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كلية الهندسة

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Impact of Conditions of Contract for Construction (FIDIC 99) on the Gaza Strip Contractor's Cost Estimation

Prepared by

Zakaria M. Aljarosha

Supervised by

Dr. Kamalain K. Shaath

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Dedication

I dedicate this work, with sincere gratitude, to my parents who emotionally supported me and I am equally appreciative of the support to my wife and daughters, Eman and Reem who silently endured the many hours I spent away from them to complete this work.

Zakaria Mohammad Aljarosha

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Abstract

Construction contract general condition clauses have a major influence on the likelihood and degree of project success. In Palestine, conditions of contract for construction (FIDIC 99) has been ratified by the Palestinian cabinet in October 2006 to represent the Palestinian unified conditions of contract for construction.

This research aims at analyzing the conditions of contract for construction (FIDIC 99), extract associated responsibilities and risks and to develop a computer based system to help the Palestinian contractors in better estimation of the cost impact of conditions of contract for construction (FIDIC 99) when pricing a bid. The system should, in principle, estimate the cost impact of FIDIC 99 through estimation of responsibility and risk factors costs implied from FIDIC 99 clauses.

Conditions of contract for construction (FIDIC 99) clauses were analyzed in order to extract associated responsibility and risk factors. A field survey, by a means of questionnaire, was conducted to investigate the local practice of estimation of cost implications of conditions of contract and to prioritize those responsibility and risk factors. The field survey reveals a significant weakness in estimating and managing responsibilities and risks, where the local contractors do not use formalized techniques for estimation of cost implications of these responsibilities and risks when pricing a bid.

For this purpose, the researcher develops a system to help the Palestinian contractors in estimating the cost impact of adopting FIDIC 99 when pricing a bid. FIDIC 99 Cost Impact Estimating System (FCIES) calculates this cost impact by utilizing Visual Basic Applications (VBA) on Microsoft (MS) Excel. FCIES sums up total values of responsibility and risk factors. The responsibility factors values are introduced directly, while FCIES deals with risk factors by using Monte Carlo simulation. The researcher hopes that contractors can bid more safely and in a practical way. It decreases the possibility of having a loss and increases the possibility of having a reasonable profit. FCIES evaluators are generally satisfied with its performance. FCIES could play an important role in cost estimation process under the conditions of contract for construction (FIDIC 99).

The researcher recommends providing more time and effort in the front-end of a project and utilizing an experienced staff to estimate and manage liabilities and risks. The researcher invites the local contractors to use FCIES in order to get more accurate cost estimation. It is also recommended to offer training courses regarding conditions of contract for construction FIDIC 99.

ملخص البحث

الشروط العامة لعقود التشييد تؤثر بدرجة كبيرة على احتمالية الفوز بالمشروع و النجاح فيه. في أكتوبر 2006 اعتمد مجلس الوزراء الفلسطيني عقد الفيديو 99 ليكون عقد المقاول الفلسطيني الموحد. تهدف هذه الدراسة إلى تحليل بنود عقد الفيديو 99 و استخلاص عوامل المسؤولية و المخاطرة المترتبة على المقاول بناءً على التزامه بشروط هذا العقد و تم تطوير نظام خاص لمساعدة المقاولين الفلسطينيين في تحسين تقديراتهم للتأثير المالي لعقد الفيديو 99 عند تسعير العطاء. هذا النظام في الأساس يقوم بتقدير هذا التأثير من خلال تقدير تكاليف عوامل المسؤولية و المخاطرة المستخلصة من عقد الفيديو 99. تم تحليل بنود عقد الفيديو 99 لاستخلاص عوامل المسؤولية و المخاطرة حيث عرضت هذه العوامل على المقاولين المحليين من خلال استبيان صمم لبحث الطرق المتبعة محلياً لتقدير التأثير المالي لشروط عقود التشييد و لترتيب هذه العوامل حسب الأهمية. أظهر البحث الميداني ضعفاً واضحاً لدى المقاولين المحليين في عملية تقدير و إدارة المسؤوليات و المخاطر حيث يفتقرون لأساليب و أدوات علمية لتقدير التأثير المالي لتلك المسؤوليات و المخاطر عند تسعير العطاء. نظام تقدير التأثير المالي لعقد الفيديو 99 (FCIES) تم تصميمه لمساعدة المقاولين الفلسطينيين لتقدير التأثير المالي لالتزامهم بهذا العقد عند تسعير العطاء، و يقوم هذا النظام بحساب التأثير المالي باستخدام تطبيقات البيسك المرئية في برنامج الاكسل. هذا النظام يقوم بجمع التأثيرات المالية لكل من عوامل المسؤولية و المخاطرة. فالبنسبة لعوامل المسؤولية يتم تقديرها بشكل مباشر بينما يتعامل النظام مع عوامل المخاطرة باستخدام نظام مونتي كارلو للمحاكاة. يأمل الباحث أن يمكن هذا النظام المقاولين من تقديم أسعار على درجة عالية من الأمان و بطريقة عملية، كما يأمل الباحث أن يقوم هذا النظام بتقليل احتمالية الخسارة و زيادة احتمالية الربح. عند عرض هذا النظام للتقييم، أبدى معظم المقيمون عن رضاهم بشكل عام عن أدائه وأشاروا إلى أنه يمكن أن يلعب دوراً حيوياً و مهماً في عملية تسعير العطاءات المبنية على أساس شروط عقد الفيديو 99. يوصي الباحث ببذل مزيد من الوقت و الجهد في بداية المشروع و توظيف فريق ذو خبرة لتقييم المسؤوليات و المخاطر، و يدعو الباحث المقاولين لاستخدام FCIES بهدف تحسين عملية تسعير العطاءات. كما يوصي الباحث بتوفير برامج تدريبية خاصة بشروط عقد الفيديو 99.

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List of Abbreviations

\$	Dollars
ADB	Asian Development Bank
BOQ	Bill of Quantities
DAB	Dispute Adjudication Board
EPC	Engineer Procure Construct
EU	European Union
FCIES	FIDIC 99 Cost Impact Estimating System
FIDIC	Federation Internationale Des Ingenieurs-Conseils
GCC	General Conditions of Contract
GUI	Graphical User Interface
Hr	Hour
IDE	Integrated Development Environment
IRMS	Integrated Risk Management System
MS	Microsoft
No.	Number
PCTD	Palestinian Central Tendering Department
PCU	Palestinian Contractor's Union
PECDAR	Palestinian Economic Council for Development and Reconstruction
PNA	Palestinian National Authority
RII	Relative Importance Index
RN	Random Number
SMDM	Support the Municipal Development and Management
STCs	Standard Terms and Conditions
UDF	User Defined Function
UN	United Nations
UNDP	United Nations Development Program
UNRWA	United Nations Relief and Works Agency
USA	United States of America
USAID	United States Agency for International Development
VBA	Visual Basic Applications
WB	World Bank

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Chapter one

Introduction

1.1 General

The construction sector has a strategic role in developed and developing countries. According to Enshassi et al (2007), the construction industry employs more than 16 percent of Palestinian workforce. The sector is the largest industrial employer in Palestine. The construction industry accounts for 17 percent of the value added to the gross national product. Cost estimation is a fundamental part of the construction practice as it represents the compilation and analysis of many items that influence, and contribute to, the total cost of project.

Conditions of contract for construction (FIDIC 99) was ratified by the Palestinian cabinet in October, 2006 to be the Palestinian unified conditions of contract for construction. The General Conditions of Contract (GCC), which are the core of the standard form, consist of twenty chapters that deal with the obligations, rights, responsibilities and risks allocations on the parties concerning contract price/payment, quality and schedule, and the procedures for claim and dispute resolutions (Zhang et al, 2006).

Since the conditions of contract for construction (FIDIC 99) has been the officially adopted conditions of contract, the contractors should consider the obligations and responsibilities included in pricing projects. Good knowledge about explicit and implicit risks and responsibilities is required for better estimation and management of these liabilities and risks.

1.2 Statement of the Problem

FIDIC 99 was recently adopted as a Palestinian unified conditions of contract for construction works. Local contractors do not have formalized systems which can deal with contractor's responsibilities and risks under the contract conditions. It is necessary to study and analyze FIDIC 99 and develop a practical system to help the contractor to estimate those responsibilities and risks in order to provide a suitable bid price.

1.3 Scope

The researcher focuses on contractors of the Gaza Strip who has a valid registration from the Palestinian Contractors Union (PCU). The limitations considered are:

- 1- Local contractors with a valid registration from the Palestinian Contractor Union (PCU). This limitation includes only the first and second classes contractors.
- 2- The conditions of contract for construction (FIDIC 99) analysis is limited to the general conditions regardless of particular conditions.

1.4 Aim

The aim of this research is to analyze the conditions of contract for construction (FIDIC 99), extract associated responsibilities and risks and to develop a practical system to help the Palestinian contractors to better estimate the cost impact of FIDIC 99 in terms of responsibilities and risks.

1.5 Objectives

- 1- To study and analyze the conditions of contract for construction (FIDIC 99) in terms of responsibilities and risks.
- 2- To investigate the practice of local contractors in estimating the cost implications of condition of contracts in the Gaza Strip and to prioritize the responsibility and risk factors implied from the conditions of contract for construction (FIDIC 99).
- 3- To develop a practical system to help the local contractors in estimating the cost impact of adopting conditions of contract for construction (FIDIC 99).
- 4- To computerize the proposed system.
- 5- To evaluate the proposed system.

1.6 Methodology Outline

First stage: literature Review

Literature and previous researches were reviewed to collect data regarding to construction contracts and their cost implications on contractors, risk management and risk management tools, standard contracts, FIDIC contracts and forms of contracts used in Palestinian territories.

Second Stage: Analysis of Conditions of Contract for Construction (FIDIC 99)

The conditions of contract for construction (FIDIC 99) was analyzed in order to extract the responsibility and risk factors from the clauses. Responsibility factors are those factors whose cost implication is more or less deterministic, where risk factors are those factors whose cost implication is rather probabilistic.

Third Stage: Field Survey

The field survey was conducted to investigate the local practice regarding to estimation of cost implications of conditions of contract. It was necessary to prioritize responsibility and risk factors implied from conditions of contract for construction (FIDIC 99), and to revise these factors by local contractors. A structured questionnaire was employed for this purpose. This questionnaire was distributed by direct contact to contractors in the Gaza Strip. Statistical analysis was carried out for the questionnaire using MS Excel. Discussions were made to obtain the results.

Fourth stage: System Development and Evaluation

A system for estimating the cost implications of the conditions of contract for construction (FIDIC 99) was developed. It was computerized utilizing the VBA facilities with MS Excel. Verification and validation tests were carried out to ensure that the system works properly and performs what it is intended to do. The system was also evaluated by experienced local contractors.

1.7 Thesis Organization

Chapter (1) Introduction

This chapter gives a general idea for this research along with research statement of problem, scope, goal, objectives, outlined methodology and thesis structure.

