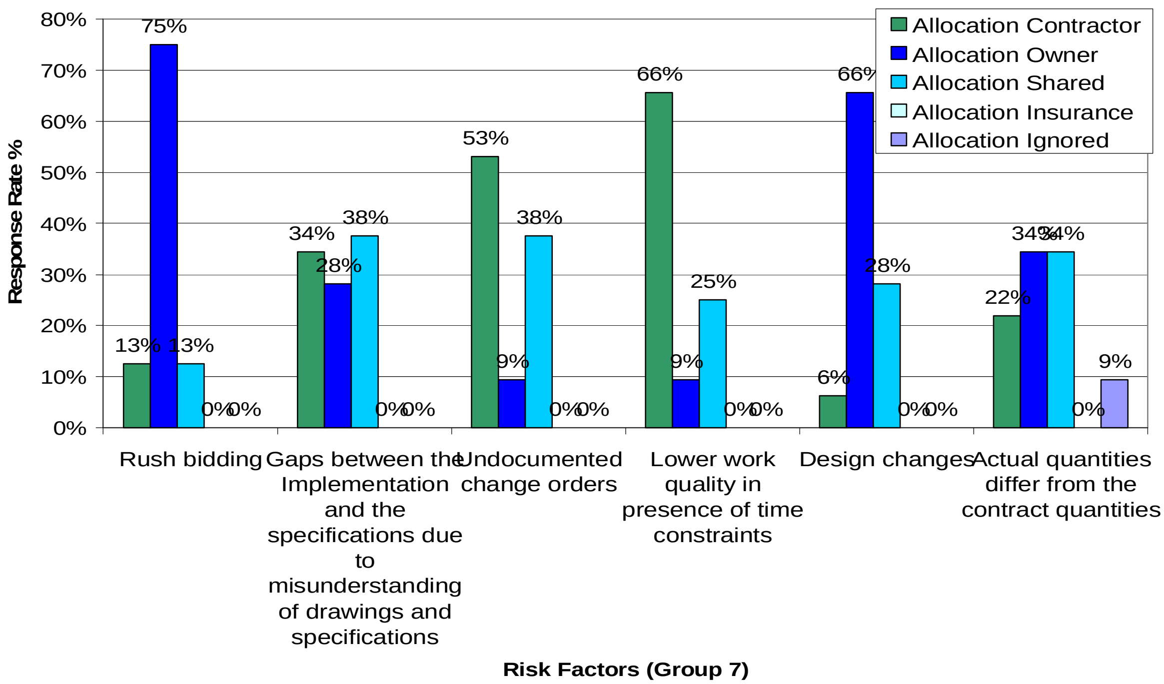


Figure 4.16. Construction group risks allocation, owners' perspective

- Misunderstandings
- Undocumented change orders
- The differences between actual quantities and contract quantities.

The last mentioned risks should be really shared risks because they could occur due to misunderstanding by either party.

4.4.8 Political group (Group 8)

4.4.8.1 Severity

Table 4.20. Political group risks ranking

No.	Political Group Risks	Weight	Severity (1-10)
36	Working at hot (dangerous) areas (close to IDF positions)	224	7.0
39	Closure	214	6.7
37	New governmental acts or legislations	172	5.4
38	Unstable security circumstances (Invasions)	172	5.4
35	Segmentation of Gaza Strip	139	4.3

Owners were worried about the political ingoing situation Table (4.20), respondents apportioned high importance to the risks of working at dangerous areas and closure. New legislations and unstable sanctuary conditions risks were medium risks. On the contrary of contractors' evaluation, owners considered the risk of segmentation of Gaza Strip is not an important risk. That is because the contractor need to move through Gaza Strip if he has several projects in several areas to be executed, but owners (Gaza Municipality for example) do not need a staff in Rafah.

4.4.8.2 Allocation

Figures (4.8) and (4.17) show that both the owners and contractors prefer to share the political risks. Political risks are out of control in most of time and should to be shared. Risks of political uncertainties should be equally applied to both parties of a contract. This is a risk where, as in the case of risk of inflation discussed above, each party may be able to manage it better under different circumstances and could be specified in the contract by defining the conditions for sharing.

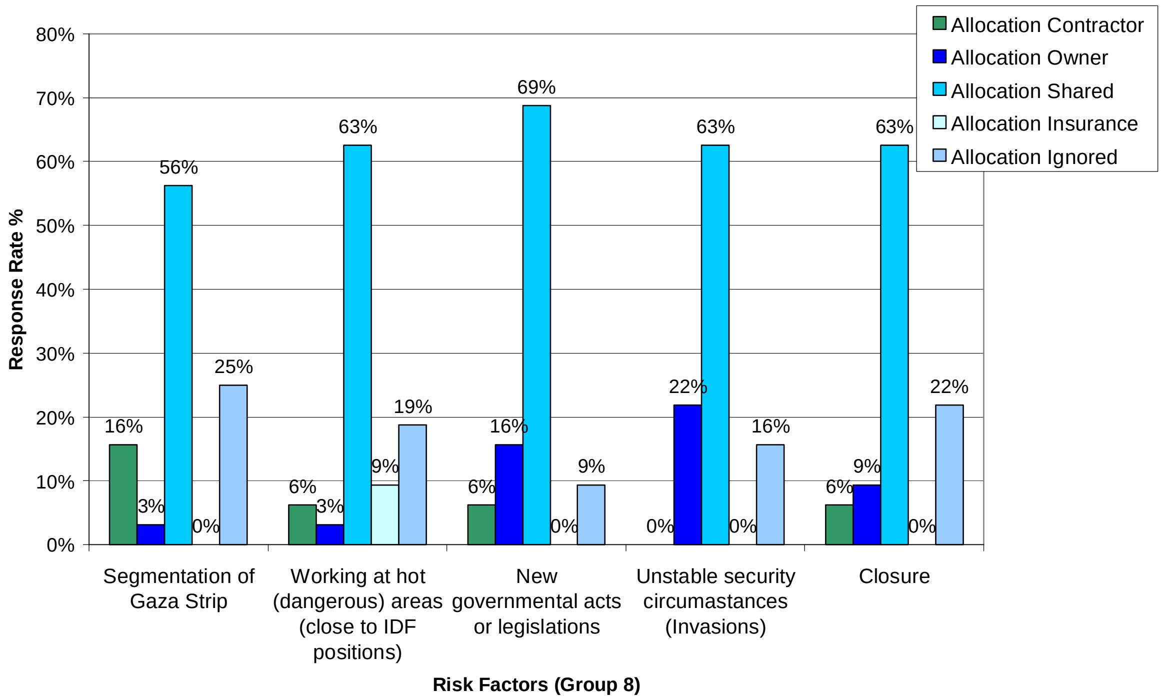


Figure 4.17. Political group risks allocation, owners' perspective

4.4.9 Management group (Group 9)

4.4.9.1 Severity

Table (4.21) illustrates the importance of management risks according to owner's respondents. Ambiguous planning and poor communication risks were the most important risks in management group with weights of (203) and (195) respectively. Other management risks are considered with medium importance. Actually the management risks are considered contractor' issues, that explains the low importance given by owner respondents.

Table 4.21. Management group risks ranking

No.	Management Group Risks	Weight	Severity (1-10)
40	Ambiguous planning due to project complexity	203	6.3
44	Poor communication between involved parties	195	6.1
43	Information unavailability (include uncertainty)	178	5.6
41	Resource management	156	4.9
42	Changes in management ways	151	4.7

4.4.9.2 Allocation

Owners allocated resource management and changes in management ways risks onto contactors Figure (4.18). Owners considered the poor communications risk should be shared with (81% responses). This consideration is sensible, since it is contractors' and owners' responsibility to maintain a good level of communication. They were uncertain about ambiguous planning and information unavailability risks. These risks also should be best shared. It is every party's favor to get a clear vision and proper planning for any project.

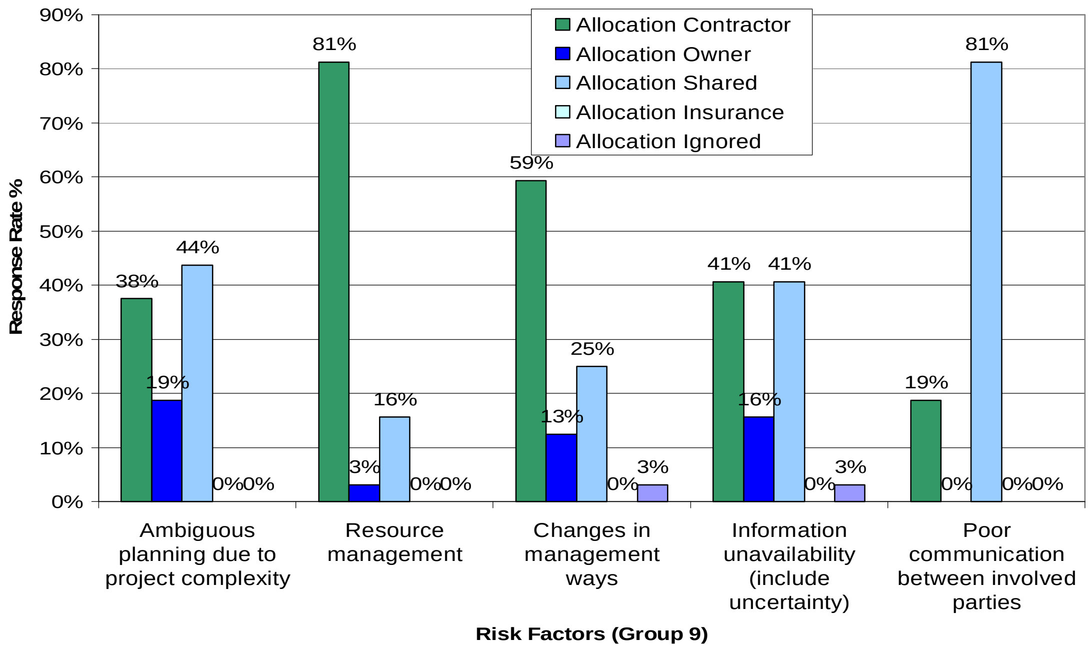


Figure 4.18. Management group risks allocation, owners' perspective

4.5 Overall risk significance and allocation, *owners' perspective*

4.5.1 Significance

Table (4.22) shows all risk factors included in the questionnaire ranked in descending order according to their weight from the owners' perspective. The most and least important risk categories for Gaza Strip owners are shown in Table (4.23) which was developed based on the data in Table (4.22). the result shows that Gaza Strip owners consider awarding the design to unqualified designer to be the most important construction risk giving it a score of (296), as shown in Table (4.22). It was followed by defective design, with a score of (260). The scores of the five most important risks range between (246) and (296).The least important risk, from the owners' perspective is the risk of difficulty to get permits, with a score of (127) followed by the risk of exchange rate fluctuation with a score of (138). The scores range between (127) and (143). The results show that owners considered only(16%) of the risk factors as highly important risks and (84%) of them as medium risks.