Chapter (2) Literature Review

This chapter presents a literature review of past research studies in estimating cost implication of conditions of contract and related fields.

Chapter (3) Analysis of Conditions of Contract for Construction (FIDIC 99)

This chapter analyzes conditions of contract for construction (FIDIC 99) clause by clause in order to extract and categorize responsibility and risk factors included in this standard.

Chapter (4) Research Methodology

This chapter presents the methodology adopted in this research including the survey questionnaire design and method of analysis.

Chapter (5) Results Analysis and Discussions

This chapter presents the results of the field survey and covers the analysis and discussions of these results.

Chapter (6) FIDIC 99 Cost Impact Estimating System (FCIES) Development

In this chapter, the developed system (FCIES) is described in details. The discussion includes concepts, description, implementation and evaluation.

Chapter (7) Conclusions and Recommendations

This chapter describes the final conclusions and recommendations of this study. It also includes the recommendations for further studies.

Chapter Two

Literature Review

2.1 Introduction

This chapter reviews the relevant literature regarding the subject of conditions of contract for construction (FIDIC 99) cost implications on the contractor project estimation. The chapter provides a broad review of topics related to construction contracts, contractor's responsibilities under the contract, risk management, risk management tools, risk allocation in contracts, standard forms of contract, FIDIC and forms of contract used in the Palestinian territories.

2.2 Construction Contracts

The most brilliant design remains just that, a design, unless turned into reality by building operations. Those operations generally require a formal agreement which sets out who does what for how much, how it should be done and allocates the risk. The transition from a successful design to a successful building requires the selection of a contract which reflects the aspirations of the parties and meets the demands of the project (Tate, 2003).

According to Samuels (1996), a contract is a voluntary agreement between two parties. The purpose of a contract is to set out the rights and liabilities of the parties. Owen (2003) defines those two parties as:

- An owner who is referred to as the employer, who has decided that he needs the project and who will pay for the project. The Employer will need to establish his requirements, decide who will prepare the detailed design and check that the construction meets his requirements, and
- A Contractor who will prepare all or any part of the design as required by the employer and who will actually construct the works.

O'Reilly (1996) states that construction contracts are the written agreements signed by the contracting parties (mainly an employer and a contractor), which bind them, defining relationships and obligations.

A construction contract sets forth the intentions and procedures to be employed in any building effort. Ideally, it should be easily understandable, mutually agreed upon document that provides the answer to every project contingency. More realistically, these intentions and procedures often

represent the owner's interests to which the business-hungry contractor agree, with the hope that enough ambiguity resides in the document to permit multiple interpretations (Samuels, 1996).

2.2.1 Contractual Problems

The construction industry suffers from low margins and contractors have difficulties making projects fully profitable. One of the reasons is that contractors are not always properly compensated for all the variations and additional work that occur during a project (Andersson et al, 2002). The modern construction industry is characterized by multi-party projects with extensive chains of sub-contracting which means that the person who is paying for the work is rarely in direct contract with the person undertaking the work. In such a situation the opportunities for misunderstandings and mismatched perceptions are rife. Contractual relationships in construction are widely held to be the major cause of inefficiency and of customer dissatisfaction with the industry (Hughes, 2006).

In Palestine, the local construction industry is still facing several contractual problems such as delays, litigation, and additional costs which are the consequences of disputes (Mortaja, 2007). Some of the pitfalls in trying to manage projects effectively and maximize project performance are: problems associated with misunderstanding of contract documents, especially general and special conditions have tremendous impact on project performance (Enshassi, 1999, cited by Ogunlana et al, 2000).

Mitropoulos et al (2001) mentions that contractual problems lead each party to evaluate its responsibility for any cost associated with the solution. The parties may agree or disagree on the issue of responsibility. Typically, the contract is the departure point for each party's position, as it allocates the risks and defines responsibilities for potential contingency. Unfortunately, interpretation and application is not always straight forward due to the following problems:

- The contract cannot predict all possible problem situations.
- The parties may have a different perception of the facts of the situation.
- Differences may exist in the party's perception of risk allocation. A study of contract clauses found that there are significant disparities among owners and contractors with respect to the perception of risk allocation of contract clauses.
- The integrity of contractual terms may be questionable. Such terms include clauses which are unfair at the outset.

- Both parties may have failed to perform some contractual duties.
- An opportunistic party may simply deny responsibility to avoid losses or claims.

To reduce these contractual problems, the following actions may be carried out:

- Use standard contract to avoid misinterpretation of risk allocations.
- Allocate risks to the parties that can best control it.

2.3 Project Risk Management

2.3.1 Definition of Risk

The word "risk" was known in the English language in the 17th century. It is believed that the word was originally a sailor's term that came from the Spanish and meant "to run into danger or to go against a rock". The money spent to fund shipments overseas was the first example of risk business in the early days of travel (Jannadi et al, 2003).

The Oxford Advanced Learner's Dictionary (1995) defines risk as "the chance of failure or the possibility of meeting danger or of suffering harm or loss". Webster's dictionary defined risk as "the possibility of loss, injury, disadvantages, or destruction".

Risk is defined in British standard No. 4778: Section 3.1, 1991, as "A combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence" (Bunni, 2005).

Usta (2005) has defined the word "risk" as "The exposure to the change of occurrences of events adversely or favorably affecting project objectives as a consequence of uncertainty".

Maqousi (2007) has defined risk as "the possibility of loss, damage, or any other undesirable event during the course of implementation of a contract". Project risk can be defined as an event or action which tends to cause a negative impact on project performance achievable, which includes project scope, quality, performance, schedule and cost. From this perspective, risk can be observed as "threats of success" (Arikan, 2005).

2.3.2 Managing Risk

One of the distinct characteristics of the construction projects is that they are full of various risks (Meng, 2002). Construction, like many other industries in a free enterprise system, has sizeable risk built into its profit structure. From beginning to end, the construction process is complex and characterized by many uncertainties (Usta, 2005). Each risk comprises three elements: source, event, and effect. A single risk event may result from single or multiple sources, and may result

in single or multiple effects (Eriksson, 2003). The riskier the activity is, the costlier the consequences if the wrong decision is made. Knowing how much risk is involved will help decide if costly measures to reduce the level of risk are justifiable (Jannadi et al, 2003).

Management of risk requires identification and analysis of risk factors. After this risk assessment step, proper response strategies have to be developed so that an optimum risk-reward structure is ensured as shown in Figure 2.1. Contracts are the grounds where risk allocation schemes between parties are settled and risk-reward mechanisms are defined. Thus, successful management of risk requires understanding of contract clauses and identification of risk factors (Usta, 2005).

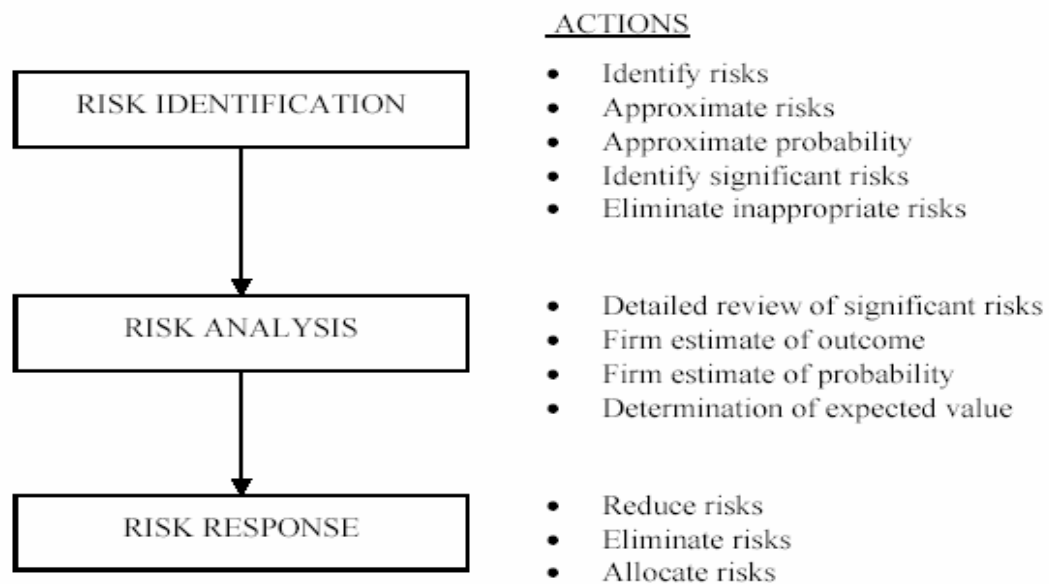


Figure 2.1: Risk Cycle Phase (Usta, 2005)

Risk management may be defined as “being the process of recognizing the factors which create risk and, where possible, organizing resources and actions in such a way as to avoid risks when possible and minimize the undesirable consequences of the risks which cannot be avoided (Fung, 2002). Risk management may also be defined as a process to control the level of risk and to mitigate its effects (Maqousi, 2007).

Construction risks are a major element that can significantly affects the final cost of any project. Specifically, how these risks are allocated has a direct bearing on the final total cost (Zaghloul et

al, 2002). In general, the contractor is unable to assume unlimited risks due to financing constraints, as doing so might exceed the scope of financing. Lower project risks make the project more attractive for competitors and lead to more extensive competition (Schneider, 2002). Many Contractors, however, have developed a systematic approach and rules of thumb when dealing with risk. These rules generally rely on the contractor's experience and judgment (Usta, 2005).

Contractors of the Gaza Strip have big consideration for the role of effective risk management in project success. The executed projects are associated with relatively high level of risk. Border closure is, in general, the most important risk factor in the last five years. (Maqousi, 2007)

Various environment impacts, government laws and regulations, changes in the economic and political environment, cost and time overruns and the unsatisfactory quality of a project are the general sources of project management disappointment (Kumar, 2002).

It is always helpful to have an objective measure of risk. The main reason for having measures of risk is to enable contractors to make better decisions especially in bidding and pricing phase. In risk cost estimation and management, there is a need for suitable tool or model to be used by contractors in Gaza Strip (Maqousi, 2007).

2.3.3 Risk and Contingency

Contractor's contingency can be thought of as a contractor's estimated value of the extraordinary risks he will encounter in a project. Extraordinary risks would be those risks not covered by bonds, insurance or the contract. For example, unresolved scope issues or unforeseen conditions would contribute to extraordinary risk. A contractor is less likely to win a contract, if contingency is set too high. Contingency set too low could result in significant financial losses. Therefore, contractors would be wise to consider the likelihood that a particular risk will occur, identify the potential financial impact and then determine the contingency. Estimating textbooks usually represent the contractor's contingency as a fixed percentage of direct cost. Generally the percentage reported is around 5–10% of the contract value. It is also assumed that contractors have their own historical records to consider in setting contingency values (Smith et al, 1999).