Table 4.22. Risk factors ranking

No.	Risk Factors	Weight	Severity (1-10)
12	Awarding the design to unqualified designers	296	9.3
7	Defective design (incorrect)	260	8.1
1	Occurrence of accidents because of poor safety procedures	258	8.1
5	Difficulty to access the site (very far, settlements)	253	7.9
9	Inaccurate quantities	246	7.7
10	Lack of consistency between bill of quantities, drawings and specifications	224	7
36	Working at hot (dangerous) areas (close to IDF positions)	224	7
20	Financial failure of the contractor	215	6.7
39	Closure	214	6.7
15	High competition in bids	213	6.7
11	Rush design	211	6.6
13	Unavailable labor, materials and equipment	211	6.6
8	Not coordinated design (structural, mechanical, electrical, etc.)	205	6.4
27	Delayed disputes resolutions	205	6.4
40	Ambiguous planning due to project complexity	203	6.3
2	Supplies of defective materials	201	6.3
16	Inaccurate project program	200	6.3
29	Rush bidding	198	6.2
44	Poor communication between involved parties	195	6.1
28	No specialized arbitrators to help settle fast	192	6
18	Inflation	191	6
17	Poor communications between the home and field offices (contractor side)	187	5.8
32	Lower work quality in presence of time constraints	186	5.8
4	Environmental factors	178	5.6
30	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	178	5.6
43	Information unavailability (include uncertainty)	178	5.6
23	Monopolizing of materials due to closure and other unexpected political conditions	176	5.5
37	New governmental acts or legislations	172	5.4
38	Unstable security circumstances (Invasions)	172	5.4
21	Unmanaged cash flow	171	5.3
34	Actual quantities differ from the contract quantities	166	5.2
3	Varied labor and equipment productivity	165	5.2
6	Adverse weather conditions	165	5.2
26	Legal disputes during the construction phase among the parties of the contract	164	5.1
19	Delayed payments on contract	157	4.9
41	Resource management	156	4.9
42	Changes in management ways	151	4.7
33	Design changes	150	4.7
14	Undefined scope of working	149	4.7
25	Ambiguity of work legislations	143	4.5
31	Undocumented change orders	140	4.4
35	Segmentation of Gaza Strip	139	4.3
22	Exchange rate fluctuation	138	4.3
24	Difficulty to get permits	127	4

Table 4.23. Most and least important risk categories as perceived by owners

Importance	Risk
High	Awarding the design to unqualified designers
	Defective design (incorrect)
(Most	Occurrence of accidents because of poor safety procedures
important	Difficulty to access the site (very far, settlements)
ranked first)	Inaccurate quantities
Low	Difficulty to get permits
	Exchange rate fluctuation
(least	Segmentation of Gaza Strip
important	Undocumented change orders
ranked first)	Ambiguity of work legislations

4.5.2 Allocation

The criterion for a risk to be appropriated to a particular category (contractor, owner, shared, insurance, or ignored), was discussed in section 4.2.1.2. Allocation of risk factors included in the questionnaire is appeared in Table (4.24), owners have allocated ten risks onto contractors, that means -from owners' perspective- contractors should be responsible for (23%) of the risk factors, they have allocated six risks onto themselves, i.e. owners accepted to bear only (14%) of the risk factors, and considered eight risks as shared risks, specifically, owners appeared ready to share (18%) of the risk factors with contractors. Finally, they were undecided about twenty risks. To be exact, owners were unsuccessful to allocate the greatest share (45%) of the risk factors on any party. These findings show the leakage of implemented contract systems regarding risk identification and allocation. Moreover, they could indicate the owners' desire to keep risk factors away of contractual issues.

4.6 Comparison of risk importance and allocation *(contractors versus owners)*

As stated in chapter 3, ranks (1-3) mean low risk importance, (4-7) medium risk and (8-10) high risk. Table (4.25) displays a comparison of contractors and owner's views on the importance and allocation of risk factors. The results indicates that contractors considered (57%) of the risks to be highly important risks. On the other hand, owners considered only (11%) of the risks to be highly important risks (sections, 4.3.1 and 4.5.1). Contractors accept (20%) of the risk factors, they have allocated (18%) of the risk factors onto owners, contractors also considered that (25%) of the risk factors should be shared and were undecided about (37%) of the risk factors. On the other hand, owners accepted (14%) of the risk factors, allocated (23%) of the risk factors onto contractors, considered (18%) of the risk factors as shared risk and failed to allocate (45%) of the risk factors.

Table 4.24. Risk allocation, Owners' perspective

Allocation	Risk Description
Contractor	Occurrence of accidents because of poor safety procedures
	Supplies of defective materials
	Varied labor and equipment productivity
	Unavailable labor, materials and equipment
	Inaccurate project program
	Poor communications between the home and field offices (contractor side)
	Financial failure of the contractor
	Unmanaged cash flow
	Lower work quality in presence of time constraints
	Resource management
Owner	Defective design (incorrect)
	Rush design
	Awarding the design to unqualified designers
	Delayed payments on contract
	Rush bidding
	Design changes
Shared	Legal disputes during the construction phase among the parties of the contract
	Delayed disputes resolutions
	No specialized arbitrators to help settle fast
	Working at hot (dangerous) areas (close to IDF positions)
	New governmental acts or legislations
	Unstable security circumstances (Invasions)
	Closure
	Poor communication between involved parties
Undecided	Environmental factors
	Difficulty to access the site (very far, settlements)
	Adverse weather conditions
	Not coordinated design (structural, mechanical, electrical, etc.)
	Inaccurate quantities
	Lack of consistency between bill of quantities, drawings and specifications
	Undefined scope of working
	High competition in bids
	Inflation
	Exchange rate fluctuation
	Monopolizing of materials due to closure and other unexpected political conditions
	Difficulty to get permits
	Ambiguity of work legislations
	Gaps between the Implementation and the specifications due to misunderstand
	Undocumented change orders
	Actual quantities differ from the contract quantities
	Segmentation of Gaza Strip
	Ambiguous planning due to project complexity
	Changes in management ways
	Information unavailability (include uncertainty)

Table 4.25. Comparison of risk factors: severity and allocation (contractors versus owners)

No.	Risk Description	*Contractors*		*Owners*	
		Severity	***Allocation***	***Severity***	***Allocation***
1	Occurrence of accidents because of poor safety procedures	*High*	*Undecided*	*High*	*Contractor*
2	Supplies of defective materials	*High*	*Contractor*	*Medium*	*Contractor*
3	Varied labor and equipment productivity	*Medium*	*Contractor*	*Medium*	*Contractor*
4	Environmental factors	*Medium*	*Undecided*	*Medium*	*Undecided*
5	Difficulty to access the site (very far, settlements)	*Medium*	*Shared*	*High*	*Undecided*
6	Adverse weather conditions	*Medium*	*Undecided*	*Medium*	*Undecided*
7	Defective design (incorrect)	*High*	*Owner*	*High*	*Owner*
8	Not coordinated design (structural, mechanical, electrical, etc.)	*High*	*Owner*	*Medium*	*Undecided*
9	Inaccurate quantities	*Medium*	*Undecided*	*High*	*Undecided*
10	Lack of consistency between bill of quantities, drawings and specifications	*Medium*	*Undecided*	*Medium*	*Undecided*
11	Rush design	*Medium*	*Owner*	*Medium*	*Owner*
12	Awarding the design to unqualified designers	*High*	*Owner*	*High*	*Owner*
13	Unavailable labor, materials and equipment	*High*	*Contractor*	*Medium*	*Contractor*
14	Undefined scope of working	*Medium*	*Undecided*	*Medium*	*Undecided*
15	High competition in bids	*Medium*	*Undecided*	*Medium*	*Undecided*
16	Inaccurate project program	*Medium*	*Undecided*	*Medium*	*Contractor*
17	Poor communications between the home and field offices (contractor side)	*High*	*Contractor*	*Medium*	*Contractor*
18	Inflation	*High*	*Undecided*	*Medium*	*Undecided*
19	Delayed payments on contract	*High*	*Owner*	*Medium*	*Owner*
20	Financial failure of the contractor	*High*	*Contractor*	*Medium*	*Contractor*
21	Unmanaged cash flow	*High*	*Contractor*	*Medium*	*Contractor*
22	Exchange rate fluctuation	*High*	*Undecided*	*Medium*	*Undecided*
23	Monopolizing of materials due to closure and other unexpected political conditions	*High*	*Undecided*	*Medium*	*Undecided*
24	Difficulty to get permits	*Medium*	*Undecided*	*Medium*	*Undecided*
25	Ambiguity of work legislations	*Medium*	*Undecided*	*Medium*	*Undecided*
26	Legal disputes during the construction phase among the parties of the contract	*High*	*Shared*	*Medium*	*Shared*
27	Delayed disputes resolutions	*High*	*Shared*	*Medium*	*Shared*
28	No specialized arbitrators to help settle fast	*High*	*Undecided*	*Medium*	*Shared*
29	Rush bidding	*Medium*	*Owner*	*Medium*	*Owner*
30	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	*High*	*Shared*	*Medium*	*Undecided*
31	Undocumented change orders	*High*	*Contractor*	*Medium*	*Undecided*
32	Lower work quality in presence of time constraints	*High*	*Undecided*	*Medium*	*Contractor*
33	Design changes	*Medium*	*Owner*	*Medium*	*Owner*

34	Actual quantities differ from the contract quantities	*Medium*	*Owner*	*Medium*	*Undecided*
35	Segmentation of Gaza Strip	*High*	*Shared*	*Medium*	*Undecided*
36	Working at hot (dangerous) areas (close to IDF positions)	*High*	*Shared*	*Medium*	*Shared*
37	New governmental acts or legislations	*Medium*	*Undecided*	*Medium*	*Shared*
38	Unstable security circumstances (Invasions)	*High*	*Shared*	*Medium*	*Shared*
39	Closure	*High*	*Shared*	*Medium*	*Shared*
40	Ambiguous planning due to project complexity	*Medium*	*Shared*	*Medium*	*Undecided*
41	Resource management	*High*	*Contractor*	*Medium*	*Contractor*
42	Changes in management ways	*Medium*	*Contractor*	*Medium*	*Undecided*
43	Information unavailability (include uncertainty)	*Medium*	*Shared*	*Medium*	*Undecided*
44	Poor communication between involved parties	*High*	*Shared*	*Medium*	*Shared*

Table 4.26. Risk severity concurrence between contractors and owners (High)

No.	**Risk Description**	*Severity*
1	Occurrence of accidents because of poor safety procedures	*High*
7	Supplies of defective materials	*High*
12	Varied labor and equipment productivity	*High*

Contractors and owners concurred to assign the same 3 risk factors to be high risks. These risks factors are related to safety measures, supplies of defective materials and varied productivity. Table 4.26 shows that contractors and owners are facing such risks during different projects. This means that these factors should be managed properly.