Unlike the designer, construction contractors work at higher risks created by the complexity of design and estimating total project costs. Recognizing this risk, owners often request bid, payment, and performance bonds from the contractor. The owner is paying for additional

assurance that the contractor will perform the project as described in the contract documents. While the owner and designer can insure or bond many of their risks, a contractor cannot purchase “insurance” or obtain a “bond” for poorly prepared drawings and specifications, biased inspections, or significant scope changes. They must self-insure by adding contingency or assigning risk into change orders (Smith et al, 1999). Contingencies placed in a bid increase the bid price, extend the schedule, or both. Contingencies protect the contractor's interests in the event of risk occurrence. To understand the risks allocated to it, the contractor must read and interpret the contract; it must understand which risks are assigned to it under the contract terms and conditions. It is therefore important that the contract clauses allocating risk be clear and unambiguous (Hartman et al, 1996).

2.3.4 Risk Classification

2.3.4.1 Construction Related Risks

Construction risk, which is inherent in the process, arises from such diverse issues as unforeseen conditions, weather, business climate, and resource availability. Construction risks are a major element that can significantly affects the final cost of any project. Specifically, how these risks are allocated has a direct bearing on the final total cost (Zaghloul et al, 2002).

Mitigation measures are the most recommended management method. The mitigation measures focus on improved planning and implementation of project control systems. Contingency is an alternative management method in quality problems, poor productivity (time contingency), changes, and delays. These problems are predictable, which suggests that they can be anticipated, but their magnitude and cost are very difficult to forecast (Smith et al, 1999).

2.3.4.2 Contractual and Legal Risks

Contractual risks emanate from contracts, and risk is increased with decreased contract clarity as well as imperfect communication and untimely contract administration (Zaghloul et al, 2002). Contractual risks arise from the documentation and administration of the construction contracts (Smith et al, 1999).

Not all contracts allocate risk equitably or such that the power and authority to manage the risk is allocated along with the risk itself (Zaghloul et al, 2002). Generally, the contractor is responsible for the majority of the contractual and legal risks. Sometimes, other mitigation measures are the

most common management method (Smith et al, 1999). Many legal and regulatory liability risks are covered by the various insurance policies purchased by the contracting parties (Usta, 2005).

2.3.4.3 Financial and Economic Risks

Project related financial risks are carried by the contractor, with the greatest exception being the overall project funding by the owner. Contractor default is a form of financial risk that the owner can reduce by prequalification, but performance and payment bonds are more directly aimed at shifting the risk to the surety. The contractor obviously has a major risk in the event of contract default. They can minimize the extent of this risk by carefully selecting projects and avoiding ventures where they have little expertise. Contractor financial risks often arise from poorly prepared estimates (Smith et al, 1999).

2.3.4.4 Physical Risks

Force Majeure Risk, as a part of physical risk, describes the circumstances beyond a project developer's or government's control such as natural disasters, war, hostilities, embargo, import, or export restrictions (Wang et al, 1999).

These are the catastrophic events that might occur during the construction of a project. Contracts usually address these risks and minimize their effects with insurance or clauses. However, without a contract clause addressing natural risks, the contractor will confront the complete risk and contingency will be the only methodology for him to manage these risks (Khalafallah, 2002). There are several clauses in conditions of contract for construction (FIDIC 99) that deal directly with the natural risks. Sub-clause 8.4 specifies in express terms, that risks concerning the climatic conditions are shared between the employer and the contractor, in that the employer shall allow an extension of time if exceptionally adverse climatic conditions affect the contractor's construction progress. This also implies that the contractor shall bear the relevant costs incurred by him due to such risks. It also implies that under "normal" adverse climatic conditions, such rainy or cold days, the contractor shall bear the corresponding responsibility (Zhang et al, 2006).

2.3.4.5 Performance Related Risks

Performance related risks includes productivity of labour, productivity of equipment, suitability of materials, defective work, Conduct hindering performance of the work, labour disputes and accidents (Panthi, 2007).

2.3.4.6 Political and Social Risks

Political risk describes the risk of government actions that may endanger a project. Actions can occur at the central, provincial, or local levels of government. More specifically, primary political risks include change in law, corruption, expropriation, and reliability and creditworthiness (Wang et al, 1999). Political risks are external to the project and unpredictable in frequency and magnitude. The management of political risks is primarily the owner's responsibility, and the management method recommended is usually a contingency (Usta, 2005).

2.3.5 Monte Carlo Simulation

The literature is rich enough in terms of risk management tools development. Starting from early 1970's, lots of studies have been conducted pertinent to risk modeling concept. The Monte Carlo simulation technique is widely seen in literature. Recently, interest in using Monte Carlo analysis for risk assessment has increased. Monte Carlo simulation was named for Monte Carlo, Monaco, where the primary attractions are casinos containing games of chance. Games of chance such as roulette wheels, dice, and slot machines exhibit random behavior. The random behavior in games of chance is similar to how Monte Carlo simulation selects variable values at random to simulate a model. When you roll a dice, you know that a 1, 2, 3, 4, 5, or 6 will come up, but one does not know which for any particular trial. A simulation produces numerous scenarios of a model by repeatedly picking values from the probability distribution for the uncertain variables and using those values for the cell (Arikan, 2005). In general, the Monte Carlo simulation is a simulation method by means of random numbers. Its basic steps are:

- i) Assess the range for the variables being considered, and determine the probability distribution most suited to that variable;
- ii) Select a value for each variable within its specified range; this value should be randomly chosen and must take account of the probability distribution for the occurrence of the variable;
- iii) Run a deterministic analysis using the combination of values selected for each one of the variables;

iv) Repeat a number of times to obtain the probability distribution of the result. The number of iterations required depends on the number of the variables and the degree of confidence required, but typically between 100 and 1000 (Khalafallah, 2002).

Monte Carlo simulation is non physical in nature and often employs a mathematical model with an objective governed by variables. The total probability range (0 to 100) has to be divided into parts and the corresponding values of the uncertainty have to be estimated. The five divisions pattern is shown in Figure 2.2 of the cumulative percentages 0, 25, 50, 75, 100 (Sha'ath, 1993).

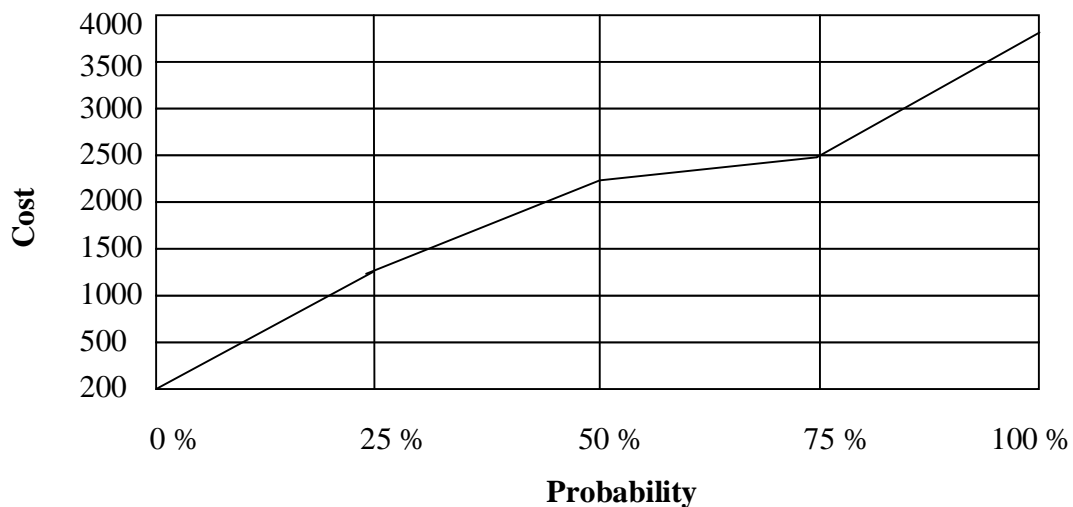


Figure 2.2: Typical Uncertainty Profile (Sha'ath, 1993)

Figure 2.3 illustrates the relationship between random number and the cost value. If the number generated was exactly 0, then the cost value corresponding to the 0% cumulative probability would be picked, which is denoted as $p(0)$. Similarly if number generated is equal to 0.75 then $P(0.75)$ would be picked and so on. On the other hand, if the number generated was (say) between 0.25 and 0.50, then cost corresponding value would be:

$P(25) + Y$,

Where Y could be obtained by interpolation as:

$$\frac{Y}{X} = \frac{P(50) - P(25)}{0.50 - 0.25}$$

Therefore;

$$Y = \frac{P(50) - P(25)}{0.25 - 0.5} \times (0.25 - \text{Number Generated})$$

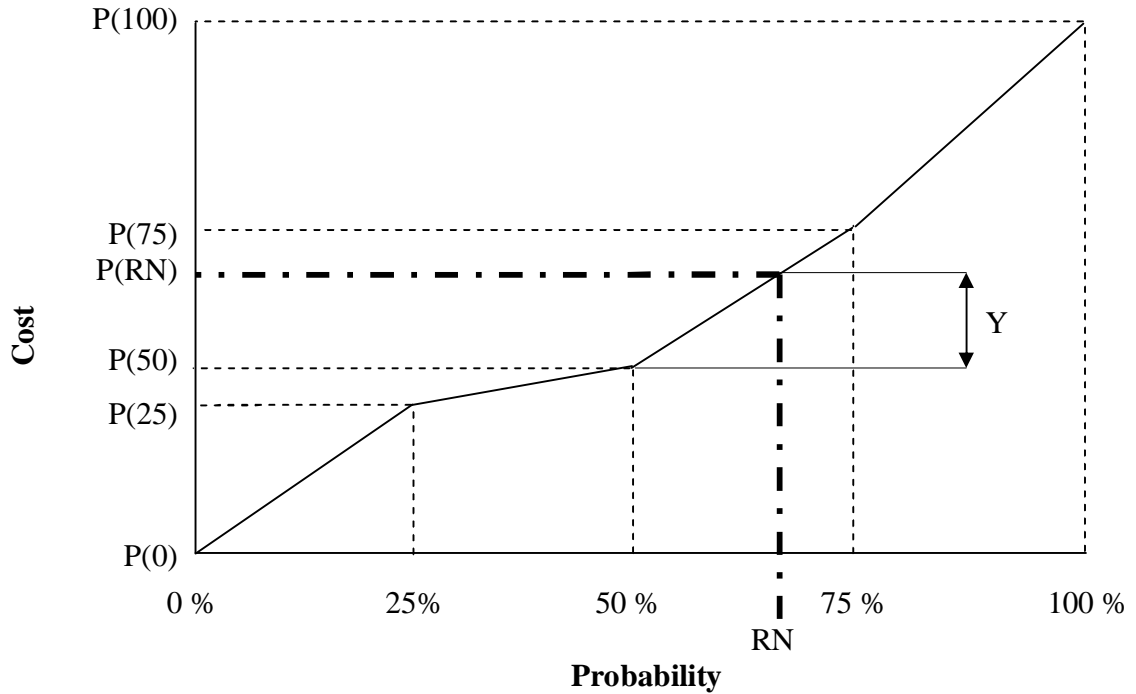


Figure 2.3: Uncertainty Profile Value Interpolations (Sha'ath, 1993)

This method has the advantage of allowing the analyst to account for relationships between input variables and providing the flexibility to investigate the effects of different modeling assumptions. The disadvantage for this method is correlation between project cost components as it is assumed that cost components are independent and change in one cost element do not affect any other component (Maqousi, 2007). Nevertheless this disadvantage could be overcome by creating dependency relationships which control the behaviour of the generated random numbers as shown in section 6.3.2.6 in sixth chapter of this research.

The construction companies need special tools to identify, analyze and response to risk (Maqousi, 2007). The following part of the literature review introduces some tools based on Monte Carlo simulation that were developed to deal with risks in construction projects.

2.3.5.1 Integrated Risk Management System for International Construction Projects (IRMS)

This system was developed by Arikan (2005). IRMS decision support system is designed to assist users at bidding stage of international construction projects. IRMS risk management model consists of following jointed phases:

- 1- Risk identification.
- 2- Risk classification and carding.
- 3- Risk analysis and response development.
- 4- Risk revising

Figure 2.4 shows IRMS carding process, three rating tasks are carried out as pre-response, post-response and final rating. In pre-response rating, the values are rated without carrying out response development. On the other hand, post-response rating is carried out based on the response strategies developed by the user. Final response rating values represent the preferences of the user based on the rating and response cost values. The user may apply several response strategies which depend on risk source type, contract clauses, estimated cost values, etc.

Final rating value is converted to linguistic term and categorized as low, moderate, significant and high. The total project cost calculated from risk analysis by Monte Carlo simulation is raised by the global risk rating value. Global risk sources are the ones which affect the whole project performance based on political, economical, social and legal country risk sources. In addition to country risk sources, force majeure risk sources such as war, earthquake, flood, etc. may be important risk source elements.

WORKPACKAGE 1															
SHOW OTHER SUBMITTANCE CONSTRUCTION															
ESTIMATED COST															
01/01/2020															
TOTAL RESPONSE															
TOTAL RESPONSE															
NO	DESCRIPTION	CONTRACTOR	PROBABILITY	IMPACT	RATING	ASSESSMENT STRATEGY	PROBABILITY	IMPACT	RATING	ASSESSMENT STRATEGY	PROBABILITY	IMPACT	RATING	ASSESSMENT STRATEGY	PROBABILITY
1	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01	21.01.01
2	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02	21.01.02
3	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03	21.01.03
4	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04	21.01.04
5	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05	21.01.05
6	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06	21.01.06
7	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07	21.01.07
8	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08	21.01.08
9	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09	21.01.09
10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10	21.01.10
11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11	21.01.11
12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12	21.01.12
13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13	21.01.13
14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14	21.01.14
15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15	21.01.15
16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16	21.01.16
17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17	21.01.17
18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18	21.01.18
19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19	21.01.19
20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20	21.01.20
21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21	21.01.21
22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22	21.01.22
23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23	21.01.23
24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24	21.01.24
25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25	21.01.25
26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26	21.01.26
27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27	21.01.27

IRMS provides six major and common probability distribution options for the decision maker for applying risk analysis. These distributions are uniform, normal, triangular, beta, trapezoidal and custom distribution functions. The results of the Monte Carlo simulation are illustrated in Figure 2.5.

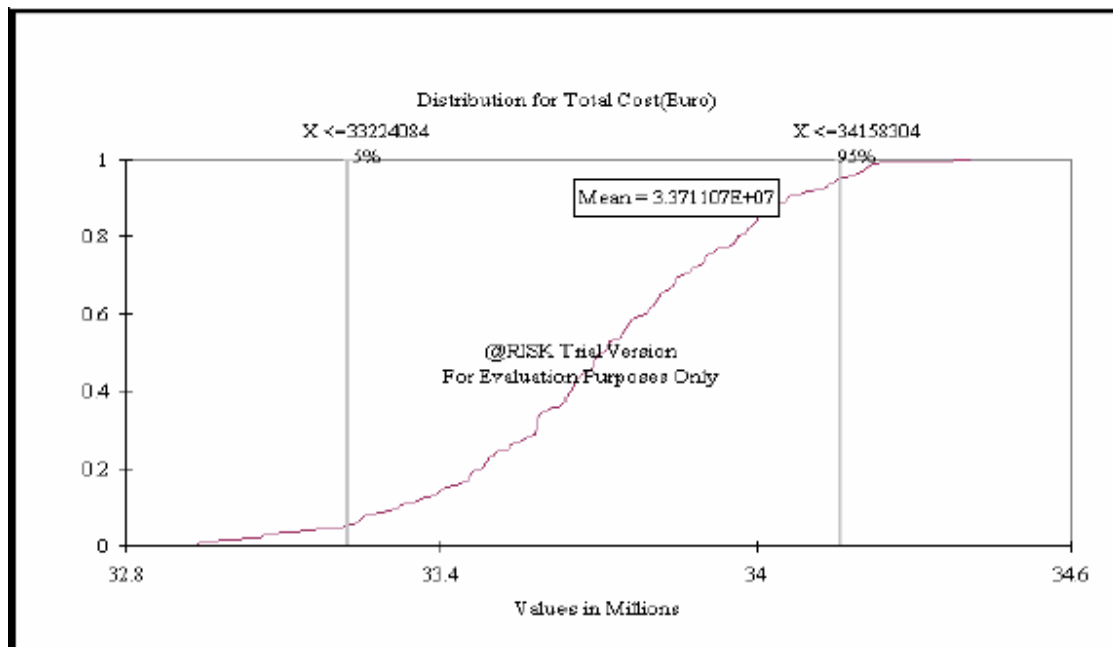


Figure 2.5: Results of simulation in form of cumulative graph (Arikan, 2005)

2.3.5.2 Project Risk Analysis Program (PRA)

This program was developed by Katmar software. It aims to enable the evaluation of risks on construction projects, and for the financial contingencies required to cover those risks. The procedure followed in this program encouraging discipline estimating, and will calculate the required contingency utilizing Monte Carlo simulation.

Figure 2.6 illustrates the data entry screen of the program, where the user enters the items description of the project, the likely cost, low cost, high cost, distribution function.

Item	Description	Likely Cost	Low Cost	High Cost	Dist	Exp Cost
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
Totals :						

Buttons: Add, Insert, Edit, Delete, ? Help, Close

Figure 2.6: The data entry screen of the Risk Analysis Program

Figure 2.7 illustrates the final project and the upper and lower limits of that cost. This screen also shows a brief summary of the basic statistics.

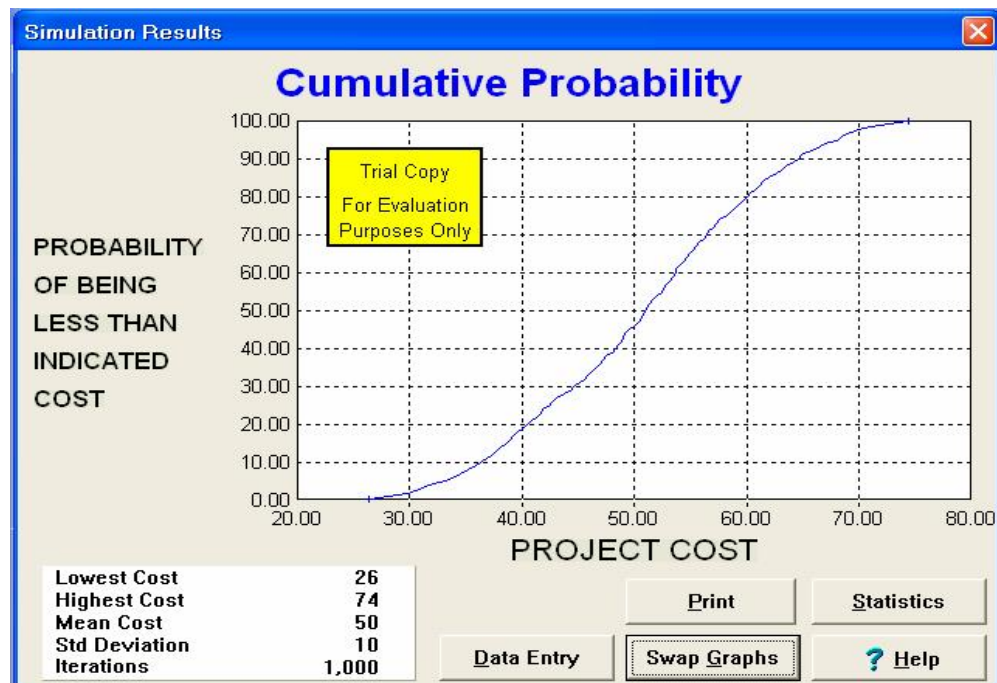


Figure 2.7: A typical "S" curve of overall cost distribution of Risk Analysis Program

2.4 Response Management Process

Response is an action or activity that is implemented to deal with a specific risk or combination of risks. Risk responses can be categorized into four different forms: acceptance, reduction, avoidance and transfer (Pipattanapiwong, 2004). The main aim of any response and mitigation strategy is to take a course of action in order to eliminate risks from a project or, at least, reduce their potential negative implications (Khalafallah, 2002).

(Maqousi, 2007) has mentioned ways that could be considered by contractors as preventive ways such as:

- Insuring against accidents.
- Increasing safety measures and tools.
- Assign the risk to the owner in the contract.
- Include allowance in tender for delay.
- Employ a designer engineer to review the design.
- Employ quantity surveyor.
- Assign the risk to the supplier.
- Subcontract parts of the work.
- Buy and store materials in advance.
- Have the company's bank accounts distributed in different currencies.
- Take the currency exchange rates into consideration in the pricing phase.
- Undertake early enquiries.
- Daily documentation of events with supervisor.
- Employ a high professional project manager.
- Employ highly skilled manpower.

Maqousi (2007) has also mentioned other steps that could be considered as mitigative ways such as:

- Increasing work hours.
- Increasing manpower.
- Increasing equipment.
- Provide alternative design.
- Increasing subcontract works as much as possible.
- Closer supervision to subordinates for minimizing abortive work.

2.4.1 Risk Avoidance

Risk avoidance means the rejection or change of an alternative to remove some hidden risks. For example, if a construction method is contingent on rain, the contractor could avoid schedule delay by adopting another construction method that will not be influenced by rain. (Wang et al, 2003). This strategy involves the elimination of the causes of risk. Risk avoidance may involve adopting alternative methods of construction, using the exemption clauses in the contract, or simply not bidding for the project. Risk avoidance approach should be addressed whenever the level of risk is high enough to render a project unfeasible (Khalafallah, 2002). Usta (2005) mentions that contractor can avoid the risk by many methods, which include the following:

- Do not bid on the project.
- Tender a very high bid.
- Place conditions on the bid.
- Do not bid on the high risk portion of the contract.