Table 4.27. Risk severity concurrence between contractors and owners (Medium)

No.	**Risk Description**	*Severity*
3	Varied labor and equipment productivity	*Medium*
4	Environmental factors	*Medium*
6	Adverse weather conditions	*Medium*
10	Lack of consistency between bill of quantities, drawings and specifications	*Medium*
11	Rush design	*Medium*
14	Undefined scope of working	*Medium*
15	High competition in bids	*Medium*
16	Inaccurate project program	*Medium*
24	Difficulty to get permits	*Medium*
25	Ambiguity of work legislations	*Medium*
29	Rush bidding	*Medium*
33	Design changes	*Medium*
34	Actual quantities differ from the contract quantities	*Medium*
37	New governmental acts or legislations	*Medium*
40	Ambiguous planning due to project complexity	*Medium*
42	Changes in management ways	*Medium*
43	Information unavailability (include uncertainty)	*Medium*

Contractors and owners allotted 17 risk factors (39% of risk factors that have been identified) to be medium risks (Tables 4.27). Given that there was no Low-category according to respondents' answers, this indicates the low effects of those risks on construction projects. These risk factors were distributed among all groups. This pointed to that each risk factor should be assessed unaccompanied with any other factor.

Table 4.28. Risk allocation concurrence between contractors and owners (Contractor)

No.	**Risk Description**	*Allocation*
2	Supplies of defective materials	*Contractor*
3	Varied labor and equipment productivity	*Contractor*
13	Unavailable labor, materials and equipment	*Contractor*
17	Poor communications between the home and field offices (contractor side)	*Contractor*
20	Financial failure of the contractor	*Contractor*
21	Unmanaged cash flow	*Contractor*
31	Undocumented change orders	*Contractor*

Concerning the allocation, contractors and owners have the same opinion about 7 risk factors (16% of the identified risk factors) to be allocated on the contractor (Table 4.28). This accordance means that contractor and owner have an initial embedded agreement about what contractors should bear of risk consequences during lifecycle of any project. This initial understanding should be enhanced towards acquiring full understanding about each risk factor allocation. Table 4.29 shows the risk factors that contractors and owners allocated them on owners. Table 4.30 for those that are assigned as shared.

Table 4.29. Risk allocation concurrence between contractors and owners (Owner)

No.	**Risk Description**	*Allocation*
33	Design changes	*Owner*
11	Rush design	*Owner*
12	Awarding the design to unqualified designers	*Owner*
19	Delayed payments on contract	*Owner*
29	Rush bidding	*Owner*
7	Defective design (incorrect)	*Owner*

Table 4.30. Risk allocation concurrence between contractors and owners (Shared)

No.	**Risk Description**	*Allocation*
44	Poor communication between involved parties	*Shared*
38	Unstable security circumstances (Invasions)	*Shared*
39	Closure	*Shared*
36	Working at hot (dangerous) areas (close to IDF positions)	*Shared*
26	Legal disputes during the construction phase among the parties of the contract	*Shared*
27	Delayed disputes resolutions	*Shared*

Table 4.31. Risk allocation concurrence between contractors and owners (Undecided)

No.	Risk Description	Allocation
22	Exchange rate fluctuation	*Undecided*
23	Monopolizing of materials due to closure and other unexpected political conditions	*Undecided*
24	Difficulty to get permits	*Undecided*
25	Ambiguity of work legislations	*Undecided*
6	Adverse weather conditions	*Undecided*
9	Inaccurate quantities	*Undecided*
10	Lack of consistency between bill of quantities, drawings and specifications	*Undecided*
14	Undefined scope of working	*Undecided*
15	High competition in bids	*Undecided*
18	Inflation	*Undecided*
4	Environmental factors	*Undecided*

Contractors and owners failed to allocate the same 11 risk factors (25% of identified risk factors). The compliance not to allocate the same 11 risk factors was significant (Table 4.31). The failure of allocating these risk factors escalates the probability of conflicts concerning who should endure these risk consequences. This, indeed, rises the need to allocate each risk factor legally and contractually.

4.7 Risk management actions, *contractors' perspective*

4.7.1 Preventive actions

According to the survey results (Figure 4.19), 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 Kartam (2001). Judgment and experience gained from previous contracts may become the most valuable information source for the use when there is limited time for preparing the project program. Construction, however, is subjected to a dynamic environment, that is why risk managers must constantly strive to 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, and updated project information should be obtained and applied. Consequently, contractors considered getting updated project information and add risk premiums to time estimation at the project planning stage to be effective risk preventive method. Yet, this result was expected since taking into consideration such risks' premiums would increase the priced bid and would consequently decrease the probability of gaining the bid due to the highly competitive Gaza Strip construction industry market.

Make more accurate time estimation through quantitative risk analyses techniques such as Primavera Monte Carlo program was not considered to be an effective preventive method for reducing the effects of risk. This tends to support Kartam (2001) that the approach of risk analysis is largely based on the use of checklists by managers, who try to think of all possible risks. Insufficient knowledge and experience of analysis techniques and the difficulty of finding the probability distribution for risk in practice could be the main two reasons for such result. Referring to similar projects to for accurate program was recommended by the practitioners to be an effective preventive method. The percentage above the column is effectiveness proportion for each method.

4.7.2 Mitigative actions

Figure (4.20) represents the six mitigative methods being proposed. The percentage above the column is effectiveness proportion for each method. The first mitigative method recommended by the respondents is close supervision to subordinates for minimizing abortive work, and the last recommended mitigative method is change the construction method.