2.4.2 Risk Mitigation

This method is directed towards decreasing the contractor's potential exposure to risk. Risk reduction methods may sometimes require some initial investment which should then reduce the likelihood of the risk occurring. Risk reduction should be addressed whenever the level of risk is unacceptable and alternative action is available. Risk reduction invariably leads to greater confidence regarding the project's outcome (Khalafallah, 2002).

Wang et al (2003) mention that risk mitigation denotes reduction of the occurring probability or the expected losses of some potential risk.

2.4.3 Risk Retention

Risk acceptance or risk retention is the most common method to dealing with risk. Parties facing risks will not take any action to encounter with those risks if they employ this technique. This method of risk retention should be used when all the avenues for other risk response strategies are blocked (Khalafallah, 2002) or none of the other strategies is possible (Maqousi, 2007).

Risk retention includes two conditions: unplanned risk retention, where the manager does not take any action for some risk whether he or she is conscious of the risk or not; and planned risk retention, where the manager decides to take no action for some risk after cautious evaluation (Wang et al, 2003).

In this method, residual risks undergo a detailed quantitative analysis in order to allocate an appropriate level of contingency for their potential implications. This does not imply that these risks would by then be ignored and not monitored throughout the cycle of the project. In fact, they should be under the eye and control of management in order to ensure that they are contained within the contingency level (Khalafallah, 2002). Hok (2005) mentions that the contractor who has realized that all these risks are imposed upon him must prepare his bid by evaluating especially the risks related to design, unforeseeable events, site data and accuracy of employer's requirements.

2.4.4 Risk Transfer

Risk transfer means the switch of risk responsibility between contracting parties in a project (Usta, 2005). Through negotiation, the contractor can transfer risk to other parties such as the owner, subcontractors or suppliers. Commonly this can be achieved through a provision in a contract or a new contract placement. Transfer of risk comprises the passing of risks to those who are more capable of maintaining control and influencing the outcome of the risk (Khalafallah, 2002). Yet, what we usually think of as a transfer of risk is also a transfer of responsibility (Baker, 2002).

In construction practice, contractual transfers of risk are quite common (Pipattanapiwong, 2004). This can be achieved by adding specific clauses to the contract (Maqousi, 2007). Wang (2003) mentions that contractors usually use three risk transfer methods to relieve of risks and responsibilities. They are insurance, subcontracting and involvement of claims to the owner for financial losses or schedule delay.

Insurance is a frequently used method of handling risk for compensating the financial losses resulting from risk events. The majority of contractors rely upon insurance for the more serious loss exposures through the purchase of an insurance policy with certain deductibles. There are different insurance policies designed to cover loss or damage to contract works, construction plant and equipment, and construction machinery. They also provide cover for third party liability up to specific limit (Sobiei et al, 2005). By subcontracting, the contractor will transfer parts of the risks to the subcontractor. Contractual adjustments can involve claims to the owner for financial losses or schedule delay resulting from risk events. Most non-insurance risk

transfers are accomplished through provisions in contracts such as hold-harmless agreements and indemnity clauses or contractual adjustments (Usta, 2005).

2.5 Markup

In the construction industry, bidding is generally the most popular form for contractors to secure the right to provide services in a new job. Whether or not the bid price is reasonable is an important factor for the risk assessment of projects. Other conditions being similar, the reasonable of the bid price will lead to lower risk for contractor (Fang et al, 2004). Identifying the optimum markup for a job is an essential part of contractor's bid preparation. Markup is defined as the sum of contingencies and profit. Markup is usually calculated as percentage of the sum of overhead and direct costs for material, labor and equipment. Determining the markup size for a construction project is not an easy task. The complexity of this issue is magnified by many influencing factors and the uncertain potential outcomes of the decision (winning or losing the contract). Many uncertain and complex factors are involved in the early stage of bid preparation, such overall economy, competitiveness of other bidders, etc. Moreover, the relationship among the factors is dynamic and complex. Therefore, for a long time, markup estimation has been perceived as a kind of mysterious work, mainly based on the estimators' intuition and experience, with some specific rules and constraints applied (Liu et al, 2005).

2.6 Responsibilities and Liabilities

Liability is the legal concept of being subjected to the power of another or to a rule of law requiring something to be done or not done. Thus a person who contracts to sell goods is liable to deliver them and the buyer is liable to pay the price. Each is required by law to do something, and can be compelled by legal process at other's instant to do it. A person is said to be under a liability when he is, or at least may be, legally obliged to do so or suffer something. Thus, one may be said to be liable to perform, to pay, to be sued, to be imprisoned, or otherwise to some legal duty or legal consequences. Liability may arise either from voluntary act or by force of some rule of law. Thus, a person who enters into a contract thereby becomes liable to perform what he has undertaken, or to pay for the counterpart performance, or otherwise to implement his part of the contract. Whilst these two notations of responsibility and liability are expressed into two different words in English language, in other languages one may find them to be combined in one expression. The difference between the two concepts is that the obligation under the law,

for example, in the French language where the word "*responsibilite*" is used to mean legal responsibility (Bunni, 2005).

Responsibilities are those actions that should or should not be done by the contractor under the conditions of contract. The cost impact of those responsibilities is considered as deterministic, where they are not or negligibly, subjected to probabilistic functions. Paying for insurance, permits and licenses is an example of deterministic responsibilities that the contractor may bear under the conditions of contract (Bunni, 2005).

2.7 Risk Allocation in Contracts

Any construction project involves risk and there is no possibility to eliminate all the risks associated with a specific project. All that can be done is to regulate the risk allocated to different parties and then to properly manage the risk. This can be done through the language of the construction contract. Regarding risk allocation, the concept of "limitation of liability" dates back more than three hundred years, when the British Parliament declared, as part of Maritime Law, that a ship's owner should not bear greater liability than the value of the ship's hull (Zaghloul et al, 2002).

The contract terms and condition should clearly state the allocation of risks to the various parties. It is not sufficient to have vague conditions where it is unclear who is responsible and could lead to misunderstanding. Such misunderstanding could result in disputes or even project failure (Liu et al, 2005). There are two ways of agreeing the allocation of risks in formal contracts: negotiating detailed terms and conditions, or using a standard form (Tate, 2003).

2.7.1 Risk Allocation by Negotiation

Many construction contracts are based on industry-wide standards, either hastily modified and executed during a hurried tendering process or kept at arms length while works proceed on a letter of intent. Good practice demands open and frank negotiations about the allocation of risk. Many large clients and consultants make this kind of negotiation part of their standard practice (Hughes, 2006).

2.7.2 Risk Allocation by Standard Conditions of Contract

One measure of contract's efficiency and effectiveness is its ability to clearly assign risks between contracting parties. Clear risk assignment means that both contracting parties have the same understanding of risk appointment and risk management accountability. Contracting parties who do not have an identical understanding of risk accountability may mismanage a risk event by assuming the event or its consequences are not their responsibility, mismanaged events cause project inefficiencies and make contract relationship adversarial. The resulting impact on project execution ultimately increase project cost (Hartman et al, 1996).

The purpose of standard forms of contract is to facilitate the contractual arrangements between actors in a project. Standard forms of contract are readymade terms and conditions when making a contract. The standards vary from country to country and from one type of project to another (Andersson et al, 2002). The existence of a unified, standardized and fair contract such as FIDIC contract will contribute in improvement the construction industry and creating successful relations between the contract parties (Murtaja, 2007).

2.7.3 Risk Allocation by Contract Clauses

Construction is a process governed by complicated contracts and involving complex relationships in several tiers, and there are many risks involved in construction projects (Abdou, 1996). General conditions of contract clauses principally identify how the risks inherent in construction are apportioned between two parties to the contract, the employer and the contractor (Yogeswaran, 1997).

Usta (2005) assumes that the clarity in a contract can be achieved by:

- Using simple and commonly occurring language;
- Using identical phrases where possible;
- Excluding contract specific data so that there is no need to change, delete or add to the core conditions of contract;
- Setting out duties and responsibilities clearly and precisely, using engineering terminology common to all disciplines wherever possible;
- Not attempting to paraphrase existing law;

- Settling for clarity above fairness in minor matters which would involve complicated text; and
- Omitting matters which are more effectively covered in the technical specifications.

Normally, owners allocate risks through contract clauses (in bid document) before contract is awarded to contractor. Contractor cannot influence how owner allocates risks through these clauses. Therefore, contractor needs to understand his responsibility of risks in contract (Wang et al, 2003).

2.7.4 Contract Wording

When disputes between contracting parties are caused by different contract clause interpretation, a method frequently used to avoid future conflict is to revise the clause wording. The author of contract usually tightens up the words in an effort to more clearly allocate risk. Often this takes the form of an exculpatory clause to ensure that such a risk is clearly allocated to the contractor (Hartman et al, 1997).

It comes as no surprise that parties to a contract often include contract language designed to shift risk to the other party so that the bases for claims and disputes are eliminated. For example, making a contractor responsible for the impact of unanticipated site conditions may effectively preclude recovery of additional costs caused by such conditions. Similarly, contract dispute clauses can be drafted so that even the submission of a valid claim is made nearly impossible, a practice which actually encourages litigation. Such contract provisions, however, do not prevent disputes from occurring (Jannadia et al, 2000).

2.8 Standard Forms of Contract

Too often construction seeks to standardize relationships that are too complex and unique for all projects (Hughes, 2006). The general conditions are the legal standards that have been established to promote fair and objective contractual stipulations between all parties involved in construction projects. A primary benefit of using standardized general conditions is that the document has been prepared with the advice of legal counsel and experienced professionals. (Murtaja, 2007).

Contractors and employers often rely on Standard Terms and Conditions (STCs) to govern their relationship. No doubt, these are helpful instrument, but they should be used with awareness and

care. When STCs constitute a part of a contract, it is essential for the contracting parties to truly understand how they allocate costs and risks between the parties and what requirements they set for variation and communication of claims, notifications, etc. (Kavaleff et al, 2004). There are advantages and disadvantages to standardizing contract forms, but it seems that common practice in the construction industry favours their use as a matter of policy (Hughes et al, 1999).

There are obvious advantages to using detailed contract provisions based upon a standard form of contract which holds a reasonable balance between the requirements and interests of the parties concerned and in particular allocates fairly the risks and responsibilities between the contracting parties. The use of standard conditions of contract will not only facilitate the successful completion of a contract but will result in lower tender prices, as tenderers will be familiar with the conditions that will apply under the contract. This implies that they will not need to make financial provision for contract conditions with which they are not familiar and whose consequences they may have difficulty in assessing (Usta, 2005).

Standard form contracts offer a useful point of reference for those inside and outside the industry. Standard forms enable consistency of roles from one project to another. In this sense, the standard forms lay down the duties that can be expected from various professionals in the process. It is then easy to refer to the standard form for guidance about roles, duties and responsibilities. Those at the periphery of the industry benefit from the continuity provided by standard forms: insurers can connect their policies to clauses in a particular standard form; funders often relate to the process through their understanding of a particular standard form; accumulated judicial precedents related to particular standard forms help to develop an established view of contract practice. If there were no standard forms, people would be forced to think about roles and responsibilities at the outset of each project (Hughes, 2006).