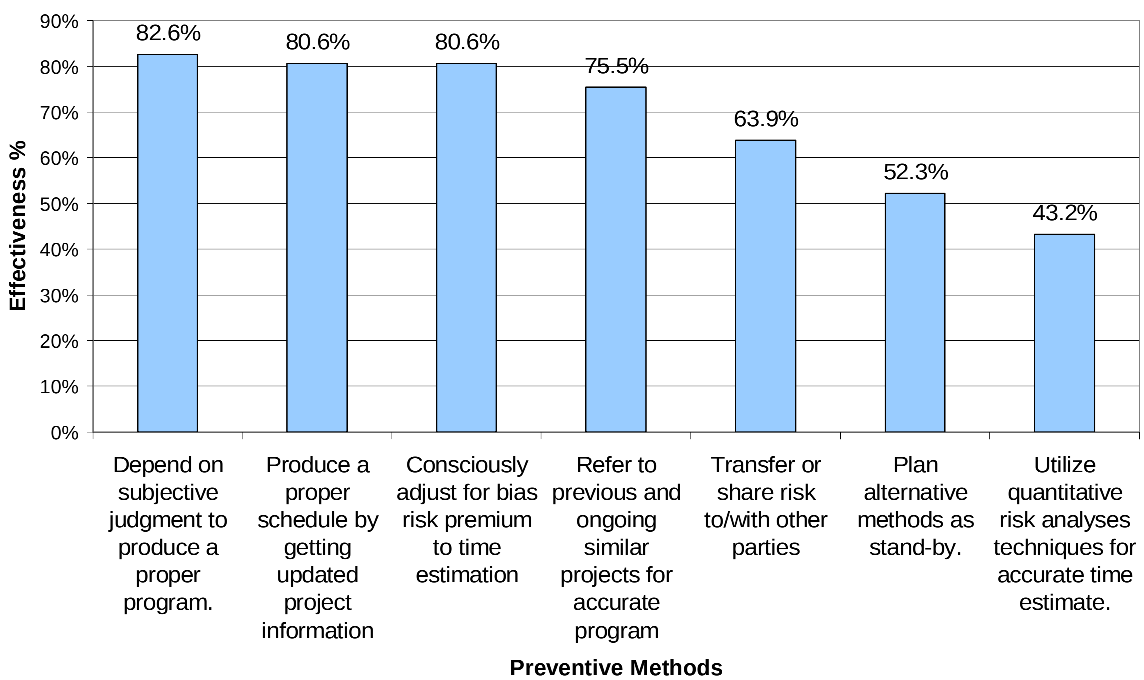


Figure 4.19. Preventive methods effectiveness, contractors' perspective

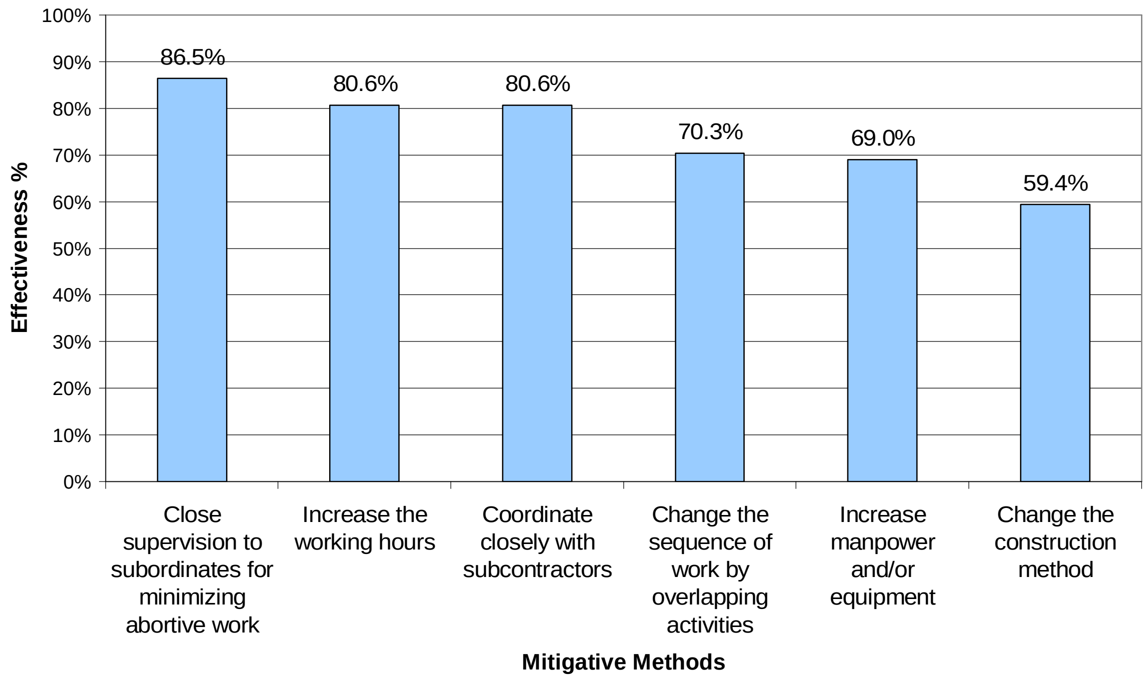


Figure 4.20. Mitigative methods effectiveness, contractors' perspective

Increase working hours and coordinate closely with subcontractors were the second most effective mitigative methods for minimizing the impacts of delay while Change the construction method was rarely used as a mitigative method. This could mean that the effort driven on site is one of the most important variables to project progress, since construction projects generally include many labor-intensive operations. In fact, as pointed out before, shortage of manpower in subcontractors' firms is one of the most serious risks to project delays. Therefore, increasing the work hours normally speeds up progress subject to the availability of materials and supervisors, physical constraints of the site, and construction sequence.

4.8 Risk management actions, *owners' perspective*

4.8.1 Preventive actions

As well as contractors, owners also considered the subjective judgment is the most effective method used to produce a proper program Figure (4.21). Next, owners considered getting updated project information and use comparative estimates are effective preventive methods. Owners also decided not to consider make more accurate time estimation through quantitative risk analyses techniques and plan alternative plans as effective preventive methods for reducing the effects of risk. Insufficient knowledge and experience of analysis techniques and the difficulty of finding the probability distribution for risk in practice could be the main two reasons for such a result. Owners did not recommend sharing risks with other parties.

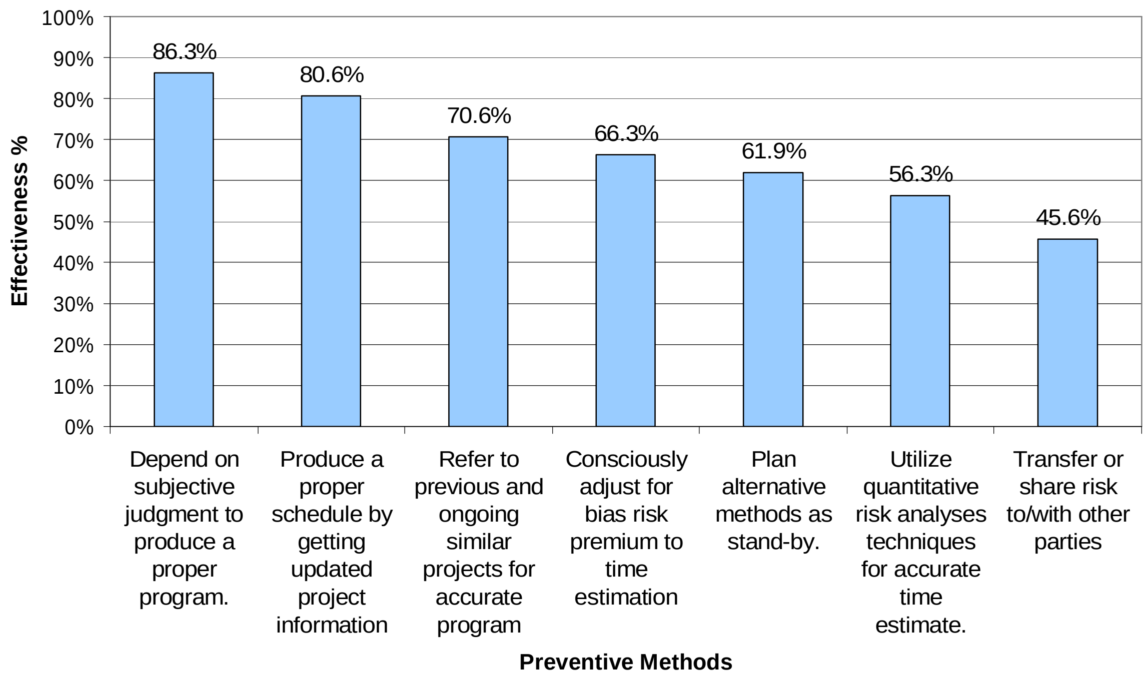


Figure 4.21. Preventive methods effectiveness, owners' perspective

4.8.2 Mitigative actions

Figure (4.22) represents the six mitigative methods. The first mitigative method recommended by the respondents is close supervision to subordinates for minimizing abortive work and the last recommended mitigative method is change the construction method. Coordinate closely with subcontractors were the second most effective mitigative methods for minimizing the impacts of delay while Change the construction method was rarely used as a mitigative method. Increase working hours and increase manpower and equipment were recommended by owners to be mitigative methods, which means that owners believe that driving more effort could enhance the contractor's performance, since construction projects generally include many labor-intensive operations. In fact, as pointed out before, shortage of manpower in subcontractors' firms is one of the most serious risks to project delays. Therefore, increasing the work hours normally speeds up progress subject to the availability of materials and supervisors, physical constraints of the site, and construction sequence.

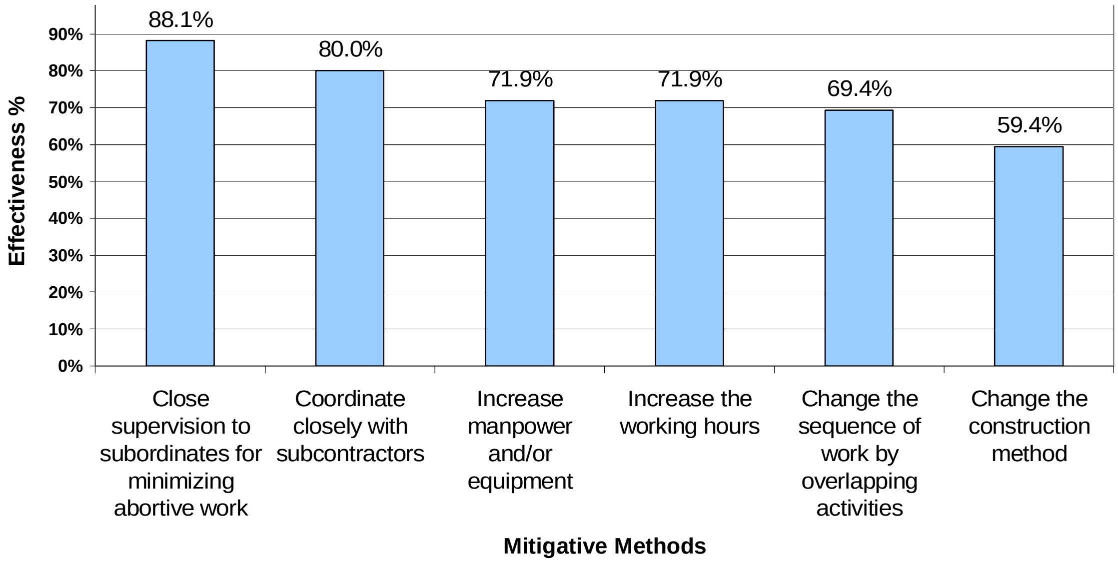


Figure 4.22. Mitigative methods effectiveness, owners' perspective

4.9 Use of risk analysis techniques, *contractors and owners*

Figures (4.23) and (4.24) demonstrate the results gained. Contractors and owners had the same results regarding the consequence. The first technique used was depend on the direct judgment and personal skills, the last was simulation analysis. These results reflected the insufficient knowledge and experience of analysis techniques and the difficulty of applying them. Expert techniques are available such as @Risk system, which integrates with time schedules and spread sheets software, should be learned and applied to obtain a precise risk estimation.

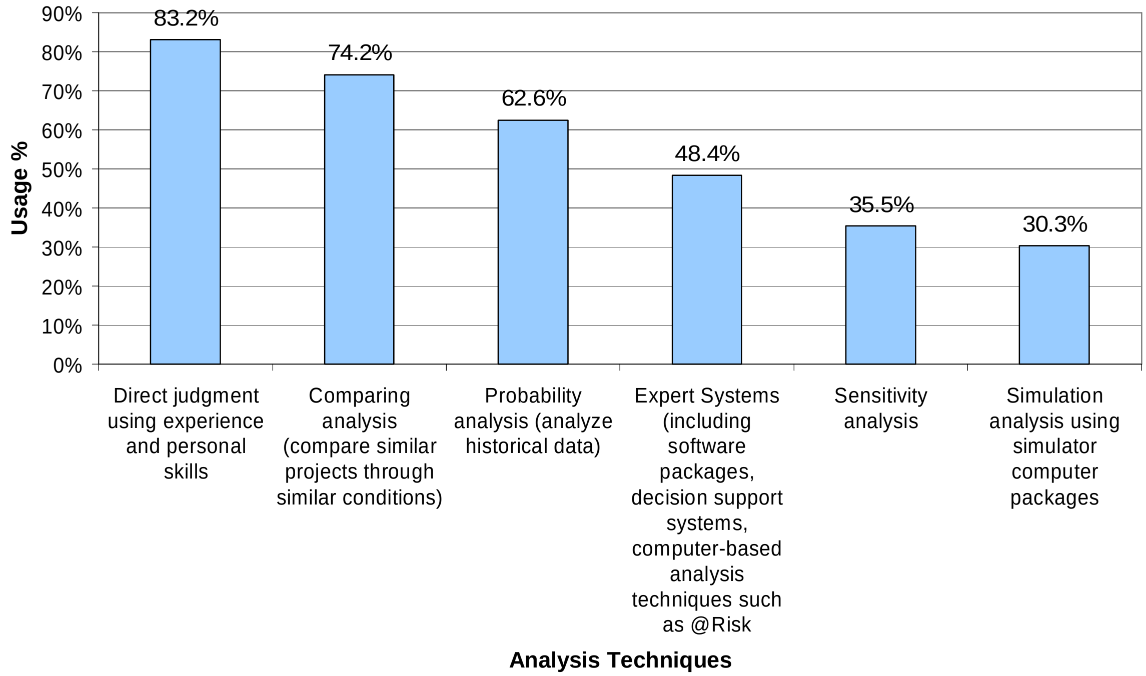


Figure 4.23. Use of risk analysis techniques by contractors

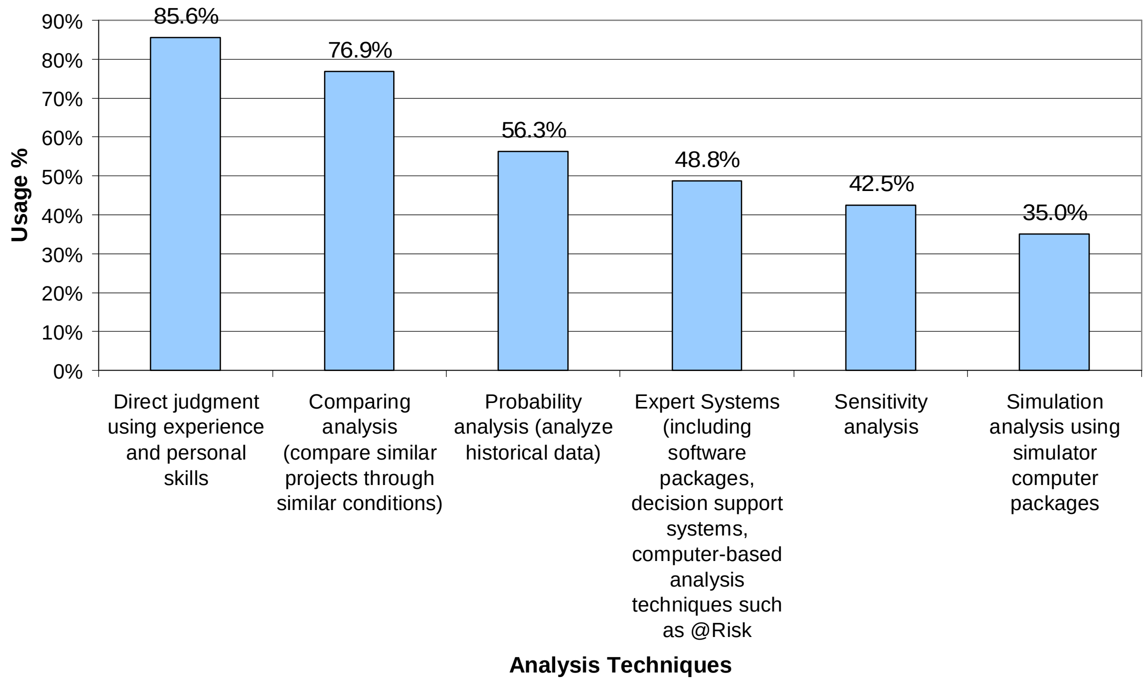


Figure 4.24. Use of risk analysis techniques by owners

Chapter 5

Case Study

With a view to testing the results of this research, the case of construction the New Pediatric Hospital at Gaza is studied, in order to get in-depth information about the actual risk factors influences in a real case. The client of the project is the Ministry of Health (MOH).

5.1 Project description

The New Pediatric Hospital is located in Kamal Nasir Street branched of Al Nasr Street. In Gaza City and consists of a main building, service building, electricity rooms, and gardener and guard rooms in addition to the infrastructure needed with a total space of 3,900 m^2. The main building of the hospital consists of four stories with a total space of 7798 m^2, the service building consists of a ground floor with space of 300 m^2, electrical rooms with a space of 70 m^2 ,guard room with a space of 27 m^2 and the gardener room with a space of 10 m^2. The project includes the construction of an underground water tank with a capacity of 240 m^3.

5.2 Contract type

- The contract of the project is an Islamic Bank form of building contract with security deposit, which is a modified World Bank contract according to the assumptions of the Islamic Bank. The tender for the project is advertised as a competition unit price contract, which includes fourteen bills of quantities as follows:
- **Bill No. 1**: for site cleaning, demolishing existing building, excavation and backfilling.
- **Bill No**. **2**: which contains all types of concrete works.
- **Bill No**. **3**: this bill includes the masonry and block works.
- **Bill No**. **4**: includes the carpentry and joinery works such as wooden doors and some furniture pieces.
- **Bill No**. **5**: aluminum and metal works like windows and metal doors and other special structures like court covering.
- **Bill No**. **6**: all internal and external plastering works.

- **Bill No. 7**: painting works, including the painting with hot bitumen for underground concrete elements.
- **Bill No. 8**: includes internal and external tiling and marble works
- **Bill No. 9**: proofing and decoration works.
- **Bill No. 10**: mechanical works (sanitary and plumping)
- **Bill No. 11**: mechanical works (medical gases and bed head units)
- **Bill No. 12**: mechanical works (HVAC works)
- **Bill No. 13**: electrical works including telecommunication works
- **Bill No. 14**: external works including gates, fencing wall, internal roads and landscaping.

5.3 Contract price

The contract price was $ 2,290,000 donated from the Islamic Development Bank – Jeddah, Palestinian Support Fund, the winner was The Arab Contractors Company.

5.4 Contract period

the duration allowed to accomplish all the works included in the project is 500 calendar days starting from 15/06/2003 which is the contract date.

5.5 Site description

The site is flat with unrestricted working space and good access. Since the soil is almost clay, all excavated materials should be removed away from the site.

5.6 Market conditions

The market conditions were classified as highly competitive at the time of tender and construction in 2003. The market conditions were subject to many factors such as closure and monopoly due to the ongoing tense situation. Gaza Strip segmentation and other sanctions were practiced by Israel. The cost fluctuations were firm.

5.7 Design and construction

The project was designed with single, combined and strip foundations, where different structural elements were used such as retaining walls, double columns, and stair bearing walls. A full set of drawings was prepared to have a good buildability of the project. Most of the construction materials could be purchased locally, some special equipment such as chillers and boilers should be delivered with lead-time, the contractor was aware to this issue and ordered them in early stages. The project design was done by the Universal Group for Engineering and Consulting.

5.8 Procurement of the contract

- The tender was advertised in newspapers. The tenders were invited by means of open tendering, in which all contractors of first class registered with Palestinian Contractors Union were invited to submit tenders.
- Nine contractors collected tender documents and submitted completed tenders before closing date on 22 February 2003.
- MOH collected an amount of $ 500 per set of tender to offset the cost of advertising and tendering and to ensure offers from bona fide contractors.
- The bidding process were executed according to the least bid. The winner was the lowest price bidder. There was an amount of $ 70,000 difference between the winner and the next bidder.

5.9 Work starting date

The work at the site has been started at 15 June 2003; after four months from submitting date. The work started by cleaning the site and demolishing the existing buildings using loaders and trucks. The project is still running and it is estimated to take six months to be accomplished.

5.10 Risk factors effects on the project

All the information below were collected after two interviews with the project parties together (contractor and owner representatives), to ensure getting the right information about the project.

5.10.1 Physical factors group

Risk factor	Effects
Occurrence of accidents because of poor safety procedures	No accident recorded during the project period until now.
Supplies of defective materials	Supplies of defective reinforcement steel, but they have no effects on the project construction time.
Varied labor and equipment productivity	Productivity decreased during some events like invasions. This caused the project time to increase by 20%

5.10.2 Environmental factors group

Risk factor	Effects
Environmental factors	No tactile effects were counted.
Difficulty to access the site (very far, settlements)	The site has good access.
Adverse weather conditions	Rain and other adverse weather conditions caused a delay time by 6% of the contract period.

5.10.3 Design factors group

Risk factor	Effects
Defective design (incorrect)	Errors in design and redesign make a delay happen by 6% of the project period.
Not coordinated design (structural, mechanical, electrical, etc.)	No physical effects were recorded.
Inaccurate quantities	Quantities were accurate.
Lack of consistency between bill of quantities, drawings and specifications	There was an acceptable level of consistency.
Rush design	Rush design was not practiced in this project.
Awarding the design to unqualified designers	The design products were suitable.

5.10.4 Logistics factors group

Risk factor	Effects
Unavailable labor, materials and equipment	The problem was occurred at the closure, segmentation and invasion times.
Undefined scope of working	The scope of work was fully defined.
High competition in bids	This affected the bidders; the difference between the winner and the next bidder was $ 70,000.
Inaccurate project program	The program was broken as a consequence of other risk factors.
Poor communications between the home and field offices (contractor side)	Due to bureaucracy and routine in the contractor side, specially in material delivery orders, a delay not less than 30% of the project period took place.

5.10.5 Financial factors group

Risk factor	Effects
Inflation	Reinforcement steel was subject 150% price increase as well as copper wires and electro-mechanics. This increase led to $ 67,000 loss to the contractor.
Delayed payments on contract	Although payments delayed, the contractor could treat this risk.
Financial failure of the contractor	The contractor is an overseas company and did not suffer from such risks.
Unmanaged cash flow	There is a clear procedure to control the incomes and outcomes of the project.
Exchange rate fluctuation	Contractor claimed this risk, where the loss was about 2% of the contract price; i.e. $ 45,000.
Monopolizing of materials due to closure and other unexpected political conditions	Due to the ongoing tense situations, this led the project to delay by 10% of the contract period.