It is necessary for contract conditions to be clearly written in terms of contract language, fairness of clauses and clear definition of roles and responsibilities of parties. Contracts are often prepared with emphasis on owner's rights and contractor's obligations (Ogunlana et al, 2000).

2.9 Federation Internationale Des Ingenieurs-Conseils (FIDIC)

FIDIC (Federation Internationale Des Ingenieurs-Conseils) is the French acronym for the international federation of associations of independent consulting engineers.

The FIDIC was originally founded in Ghent, Belgium in 1913 by the national associations of consulting engineers of Belgium, France, and Switzerland. Today, the FIDIC represents associations from approximately 60 countries around the world. The first edition of the FIDIC conditions of contract was published in 1957 and was based on the English domestic conditions from the English Institution of Civil Engineers (ICE). FIDIC conditions of contract became most widely used during the construction boom in oil producing countries following the significant increase of oil prices in 1973 (Lina, 1997). FIDIC conditions of contract are the most widely used international construction forms of contract in the world. FIDIC conditions of contract for construction are the standard conditions used for over 30% of civil works in the Middle East and almost all of the construction projects financed by the World Bank. The FIDIC conditions are also becoming the international “common law” of construction contracting (Seifert, 2005).

FIDIC has recognized that radical changes that are taking place not only in the engineering field but also in all other fields at the global level. The magnitude and rapidity of these changes require special attention and major changes in strategies and approaches from the consulting engineering firms (Tortajada, 2000). The main users of the standard are engineers and contractors working internationally. Among financiers that demand the FIDIC contract for their projects are the World Bank (WB), the Asian Development Bank (ADB) and different United Nations (UN) bodies (Andersson, 2002).

2.9.1 FIDIC Advantages

FIDIC contracts are concerned that they have traditionally been based on the principle of balanced risk sharing and have been widely accepted by the employer and contractor as reasonable compromise (Osinski, 2002). The general conditions were drafted on the principle that users would find it more convenient if any provisions which they did not wish to apply could simply be deleted or not invoked, than if additional text had to be written in the particular conditions. Therefore, some of the provisions contained in the general conditions might be inappropriate for an apparently typical contract. The basic concept was to provide maximum convenience for users, particularly for those who prepare the tender documents (Booen et al, 2001).

A further advantage of this standard form is the availability of commentaries and literature for less experienced users, as well as arbitration awards providing specific legal interpretations.

Commentaries can be useful in reducing the incidence of disputes after signing of the contract, because they will let the parties know how a certain contract clause would be interpreted by reasonable, independent person. Finally, as a result of the allocation of risks being standard, the contractor will be able to evaluate what risks he needs to include in his price and optimize his calculations at the tender stage (Osinski, 2002). Most international infrastructure projects use the standard contract conditions prepared by FIDIC (Firman, 2006).

FIDIC standard forms are widely used internationally, which should lead to contractor confidence and lower risk contingencies. The FIDIC forms have been adopted by organisations such as the European Commission, the World Bank, the Islamic Bank for Development and the Asian Development Bank (Allan, 2007).

2.9.2 FIDIC Disadvantages

FIDIC standard contract includes clauses dealing with the normal changes expected to occur in contract. Unfortunately, it is not so well adopted to cope with large number of changes. FIDIC assumes the project to be reasonably well defined prior to contract signature and that the contractor's unit prices remain valid during the contract. Clearly with so many changes, the contractor has easily been able to demonstrate that his original tender prices can no longer be valid and that new rates are required. The determination of new rates, which, following proposals from the contractor is carried out by the consultant engineer, is a difficult process that inevitably leads to disagreement and dispute. A second problem that arose in trying to implement the FIDIC contract when faced with such fundamental changes was that of contractor involvement in decisions relating to design and construction techniques. Under FIDIC, the contractor is expected to carry out the construction work in accordance with the drawings, specifications, planning etc as was presented to the contractor when he compiled his offer (Watson, 2001).

The wide usage and acceptance of the FIDIC contract is not, however, without its problems. In redrafting the FIDIC contract conditions to suit a certain project, very often, some clauses are biased against the contractor often if they are strictly applied. Where the negotiations are on a "take-it-or-leave-it" basis and these are not uncommon in international contracts where owners rely on their "strength" and advantage during negotiations, the consequences can be quite serious (Matter, 2001).

2.9.3 FIDIC 99

In 1999, FIDIC published the first edition of four new standard forms of contract:

2.9.3.1 The Red Book

The red book is used when the contract is of the measurement or bill of quantity contracts. In these types of contracts there is a separation of construction and design (Owen, 2003). This form of contracting goes back to the mid-nineteenth century and is widely used; however it is decreasing in popularity. This is because more and more lump sum contracts are being used where the risk is allocated to the contractor (Andersson, 2002).

The General Conditions of Contract (GCC), which are the core of the standard form, consist of twenty chapters that deal with the obligations, rights responsibilities and risk allocations of the parties concerning contract price/payment, quality and schedule, and the procedures for claim and dispute resolutions (Zhang et al, 2006). Conditions of contract for construction (Red Book) are recommended for building or engineering works designed by the employer or by his representative, the engineer. Under the usual arrangements for this type of contract, the contractor constructs the works in accordance with a design provided by the employer. However, the works may include some elements of contractor-designed civil, mechanical, electrical and/or construction works (FIDIC Conditions of contract for construction, 1999).

2.9.3.2 The Yellow Book

Conditions of contract for plant and design-build which are recommended for the provision of electrical and/or mechanical plant, and for the design and execution of building or engineering works. Under the usual arrangements for this type of contract, the contractor designs and provides, in accordance with the employer's equipments, plant and/or other works; which may include any combination of civil, mechanical, electrical and/or construction works (FIDIC Conditions of contract for construction, 1999).

In yellow book, valuation and payment based on lump sum with payment plan, but re-measurement possible (Jenkinson, 2002).

2.9.3.3 The Silver Book

The silver book is used when mainly private institutions finance a project and is an Engineer Procure Construct (EPC) project (Andersson, 2002). Conditions of contract for EPC/turnkey

projects which may be suitable for the provision on a turnkey basis of a process or power plant, of a factory or similar facility, or of an infrastructure project or other type of development, where (i) a higher degree of certainty of final price and time is required, and (ii) the contractor takes total responsibility for the design and execution of the project, with little involvement of the employer. Under the usual arrangements of turnkey projects, the contractor carries out all the Engineering, Procurement and Construction (EPC), providing a fully-equipped facility, ready for operation at the "turn of the key" (FIDIC conditions of contract for construction 1999).

Jenkinson (2002) has defined some Special Features of the Silver Book:

- Responsibility for design lies with contractor.
- Employer's requirements usually a 'performance specification' (functional basis).
- Contractor carries out all engineering, procurement, construction, ready for operation at the 'turn of a key'.
- No engineer - instead the employer
- Lump sum contract price (but adjustments in limited specified cases).
- Testing procedures to demonstrate achievement of specified end result.
- Contractor carries majority of risks, so employer pays more.
- Small number of tenderers with negotiation.
- Contractor is given freedom to use own methods.
- Has to prove reliability and performance.

2.9.3.4 The Green Book (Short Form of Contract)

Short form of contract which is recommended for building or engineering works of relatively small capital value. Depending on the type of work and the circumstances, this form may also be suitable for contracts of greater value, particularly for relatively simple or repetitive work or work of short duration. Under the usual arrangement for this type of contract, the contractor constructs the works in accordance with a design provided by the employer or by his representative (if any), but this form may also be suitable for contract which includes, or wholly comprises, contractor-designed civil, mechanical, electrical and/or construction works (FIDIC conditions of contract for construction 1999).

Jenkinson (2002) defines some special features of the green book:

- US\$ 500,000 and six months duration

- Simple and repetitive works
- All provisions necessary in 15 clauses
- Language uncomplicated and simple
- Incorporated in World Bank Standard Bidding Documents for Simple Works.
- Balanced risk sharing - no engineer
- Design by either party - all types of construction
- Payment on lump sum or any other basis.

2.9.4 FIDIC and Risk

Risks have been defined better in FIDIC conditions. FIDIC examines the relations between the employer and the contractor in more details. Most of the risks are charged by contractors in FIDIC construction contracts (Ugur et al, 2006). Risk analysis is becoming a frontline science in construction projects. Most of the risks are being placed upon contractors. Unfavorable ground conditions, strikes, weather conditions, shortages of labour and materials are now regularly allocated on the contract as a contractor's risk. The contractor should prepare proper planned risk management to accommodate his risk items which cannot be accurately predetermined in terms of time involvement, and also to provide time for correcting mistakes (Usta, 2005).

In general, the contractor accepts all the risks that are not specifically allocated to the employer. The employer's liabilities include what are known as special risks, which are described out in Clause 17.3. Murdoch (2003) claims that FIDIC holds the view that there should be a total limitation on the contractor's liabilities, which can be agreed at any level by the parties if they so wish, but otherwise will default to the contract price. An analysis of the risk allocations in FIDIC conditions of contract for construction reveals that, while a number of risk allocation principles are theoretically correct, more realistic considerations should be made of risk allocation in the construction contract, i.e. language clarity and the particular contextual construction culture (Zhang et al, 2006).

2.10 Contract General Conditions Used in the Palestinian Territories

The environment of construction in Palestine is abnormal as compared with world wide construction environments. The cause could be the extraordinary circumstances where the construction field has been consolidated, due to the occupation forces which have a strong effect on the Palestinian economy including construction field (Rustom, 2004).

Before the year 1994, the used general conditions were very concise and consist of technical, financial and administrative conditions. There were three types of general conditions in the Gaza Strip:

- a) General conditions which were used by the municipalities, in Arabic. These conditions were originally quoted from Israeli contracting system;
- b) General conditions that were used in the public works department which were originally quoted from Israeli contracting system (technical, legal and financial items) and;
- c) General conditions that were used by the United Nations Relief and Works Agency (UNRWA) in English.

After the year 1994, there were many relatively large scale projects which had been funded by international donors. Other types of general conditions had been introduced by international donors. This variety of general conditions creates a challenge and source of problems that face the local construction industry since these types of general conditions of contract do not frequently suit the special local circumstances of the Palestinian Territories. These problems are such as:

- Because of different sources of these conditions, many of the contractors were improperly pricing and tendering. This produces problems between the supervision and contractor during execution that lead to loss and delay in the project.
- Donors usually impose their own contract for a certain project, which frequently lead to increase in cost estimates and misinterpretation of the contract clauses during execution (Rustom, 2004).