5.10.6 Legal factors group

Risk factor	Effects
Difficulty to get permits	There was no effect.
Ambiguity of work legislations	There is low attention paid to this risk in general.
Legal disputes during the construction phase among the parties of the contract	No disputes were recorded.
Delayed disputes resolutions	No disputes were recorded.
No specialized arbitrators to help settle fast	No disputes were recorded.

5.10.7 Construction factors group

Risk factor	Effects
Rush bidding	The project was bid after 4 months from the submitting date.
Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications	This risk has low effect on the project time, where it caused 1% delay to the duration.
Undocumented change orders	Every change order was documented.
Lower work quality in presence of time constraints	Rework processes made 5% of delay happen.
Design changes	There were design changes, but no touchable effects.
Actual quantities differ from the contract quantities	The quantities of the contract were accurate enough.

5.10.8 Political factors group

Risk factor	Effects
Segmentation of Gaza Strip	This risk led to 12% delay.
Working at hot (dangerous) areas (close to IDF positions)	the site is considered in a safe place.
New governmental acts or legislations	No effects
Unstable security circumstances (Invasions)	Affected the absence of workers and staff.
Closure	Affected in different ways increasing the duration by 12%.

5.10.9 Management factors group

Risk factor	Effects
Ambiguous planning due to project complexity	The contractor overcame this risk by hiring specialized sub-contractors.
Resource management	The contractor assigns a share for each of his teams.
Changes in management ways	The contractor adopted the management by projects and enhanced the performance by 35%.
Information unavailability (include uncertainty)	There were no unforeseen conditions
Poor communication between involved parties	The communications between parties are in a satisfactory manner.

5.11 Overall evaluation of risk factors effects on the project duration, extra-cost and quality

The following information is according to the project teams' evaluation, contractor' claims and according to progress reports.

5.11.1 Estimation of delay

According to the project teams, the duration of the project is estimated to increase by 40% of the contract period; i.e. 210 days.

5.11.2 Calculation of estimated cost overrun

- **Salaries**

Staff	Salary Amount / Month ($)
Project Manager	1200
Site Engineer	1000
Assistant Engineer	600
2 Superintendents	1000
Driver	300
Coffee-boy	200
Permanent workmanship	1000
Total/month	5300
Total/day	177
Total/for the project	37,170

- **Inflation**

Material	Additional cost($)
Reinforcement steel	67,000
Electrical materials	22,000
Chillers	10,500
Exchange rate fluctuation	45,000
Overhead	34,350
Total	178,850

5.11.3 Quality of the works

As a result of existing of high qualified staffs at the contractor and the owner, the quality was not affected.

5.12 Conclusion and discussion

- The findings obtained from the case study show that the most five important risk factors that seriously caused the project to delay are in a descending order:
    - § Poor communications between the home and field offices (contractor side)
    - § Varied labor and equipment productivity (due to political and environmental circumstances)

- § Closure
- § Segmentation of Gaza Strip
- § Incorrect design, that led to re-design work, which took – sometimes - several days to be approved.

This result strengthen the contractors evaluation of the risk factors (Table 4.10 and Table 4.11)

- The most risk factors that triggered the cost overrun (or the contractor loss) are in a descending order:
  - § Inflation
  - § The exchange rate fluctuation, for more information about this factor and the above, see section (5.10.5)
  - § The delay (the risk factors that made delay happened, section 5.11.2)

Tables (4.10 and 4.22) show that contractor and owner respondents passed over issues like inflation and exchange rate fluctuation. Conversely, the case study results show the great effects of those risk factors on the project and on the contractor.

- The contracting company can improve its staff performance by many ways. Here the contractor replaced the whole team of the project to increase the functioning of the staff. The results were positive for the interest of work; i.e. contractor's team composed of two civil engineers in the past and they could not endure the work load. Now, the technical team composed of a project manager, two civil engineers, a part-time mechanical engineer and two superintendents.

Chapter 6

Conclusions and Recommendations

6.1 Introduction

This study was carried out to identify the construction industry risk factors, their importance and their allocation. Moreover, risk management actions, risk analysis techniques and their effectiveness and usage were settled on. The above topics were examined from contractors and owners' perspectives. These objectives were brought out, some tendencies were concluded and some actions that may improve risk management practices were recommended.

6.2 Conclusions

The construction industry has characteristics that sharply distinguish it from other sectors of the economy. It is fragmented, very sensitive to economic cycles, and highly competitive because of the large number of firms and relative ease of entry. It is basically due to these unique characteristics considered a risky business.

In this study, identifying the risk factors faced by construction industry is based on collecting information about construction risks, their consequences and corrective actions that may be done to prevent or mitigate the risk effects. Risk analysis techniques were investigated too. However, determination of severity and allocation of these risk factors was the main result of this research.

The focal point of this research is to explore the key risk factors and identify these factors that could be faced in construction industry in Gaza Strip. Analysis of these risk factors was carried out to measure their effects on building projects and to assign each risk factor on the party who is in the best position to handle such situations. The risk factors that were identified are shown in Table (3.1). These factors were investigated to measure the severity of each. The most ten sever risk factors are appeared in Table (6.1).

Table 6.1. Most ten sever risk factors and allocation according to contractors

Rank	Risk Description	Allocation
1	Financial failure of the contractor	Contractor
2	Working at hot (dangerous) areas (close to IDF positions)	Shared
3	Closure	Shared
4	Defective design (incorrect)	Owner
5	Delayed payments on contract	Owner
6	Segmentation of Gaza Strip	Undecided
7	Unstable security circumstances (Invasions)	Shared
8	Poor communication between involved parties	Shared
9	Unmanaged cash flow	Contractor
10	Awarding the design to unqualified designers	Owner

On the other hand, owners had a different opinion about the most ten sever risks, they ranked:

Table 6.2. Most ten sever risk factors and allocation according to owners

Rank	Risk Description	Allocation
1	Awarding the design to unqualified designers	Owner
2	Defective design (incorrect)	Owner
3	Occurrence of accidents because of poor safety procedures	Contractor
4	Difficulty to access the site (very far, settlements)	Undecided
5	Inaccurate quantities	Undecided
6	Lack of consistency between bill of quantities, drawings and specifications	Undecided
7	Working at hot (dangerous) areas (close to IDF positions)	Shared
8	Financial failure of the contractor	Contractor
9	Closure	Shared
10	High competition in bids	Undecided

The results showed the difference between contractors and owners evaluation of risks; The results show that contractors considered (57%) of the risk factors as highly important risks and (43%) of them as medium risks. However, owners considered only(11%) of the risk factors as highly important risks and (89%) of them as medium risks. That reflects the high concern of contractors about such issues. More details are in section (4.3.1 and 4.5.1). Contractors were more specific in allocating risks and were more likely to share these risks with owners who were undecided about 45% of risks, but contractors were undecided about 37% of risks. Contractors allocated 20% of risks on themselves, 18% on owners and 25% to be shared. Owners allocated on themselves 14% of risks, 23% on contractors and allotted 18% of risks as shared. (See sections 4.3.2 and 4.5.2). It was noted that no risk factor has been assigned out of the previous three categories (contractor, owner and shared) despite the existence of other two areas; insurance and ignored. Comparison between the two viewpoints is elaborated in Table (4.25).

Contractors and owners still depend on traditional approaches to manage risk factors and their consequences; the use of direct judgment to control risk factors was the most applied method used to control risk events (sections 4.7 and 4.8). These results assure the need to develop the used methods for managing risk factors.

Use of quantitative methods, computer systems or sensitivity analyses were not practiced by respondents, they also depend on direct judgment and comparing analysis to analyze risk consequences (section 4.9).

6.3 Recommendations

6.3.1 Recommendations to contractors

- Contracting companies should compute and consider risks by adding a risk premium to quotation and time estimation. This trend has to be supported by organizations like Palestinian Contractors Union, PECDAR, UNRWA, UNDP and other organizations concerned about the construction industry.
- Contractors should struggle to prevent financial failure by practicing a stern cash flow management and minimizing the dependence on bank loans.
- Contractors should learn how to share and shift different risks by hiring specialized staff or specialized sub-contractors.

- Contracting firms should utilize computerized approaches used for risk analysis and evaluation such as @Risk package which integrates with widely used programs like Microsoft Project and Microsoft Excel. Otherwise, apply manual approach such as the one shown in Annex 4.
- Moreover, contractors should work on training their personnel to properly apply management principles. It is the duty of institutes to provide such training.

6.3.2 Recommendations to owners

- Tenders should be awarded to accurate estimated cost and not necessarily to the lowest bidder. This could take the edge of high competition in bids and reduce risks' consequences by providing more profit margin for contractors.
- Exchange rate fluctuation should be considered as a risk factor by owners and donors and they should offer a compensation mechanism if there was any damage due to this risk.
- The contract clauses should be modified and improved to meet the impact of closure and segmentation of Gaza Strip and not to allocate the whole impacts on the contracting companies. These contracts are supposed to make companies make profits.
- Owners should conduct continuous training programs with cooperation with PCU to advance managerial and financial practices to explain the internal and external risk factors affecting the construction industry and to initiate the proper ways to deal with such factors.
- The design process is the most important phase in the construction process. Design products should be at the highest level of quality, because of that it should have more focus by owners.

6.3.3 Shared recommendations

- Possible risks should be allocated contractually and clearly on each party. That could be done by defining the potential risk factors and allocate them on the party which is in the best place to manage these risks.
- Both contractors and owners have to be more aware about safety measures.

- A satisfactory level of communications between parties should be maintained to convey needed information emphasizing documentation.
- Specialized construction arbitrators are needed to help in settling conflicts and disputes in a way the amalgamate legal and construction needs.
- Documentation works should be applied widely in the industry. In addition, contractors and owners are requested to keep computerized historical data of finished projects. This may help in rights reservation and to be an information source for future comparison.
- There is an essential need for more standardization and effective forms of contract, which address issues of clarity, fairness, roles and responsibilities, allocation of risks, dispute resolution and payment – this could be done by adopting a standard form of contracts e.g. "FIDIC".
- There should be an addendum or addenda for every standard contract defining the risk factors associated with construction industry in the Gaza Strip and the allocation of every factor.