In the Palestinian Territories still, there are many general conditions of construction contract used by different institutions (Murtaja, 2007). The FIDIC 87 contract is still used in the construction projects. The Palestinian National Authority (PNA) has recently adopted condition of contract for construction (FIDIC 99) to be a unified formal contract for construction projects. While, local project performance faces several contractual problems such as delays, litigation, and additional costs which are the consequences of disputes (Murtaja, 2007).

Murtaja (2007) has also summarized the standard contracts used in the Palestinian territories. Those include Palestinian Central Tendering Department (PCTD) contract, UNRWA Contract, United Nations Development Program (UNDP) contract, Palestinian Economic Council for Development And Reconstruction (PECDAR) contract, United States Agency for International

Development (USAID) contract, World Bank (WB) contract, European Union (EU) contract, Danish Project "Support the Municipal Development and Management" in the Gaza Middle Area (SMDM) contract.

Chapter Three

Research Methodology

3.1 Introduction

This chapter shows the data collection procedure adopted for this research. It also provides a broad view of the questionnaire design, target population, survey samples and evaluation of the computerized system. In the previous chapter, the conditions of contract for construction (FIDIC 99) clauses were analyzed. The clauses which have potential cost impact on contractor have been the core subject matter of the questionnaire.

3.2 Research Strategy

Research strategy can be defined as the way in which the research objectives can be questioned (Naoum, 1998). The first step of this research includes a comprehensive summary of literature review in order to support the survey methodology. The second step represents the analysis of conditions of contract for construction (FIDIC 99). This analysis focuses on extracting clauses which have potential cost impact on the contractor's project cost estimates.

The risk factors included in the FIDIC 99 clauses were extracted and structured in a way that enables the contractor to evaluate them easily. The risk factors were classified according to Panthi (2007) into five categories: construction related risks, performance related risks, contractual and legal risks, physical risks and political and social risks. The responsibility factors which have generally deterministic cost impact on the contractor have also been extracted and structured.

The third step of this research is the data collection. This step includes revising and prioritizing of cost impact factors which were implied from the clauses of conditions of contract for construction (FIDIC 99). It also includes investigating the local practice related to estimation of cost implications of contracts in the Gaza Strip. A questionnaire is used as a data collection tool. The fourth step of this research is to analyze the data collected by using MS Excel applications. The fifth step is to develop a system that calculates the cost impact of adopting conditions of contract for construction (FIDIC 99) on contractors of the Gaza Strip. The procedure followed in this system encourages disciplined estimation, and helps calculate the required contingency using the Monte Carlo simulation probabilistic technique.

The sixth step is to computerize the proposed system and have it user friendly. It sums up the cost of responsibility and risk factors and allows the contractor to use mitigation actions to reduce the cost impact of risk factors and then the system calculates the effect of mitigation actions along with the final cost impact.

The seventh step of the research is to evaluate the system. It is distributed to five local contractors who are classified first rank contractors according to Palestinian Contractors Union (PCU) and allows them to use the system and answer a questionnaire designed to evaluate the system. The feed back is considered to improve the quality of the system.

These steps satisfy the project objectives and collectively achieve the research aim as shown in Figure 3.1.

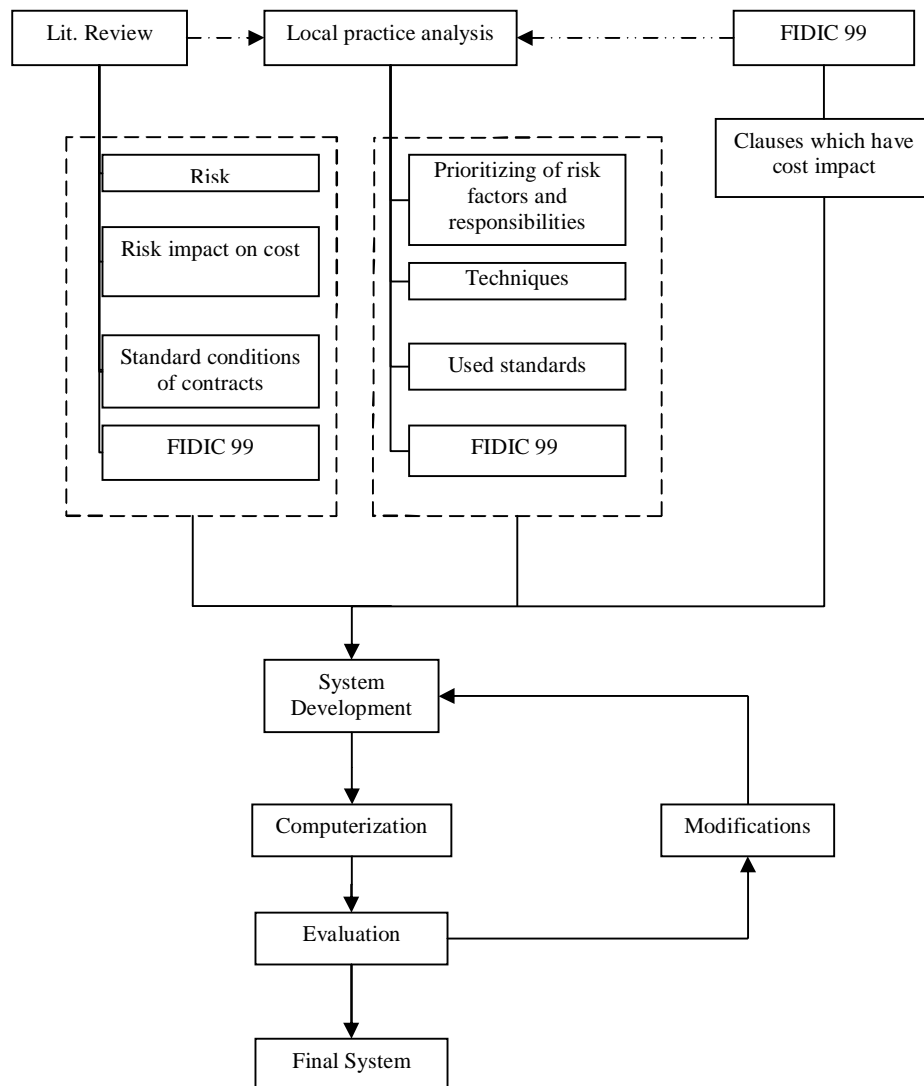


Figure 3.1: Methodology flow chart

3.3 Questionnaire Development

The questionnaire has been used as a tool to collect data which is directly related to this study. The questionnaire is probably the most widely used data collection technique for conducting surveys. It is most suited to surveys whose purpose is clear enough to be explained in a few paragraphs of print, in which the scheme of questions is not over-elaborated. Questionnaires have been widely used for descriptive and analytical surveys in order to find out facts, opinions and views of what is happening, who, where, how many and how much (Naoum, 1998).

The questionnaire was developed in Arabic language (Annex No. 2). An English version was also prepared (Annex No. 3) for documentation purposes.

3.4 Pilot Study

A pilot study was conducted to evaluate the questionnaire. A sample of 5 experienced persons was contacted to evaluate the questionnaire. Generally, it appeared that respondents had no difficulty to understand and can easily complete the questionnaire. Minor modifications to the questionnaire were carried out accordingly.

3.5 Questionnaire Design

To ensure obtaining a serious and meaningful response to the questionnaire, as many interviews as possible were conducted with respondents to explain the objectives of each part of the questionnaire to avoid any misunderstanding and to gain any relevant data regarding their answers.

The questionnaire consists of three parts as the following:

Part 1: Contractor's profile

The contractor profile part was designed to show the population properties in terms of types of executed projects, position of the respondent and the status of the contractor in the past 5 years. This part was mainly designed according to study of previous researches e.g. Maqousi (2007) and Murtaja (2007).

Part 2: Contracting general information

The contracting issues part was designed to show the respondent's perceiving the conditions of contract for construction (FIDIC 99), the history of contractor regarding to contracting conditions of contract and evaluating of the features of conditions of

contract for construction (FIDIC 99). This part was designed according to study of previous researches related to the subject, e.g. Khalafallah (2002) and Hughes (1996).

Part 3: Risk and responsibility factors

The third part of the questionnaire was designed to prioritize the risks and responsibilities implied from the conditions of contract for construction (FIDIC 99) on contractor's project cost estimation. This part was designed after studying and analyzing of the conditions of contract for construction (FIDIC 99) and extracting the cost impact clauses in terms of risks and responsibilities. Previous studies were conducted to support this part, e.g. Ugur (2006) and Zhang (2006).

3.6 Research Population

The population of this research includes contractors of Gaza Strip who are classified under the first (A and B) and second classes in the various types of work fields by the Palestinian Contractor's Union (PCU). The target group was the people who are involved in pricing and decision making processes within the contractor's companies.

3.7 Survey Samples

Seventy one copies of the questionnaire were distributed to local contractors with characteristics as mentioned in section 3.7. The distribution was based on a contractors classification list obtained from PCU and also based on the ability of the researcher to contact these contractors. Thirty two questionnaires were answered and received, which represents 45% response rate. No doubt that this rate is relatively low, but the abnormal political, social and financial situation and the siege on the Gaza Strip led to such a low response rate.

3.8 Limitations of the Research

Contractors classification of first (A and B) and second classes by the Palestinian Contractor Union (PCU) represent the population of this study. Other classes were excluded. The researcher focuses on having high quality and credibility answers which could only be obtained from experienced people. First and second classes contractors are assumed to satisfy this requirement.

3.9 Relative Importance Index

The respondents were asked, in the third part of the questionnaire, to express their judgment on the impact of adopting the conditions of contract for construction (FIDIC 99) in terms of responsibilities and risks on the project cost estimate.

Relative importance index is calculated in equation 3.1 according to Sampasivan (2007).

$$\text{Relative Importance Index (RII)} = \frac{\sum w}{AN} = \frac{5n1 + 4n2 + 3n3 + 2n4 + 1n5}{5N} \quad \dots \text{Equation 3.1}$$

Where w is the weight given to each factor by the respondent, $n1$ = number of respondents for the highest rank (very big), $n2$ = number of respondents for the answer of (Big), $n3$ = number of respondents for the answer of (medium), $n4$ = number of respondents for the answer of (small), and $n5$ = number of respondents for the answer (very small), (A) is the highest weight and (N) is the total number of respondents. The relative importance index range is from zero to one.

3.10 Developing and Evaluation of the Computerized System

Conditions of contract for construction (FIDIC 99) was officially adopted in the Palestinian territories. Under FIDIC 99, most of risks are charged by contractors (Ugur et al, 2006).

Most contractors estimate the impact of risks and responsibilities on their bid price manually in the absence of suitable tools for this purpose. This gives more credibility to the goal of this study to develop a computer-based system to help Palestinian contractors in better estimation and management of risks and responsibilities included in the conditions of contract for construction (FIDIC 99) for any given project.

The development process of the computerized system was based on some concluded ideas from literature review. The software was developed using Visual Basic Applications (VBA) in MS Excel. Many tests were conducted after and while developing of the system and discussed with the supervisor where some improvements were made accordingly.