6.3.4 Recommendations based on the findings of case study

- Contractors should provide the professional staff to manage the project properly, which will considerably reduce the cost and time of execution.
- Contracting companies should maintain a satisfactory level of communication between the home office and field offices and apply appropriate management practices.

6.3.5 Proposed future studies

- This study was conducted during the ongoing Al-Aqsa Intifada. It is better to repeat this study in ordinary circumstances to compare to what extent the impact of Intifada has on construction industry.
- It is necessary to repeat this research every 2 years by an authorized institute to survey the new risk factors and their allocation, and publish the results for owners and contractors.

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List of Annexes

Annex 1

بسم الله الرحمن الرحيم

Islamic University - Gaza
Deanery of Graduate Studies
Faculty of Engineering – Construction Management

Questionnaire

Risk Management in Building Projects in Gaza Strip

Researcher: Jaser H. Abu Mousa

Supervised by: Professor Dr. Adnan Enshassi

May, 2004/ Rabi’ Awwal 1425

First Part: Organization Profile

1- The position of the respondent:

Director | Deputy Director

Project Manager | Site/Office Engineer

2- Experience and Educational Qualifications

- Education: ___________________
- Experience in Years: ___________

3- Number of Employees

Managerial Employees: ______________ Technical Employees: __________

4- Number of executed projects in the last 5 years

10 Projects or less | 11-20 Projects

20-30 Projects | 31- 40 Projects

More than 40 projects

5- Experience of the organization in construction (Years)

1 year or less | 1-3 years

More than 3 years -5 years | More than 5 years – 10 years

More than 10 years

6- Work volume in the last 5 years (USD)

More than $10 million | 5 – $10 million

1- less than $5 million | $500,000 – less than $1 million

Less than $500,000

Part 2-A: Risk Factors Severity and Allocation

1. Below is the table which contains the risk factors, please assign the severity of each factor, and allocate each on one of the parts shown.

Symbol	Meaning
1--3	Low risks
4--7	Medium risks
8--10	High risks

	Factors	Severity										Allocation				
		1	2	3	4	5	6	7	8	9	10	Contractor a	Owner b	Shared a&b	Insurance	Ignored
1	Occurrence of accidents because of poor safety procedures															
2	Supplies of defective materials															
3	Varied labor and equipment productivity															
4	Acts of God															
5	Difficulty to access the site (very far, settlements)															
6	Adverse weather conditions															
7	Defective design (incorrect)															
8	Not coordinated design (structural, mechanical, electrical, etc.)															
9	Inaccurate quantities															
10	Lack of consistency between bill of quantities, drawings and specifications															
11	Rush design															
12	Awarding the design to unqualified designers															
13	Unavailable labor, materials and equipment															
14	Undefined scope of working															
15	High competition in bids															
16	Inaccurate project program															
17	Poor communications between the home and field offices (contractor side)															
18	Inflation															
19	Delayed payments on contract															
20	Financial failure of the contractor															
21	Unmanaged cash flow															
22	Exchange rate fluctuation															
23	Monopolizing of materials due to closure and other unexpected political conditions															
24	Difficulty to get permits															
25	Ambiguity of work legislations															
26	Legal disputes during the construction phase among the parties of the contract															
27	Delayed disputes resolutions															
28	No specialized arbitrators to help settle fast															

	continue Factors	Severity										Allocation				
		1	2	3	4	5	6	7	8	9	10	Contract or a	Owner b	Shared a&b	Insurance	Ignored
29	Rush bidding															
30	Gaps between the Implementation and the specifications due to misunderstanding of drawings and specifications															
31	Undocumented change orders															
32	Lower work quality in presence of time constraints															
33	Design changes															
34	Actual quantities differ from the contract quantities															
35	Segmentation of Gaza Strip															
36	Working at hot (dangerous) areas (close to IDF positions)															
37	New governmental acts or legislations															
38	Unstable security circumstances (Invasions)															
39	Closure															
40	Ambiguous planning due to project complexity															
41	Resource management															
42	Changes in management ways															
43	Information unavailability (include uncertainty)															
44	Poor communication between involved parties															

Part 2-B: Remedial Methods

2. In the table shown below, please determine the relative use of each preventive method in the table:

		Never	Rarely	Sometimes	Often	Always
I	***Preventive Method***	**1**	**2**	**3**	**4**	**5**
1	Utilize quantitative risk analyses techniques for accurate time estimate.					
2	Depend on subjective judgment to produce a proper program.					
3	Produce a proper schedule by getting updated project information					
4	Plan alternative methods as stand-by.					
5	Consciously adjust for bias risk premium to time estimation					
6	Transfer or share risk to/with other parties					
7	Refer to previous and ongoing similar projects for accurate program					

3. In the table shown below, please determine the relative use of each mitigative method in the table:

		Never	Rarely	Sometimes	Often	Always
I	***Remedial Method***	**1**	**2**	**3**	**4**	**5**
1	Increase manpower and/or equipment					
2	Increase the working hours					
3	Change the construction method					
4	Change the sequence of work by overlapping activities					
5	Coordinate closely with subcontractors					
6	Close supervision to subordinates for minimizing abortive work					

Part 2-C: Risk Analysis Techniques

4. The table below contains some techniques used in risk analyses, please assign the relative use of each technique:

		Never	Rarely	Sometimes	Often	Always
	Risk Analysis Technique	**1**	**2**	**3**	**4**	**5**
1	Expert Systems (including software packages, decision support systems, computer-based analysis techniques such as @Risk					
2	Probability analysis (analyze historical data)					
3	Sensitivity analysis					
4	Simulation analysis using simulator computer packages					
5	Direct judgment using experience and personal skills					
6	Comparing analysis (compare similar projects through similar conditions)					

Annex 2

بسم الله الرحمن الرحيم

الـجامـعة الإسـلامـية – غـزة
عـمـادة الـدراسـات الـعلـيـا
كلية الهندسة – قسم إدارة التشييد

استبيان

إدارة المخاطر في مشاريع البناء في قطاع غزة

الباحث: جاسر حميد أبو موسى

المشرف: الأستاذ الدكتور عدنان إنشاصي

غزة في ربيع أول 1425 هجرية – مايو 2004

بسم الله الرحمن الرحيم

استبيان للمقاولين وممثلي المؤسسات المالكة في قطاع غزة

السلام عليكم ورحمة الله وبركاته وبعد،

أتقدم لكم بجزيل الشكر والامتنان لمساهمتكم بجزء من وقتكم للإجابة على هذه الاستبانة وألفت عناية حضراتكم إلى الملاحظات التالية:

1. إن هذا الاستبيان هو جزء من دراسة عناصر المخاطر الرئيسية في صناعة الإنشاءات في قطاع غزة وتأثيراتها السلبية أو الإيجابية على سير المشاريع التي تقومون بتنفيذها والإشراف عليها.
2. الدراسة هي البحث التكميلي لنيل شهادة الماجستير في إدارة المشاريع الهندسية في الجامعة الإسلامية بغزة، ويأمل الباحث أن تسهم الدراسة في تحسين أداء المقاولين والهيئات المالكة في تنفيذ المشاريع.
3. تقديرًا لكم على مشاركتكم في هذه الاسبانة فإن الباحث سيطلعكم على نتائج الدراسة للاستفادة منها قدر الإمكان.
4. المعلومات التي ستساهمون بها هي لغرض البحث الدراسي، مع الالتزام التام بالمحافظة على سرية المعلومات الخاصة بكم.
5. يرجو الباحث أن تكون المعلومات دقيقة وصحيحة للوصول إلى النتائج المرجوة من هذا البحث.
6. مكونات الاستبيان:
   - السيرة الذاتية للمؤسسة.
   - عوامل وعناصر المخاطر المختلفة التي تظهر في صناعة الإنشاءات.
   - توزيع هذه العناصر (الطرف الذي سيتحملها: المقاول – المالك...).
   - وسائل تحليل عناصر المخاطر وآثارها.
   - طرق تدارك آثار المخاطر.

مع الشكر الجزيل

الجزء الأول : السيرة الذاتية للمؤسسة

1. **المركز الإداري لمن يقوم بتعبئة الإستبانة :**

مدير المؤسسة

نائب المدير

مدير مشروع

مهندس موقع / مكتب

2. **الخبرة والمؤهل العلمي**

§ المؤهل العلمي ____________

§ الخبرة بالسنوات ____________

3. **عدد الموظفين في المؤسسة**

فنيين ____________ **إداريين** ____________

4. **عدد المشاريع المنفذة خلال السنوات الخمس الماضية:**

10 مشاريع فأقل

من 11 إلى 20 مشروع

من 21 إلى 30 مشروع

من 31 إلى 40 مشروع

أكثر من 40 مشروع

5. **عدد سنوات خبرة المؤسسة في مجال الإنشاءات :**

سنة فأقل

أكثر من سنة إلي ثلاث سنوات

أكثر من ثلاث سنوات إلي خمس سنوات

أكثر من خمس سنوات إلى عشر سنوات

أكثر من عشر سنوات

6. **حجم العمل بالدولار خلال السنوات الخمس الماضية:**

أكثر من 10 مليون دولار

من 5 إلى 10 مليون دولار

من 1 إلى أقل من 5 مليون دولار

من 500,000 إلى أقل من مليون دولار

أقل من 500,000 دولار

Part 2-A: عوامل المخاطر: الأهمية، والتوزيع

1. فيما يلي عوامل المخاطرة، الرجاء إعطاء درجة الأهمية لهذه العوامل بالإضافة إلى تحديد الطرف الذي سيتحمل هذه المخاطر بالاستعانة بالرموز الموضحة أدناه:

الرمز	المعنى
1-3	مخاطر قليلة الأهمية
4-7	مخاطر متوسطة الأهمية
8-10	مخاطر هامة

	عوامل المخاطرة	أهمية عوامل المخاطرة										تحمل الأخطار				
		1	2	3	4	5	6	7	8	9	10	المقاول a	المالك b	مشتركة a&b	شركات التأمين	إهمال الأخطار
1	وقوع الحوادث بسبب قلة احتياطات الأمان															
2	توريد المواد غير الصالحة للاستخدام															
3	تغير القدرة الإنتاجية للعمال والآلات															
4	القضاء والقدر(الكوارث البيئية)															
5	تعذر الوصول للموقع															
6	أحوال جوية غير لائقة															
7	الأخطاء في التصميم															
8	انخفاض مستوى التوافق في التصميم بين التخصصات المختلفة (إنشائي، ميكانيكي، كهربائي، إلخ)															
9	أخطاء في حساب الكميات															
10	عدم التوافق بين جدول الكميات والمخططات والمواصفات															
11	التصميم العاجل															
12	العهود بالتصميم لمصمم ليس كفوًا															
13	النقص في العمالة البشرية والآلات والمواد															
14	عدم تعريف أهداف العمل															
15	المنافسة في العطاءات															
16	برنامج غير دقيق للمشروع															
17	عدم وجود مستوى مقبول من الاتصالات بين الموقع والإدارة (طرف المقاول)															
18	التضخم المالي															
19	تأخر دفع المستخلصات															
20	فشل المقاول ماليًا															
21	سوء إدارة التدفق النقدي للمقاول															
22	عدم استقرار أسعار صرف العملات															
23	احتكار المواد بسبب الإغلاق أو بسبب عوامل سياسية غير متوقعة															
24	صعوبة الحصول على بعض التصاريح اللازمة للعمل															
25	عدم وضوح القوانين الخاصة بالعمل															
26	ظهور الخلافات القانونية خلال مرحلة التنفيذ بين أطراف المشروع															
27	التأخير في حل الخلافات بين أطراف المشروع															
28	عدم وجود المحكمين المختصين في حل النزاعات الهندسية															

	تابع / عوامل المخاطرة الأهمية والتوزيع	1	2	3	4	5	6	7	8	9	10	المقاول a	المالك b	مشتركة a&b	شركات التأمين	إهمال الأخطار
29	الترسية العاجلة للعطاءات															
30	وجود الفجوات بين التنفيذ والمواصفات بسبب سوء فهم المخططات والشروط والمواصفات															
31	عدم توثيق الأوامر التغييرية															
32	انخفاض مستوى جودة الأعمال بسبب وجود القيود الزمنية المتاحة للتنفيذ															
33	التغيير في التصميم															
34	الكميات الحقيقية تختلف عن كميات العقد															
35	فصل مناطق قطاع غزة															
36	العمل في المناطق الخطرة (مجاورة لمواقع الجيش الإسرائيلي)															
37	تشريعات أو قوانين حكومية جديدة تؤثر على سير الأعمال															
38	عدم الاستقرار الأمني (الاجتياحات كمثال)															
39	الإغلاق والحصار															
40	عدم وضوح التخطيط بسبب تعقيد المشروع															
41	سوء إدارة الموارد															
42	تغيير طرق الإدارة															
43	عدم توفر المعلومات (ظروف غامضة)															
44	الاتصالات السيئة بين أطراف المشروع															

Part 2-B: طرق تدارك آثار المخاطر

2. الجدول الموضح أدناه يحتوي بعض الطرق لتدارك آثار المخاطر قبل مرحلة التنفيذ، الرجاء تحديد نسبة استخدام هذه الطرق تبعًا للرموز الموضحة:

	طرق تدارك آثار المخاطر	مطلقًا 1	نادرًا 2	أحيانًا 3	غالبًا 4	دائمًا 5
1	استخدام طرق تحليل المخاطر الكمية لتوقع المدة الزمنية بشكل دقيق					
2	الاعتماد على الخبرة العملية في عمل برنامج عمل قابل للتنفيذ					
3	عمل جدول زمني قابل للتحديث بالحصول على كل المعلومات المحدثة عن المشروع					
4	وضع خطط/طرق تنفيذ بديلة					
5	إضافة احتياطي زمني للمدة كاحتياط لمخاطر الجدول الزمني					
6	نقل المخاطر أو تقاسمها مع أطراف المشروع					
7	الرجوع إلى المشاريع المشابهة المنفذة أو الجاري تنفيذها والحصول على المعلومات لانتاج برنامج عمل دقيق					

3. الجدول الموضح أدناه يحتوي بعض الطرق لتدارك آثار المخاطر أثناء التنفيذ، الرجاء تحديد نسبة استخدام هذه الطرق وفقًا للرموز الموضحة:

		مطلقًا	نادرًا	أحيانًا	غالبًا	دائمًا
	طرق تدارك آثار المخاطر أثناء التنفيذ	**1**	**2**	**3**	**4**	**5**
1	زيادة العمالة و/أو الآلات					
2	زيادة ساعات العمل					
3	تغيير طرق التنفيذ					
4	تغيير تتابع عمليات التنفيذ أو التداخل بينها					
5	التنسيق التام مع مقاولي الباطن					
6	الإشراف الدقيق على الأعمال لتلاشي رفض الأعمال وإعادة التنفيذ					

Part 2-C: طرق تحليل المخاطر

4.الجدول الموضح أدناه يحتوي بعض الطرق لتحليل المخاطر، الرجاء تحديد نسبة استخدام هذه الطرق تبعًا للرموز الموضحة:

		مطلقًا	نادرًا	أحيانًا	غالبًا	دائمًا
	طرق تحليل المخاطر	**1**	**2**	**3**	**4**	**5**
1	استخدام الأنظمة الحديثة (برامج كمبيوتر متكاملة)					
2	تحليل الاحتمالات باستخدام معلومات تاريخية					
3	تحليل الحساسية					
4	تحليل المحاكاة باستخدام الكمبيوتر					
5	استخدام الخبرة وإعطاء التقييم مباشرة					
6	التحليل المقارن بتحليل المعلومات عن مشاريع مشابهة					

شاكرًا لكم حسن تعاونكم

Annex 3

Part 1: Organization Profile

1. Year of establishment:
2. Position:

☐ Director ☐ Vice director

☐ Project manager ☐ Site/office engineer

3. Number of employees ___________
4. Number of labors

☐ Less than 50 ☐ From 50 to less than 100

☐ From 100 to 250 ☐ More than 250

5. Number of projects

☐ Less than 10 ☐ From 11 t o 20

☐ From 21 to 30 ☐ From 31 to 40

☐ More than 40

6. Years of experience in the line of work

☐ Less than 1 year ☐ From 1 to 3 years

☐ More than 3 to 5 years ☐ More than 5 to 10 years

☐ Over 10 years

7. Volume during the last 5 years

☐ More than $10 million ☐ From $5 to $10 million

☐ From $1 to less than $5 million ☐ From $0.5 to less than $1 million

☐ Less than $0.5 million

Part 2: Risk Factors (Significance and Allocation)

Symbol	Meaning
1-3	Not significant risks
4-7	Significant risks
8-10	Very high significant risks

												Allocation		
I.	**Physical**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Contra -ctor**	**Owner**	**Shar -ed**
1	Occurrence of accidents and poor safety procedures													
2	Supplies of defective materials													
3	Varied labor and equipment productivity													
II.	**Environmental**													
1	Acts of God													
2	Difficulty to access the site (very far, settlements)													
3	Adverse weather conditions													
4	Differing site conditions													
III.	**Design**													
1	Defective design (incorrect)													
2	Not coordinated design (structural, mechanical, electrical, etc.)													
3	Inaccurate quantities													
4	Lack of consistency between bill of quantities, drawings and specifications													
5	Awarding the design to unqualified designer													

												Allocation		
IV.	**Logistics**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Contra -ctor**	**Owner**	**Shar -ed**
1	Labor, material and equipment													
2	Scope of work defining													
3	Accuracy of project program													
V.	**Financial**													
1	Inflation													
2	Delayed payment on contract													
3	Financial failure													
VI.	**Legal**													
1	Permits and regulations													
2	Labor disputes													
3	Third-party delays													
4	Delayed dispute resolution													
VII.	**Construction**													
1	Change order negotiations													
2	Quality of work and time constraints													
3	Changes in work													
4	Actual quantities of work													
VIII.	**Political**													
1	Government acts													
2	Legislation													
3	War threats													
4	Blockade													
IX.	**Management**													
1	Project complexity													
2	Organization and change management													
3	Coordination with sub-contractors													
4	Resource management													
5	Information													
6	Communication													

Part 3: Risk Mitigation Action (Effectiveness)

Symbol	Meaning
1	In applicable
2	Very low
3	Low
4	High
5	Very High

I.	Remedial Method	1	2	3	4	5
1	Increase manpower and/or equipment					
2	Increase the working hours					
3	Change the construction method					
4	Change the sequence of work by overlapping activities					
5	Coordinate closely with subcontractors					
6	Close supervision to subordinates for minimizing abortive work					

Annex 4

Risk Analysis Form

This form may be used for simple analyses covering identified risk factors. This form may be also used as an outline for a formal report of analyses requiring extensive explanations, calculation, or tables. It can be modified or expanded as needed.

Project Name____ WBS code________________________________

Table 1. Risk Factors and Effects Analysis (Quantitative)

1	*2*	*3*	*4*	*5*	*6*	*7*
Risk Factor	***Consequence***	***Severity (0-10)***	***Probability (0-1)***	***Impact = 3×4***	***Recommendation***	***Expected losses or benefits (if known)***
						Total Costs

Table 2. Risk Factors and Effects Analysis (Qualitative)

1	*2*	*3*	*4*	*5*	*6*	*7*
Risk Factor	***Consequence***	***Severity (Low – High)***	***Probability (Never – Frequent)***	***Risk Discussion***	***Recommendation***	***Expected losses or benefits (if known)***
						Total Costs

Table 3. Risk Assessment Table (Quantitative)

Likelihood level (1)	*Consequence Assessment*				
	I Negligible (2)	*II Acceptable (3)*	*III Marginal (4)*	*IV Critical (5)*	*V Catastrophic (6)*
A. Improbable	*N*	*L*	*L*	*L*	*M*
B. Unlikely	*L*	*L*	*L*	*M*	*H*
C. Likely	*L*	*L*	*M*	*H*	*H*
D. Highly Possible	*L*	*L*	*M*	*H*	*H*
E. Certainty	*L*	*L*	*M*	*H*	*H*
Risk Assessment Guide					
N = Essentially no risk can assume risk will not occur.					
L = Low risk, minor project cost escalation.					
M = Medium risk, average project cost escalation					
H = High risk, certain or if occurs will result in significant cost escalation.					

Summary
Introduce explanations or calculation of the Risk Impact on the project.

Recommendation
List important recommendations or alternatives that could reduce risk and its consequences.