Verification tests were carried out to ensure that the system is running correctly as shown in section 6.5.1. They include Antibugging, deterministic model, continuity testing and degeneracy testing. Model validation tests were also carried out to ensure that the system results are realistic and useful, as shown in section 6.5.2. These validation tests include expert intuition.

A structured questionnaire was also used to evaluate the system. The evaluation questionnaire was designed in Arabic language (Annex No.4). The questionnaire was designed in a way to enable the developer to get realistic feed back. The questionnaire consists of several questions. Some of these questions were designed as open questions in which the respondent can freely write down his comments and opinions.

For documentation purposes, the questionnaire was also developed in English language as shown in Annex No. 5.

Chapter Four

Review of Conditions of Contract for Construction (FIDIC 99)

4.1 Introduction

This chapter was mainly prepared to review the clauses included in the conditions of contract for construction (FIDIC 99). The clauses which have cost impact, from the contractor point of view, have been extracted and structured into two main categories:

- 1- Risk clauses (probabilistic cost impact).
- 2- Responsibilities clauses (almost deterministic cost impact).

In this chapter, the clauses which allocate risks on contractor are collected and structured in a way that enables the contractor to estimate the cost impact of these risks. The clauses which allocate responsibilities on the contractor are also collected and structured to enable the contractor to calculate the cost impact of these responsibilities. This enables the contractor to calculate the overall cost impact of risk and responsibility factors extracted from conditions of contract for construction (FIDIC 99). This will make the contractor aware of such cost impact at bid pricing phase.

4.2 Risk Clauses

All construction projects involve risks and there is no possibility to eliminate all the risks associated with a specific project. Management of risk requires identification and analysis of risk factors. Contracts are the grounds where risk allocation schemes between parties are settled and risk reward mechanisms are defined. Since contractors are usually unable to influence the contract conditions and clauses, they should understand which risks they are retaining under contract conditions. Thus, successful management of risks requires understanding of contract clauses and identification of risk factors (Usta, 2005).

It is important for the contractor to well understand the risks included in the conditions of contract for construction (FIDIC 99) and identify these risks. These risks should be precisely considered at cost estimation when pricing the bid.

4.2.1 Conditions of Contract for Construction (FIDIC 99) Survey for Risk Factors

The conditions of contract for construction (FIDIC 99) has been surveyed in order to locate and extract risk factors from the relevant clauses.

4.2.1.1 Chapter 1 (General provisions)

- **Clause 1.9 Delayed drawings or instructions**

"If and to the extent that the engineer's failure was caused by any error or delay by the contractor, including an error in, or delay in the submission of any of the contractor's documents, the contractor shall not be entitled to extension of time, cost or profit".

Under this clause, the contractor shall bear the consequences of the risk "Delayed drawings or instructions due to contractor's fault". These consequences may include planning errors, delay in approval, late approval of drawings, late payment, specifications and drawings inconsistencies and scheduling errors.

Implied risk:

§ Delayed drawings or instructions due to contractor's fault.

4.2.1.2 Chapter 2 (The employer)

- **Clause 2.1 Rights of access to the site**

"If and to the extent that the employer's failure was caused by any error or delay by the contractor, including an error in, or delay in the submission of any contractor's documents, the contractor shall not be entitled to such extension of time, cost or profit"

The typical risk which the contractor is liable for under this clause is "Employer failure to give right of access or possession of site" if this failure was caused by the contractor. When this failure occurs, the schedule starting point will be delayed, and hence the time schedule will be defected. The contractor bears the consequences of this risk which may include cost overrun due to schedule delay.

Implied risk:

§ Employer's failure (caused by contractor) to give right of access or possession of site.

4.2.1.3 Chapter 4 (The contractor)

- **Clause 4.1 Contractor's general obligations**

"The contractor shall provide contractor's personnel, goods, consumables and other things and services...The contractor shall be responsible for all contractors' documents, temporary works....., if the contract specifies that the contractor shall design any part of the permanent works, the contractor shall be responsible for this part"

Under sub-clause 4.1 the contractor shall bear all the consequences of the risks of unavailability of the required materials and equipment (Zhang, 2006). The contractor shall also bear the consequences of the risks of contractor's document loss or damage, temporary works loss or damage and permanent works designed by contractor failure.

Implied risks:

- § Non-availability of contractor's goods, consumables, etc.
- § Contractor's documents loss or damage;
- § Temporary works loss or damage;
- § Failure of permanent works designed by the contractor.

- **Clause 4.2 Performance security**

"The contractor shall ensure that the performance security is valid and enforceable until the contractor has executed and completed the works and remedial of defects. The employer shall not make a claim under the performance security except for: a) failure by contractor to extend the validity of the performance security, b) failure by the contractor to pay the employer an amount due, and c) failure by the contractor to remedy a default"

Under this clause, the contractor is subjected to liquefy the performance security as a result of contractor's failure to extend the validity of performance security, failure to pay the employer a due amount and failure to remedy a default.

Implied risks:

- § Failure to extend the validity of performance security;
- § Failure to pay the employer a due amount;
- § Failure to remedy a default;

- **Clause 4.4 Subcontractor**

"The contractor shall be responsible for the acts or defaults of the subcontractor, his agent or employees as if they were the acts or defaults of the contractor"

Zhang (2006) specifies the acts or defaults by the subcontractor as contractor's behavioural risk which could be implied from sub-clause 4.4.

The consequences of such risk may include unsatisfactory quality of subcontractor's skills, deficiency of supplier quality of materials and subcontractor's misact.

Implied risk:

- § Faults or misacts of the subcontractor;
- § Deficiency of suppliers.

- **Clause 4.7 Setting out**

"The contractor shall be responsible for the correct positioning of all parts of works and shall rectify any error in the positions, levels, dimensions or alignment of the works"

Under clause 4.7, the contractor shall bear the consequences of any error in the positions, levels, dimensions or alignments. These consequences may include demolishing and rework.

Implied risk:

§ Error in the positions, levels, dimensions or alignments.

- **Clause 4.8 Safety procedures**

"The contractor shall comply with all applicable safety regulations...."

Under clause 4.8, the contractor shall bear the consequences of his failure to comply with safety regulations. These consequences may include loss due to fire or accident, poor site safety and cost overrun.

Implied risk:

§ Failure to comply with safety regulations.

- **Clause 4.10 Site data**

"To the extent which was practicable (taking account of the cost and time), the contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the tender or works. To the same extent, the contractor shall be deemed to have inspected and examined the site, its surroundings...."

Under clause 4.10, the contractor shall bear the consequences of the risk "Miss of data" related to work execution. These consequences may include unforeseen ground conditions, subsurface problems and inefficient information to contractor for preparing bid.

Implied Risk:

§ Miss of site related data.

- **Clause 4.14 Avoidance of interference**

"The contractor shall not interfere unnecessarily or improperly with the convenience of the public or the access to and use and occupation of all roads...., the contractor shall indemnify and hold the employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference"

Extra cost in taking precautions to guarantee the convenience of the public is an obligation which the contractor bears under FIDIC 99.

Implied risk:

§ Improper interference in the convenience of the public.

- **Clause 4.16 Transport of goods**

"...the contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing, and protecting of all goods...., the contractor shall indemnify and hold the employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from transporting of goods and shall negotiate and pay all claims arising from their transport"

Under clause 4.16, Zhang (2006) specifies damages caused by transportation of goods as contractor's behavioural risk.

The Contractor is required to use all reasonable care and means to prevent damage to roads or bridges due to exceptional loads or intense traffic, whether the transported goods are materials, plant, contractor's equipment or temporary works (Usta, 2005).

Implied Risks:

§ Goods loss or damage during transportation;

§ Roads or bridges damage during transportation.

- **Clause 4.17 Contractor's equipment**

"The contractor shall be responsible for all contractors' equipment...."

Under clause 4.17, the contractor shall be responsible for the availability and protection of his equipment. The contractor shall bear the risk of his equipment loss or damage. Once the contractor equipment are resourced to a certain project, those equipment shall be exclusively intended for the execution of works in that project. The contractor is not entitled to remove any of his equipment without prior permission from the engineer.

Implied risks:

§ Contractor's equipment loss or damage.

- **Clause 4.18 Protection of environment**

"The contractor shall take all reasonable steps to protect the environment (both on and off the site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations"

Under clause 4.18, the contractor shall bear the risk of his failure to protect the environment. These consequences may include ecological damage, pollution and waste treatment.

Implied risk:

§ Failure to protect the environment.

- **Clause 4.20 Employer's equipment and free-materials**

"The contractor shall be responsible for each item of the employer's equipment whilst any of the contractor's personnel is operating it, driving it, directing it or in possession or control of it"

Under clause 4.20, the contractor shall bear the risk of employer's equipment loss or damage while under contractor's control.

Implied risks:

§ Employer's equipment loss or damage while under contractor's control.

- **Clause 4.22 Security of the site**

"The contractor shall be responsible for keeping unauthorized persons off the site"

Under clause 4.22, the contractor shall bear the consequences of the unauthorized entry to the site. These consequences may include property or equipment loss or damage owing to theft and threats from gangs.

Zhang (2006) mentions that clause 4.22 contains a risk of unauthorized entry as a third party behaviours risk which the contractor is responsible for.

Implied Risk

§ Unauthorized entry to the site.

- **Clause 4.24 Fossils**

"...the contractor shall take reasonable precautions to prevent contractor's personnel or other persons from removing or damaging any of these findings"

Under clause 4.24, the contractor is responsible to take care of fossils found and protect them from theft or damage. The contractor shall be liable for the consequences of fossils loss or damage. This may include work delay and claims.

Implied risk:

§ Fossils loss or damage.

4.2.1.4 Chapter 6 (Staff and Labour)

- **Clause 6.1 Engagement of Staff and Labour**

"...the contractor shall make arrangement for the engagement of all staff and labour..."

Under clause 6.1, the contractor shall make arrangements for the engagement of all staff and labour and for their payment. It can be inferred from such provision that the contractor shall bear the consequences of the risks of unavailability of required personnel (Zhang, 2006). These consequences may include delay and work interruption.

Implied Risk:

§ Non-availability of labour or personnel.

- **Clause 6.11 Disorderly Conduct**

"The contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the contractor's personnel"

Under clause 6.11, the contractor shall bear the risk of "Unlawful, riotous or disorderly conduct by contractor's personnel". The consequences of this risk may include labour strikes, lawlessness and fighting.

Implied risk

§ Unlawful, riotous or disorderly conduct by contractor's personnel.

4.2.1.5 Chapter 7 (Plant, Materials and Workmanship)

- **Clause 7.1 Manner of execution**

"The contractor shall carry out the manufacture of plant, the production and manufacture of materials and all other execution of the works: a) in the manner specified in the contract, b) in a proper workmanlike and careful manner, in accordance with recognized good practice, and c) with properly equipped facilities and non-hazardous materials"

Zhang (2006) mentions defects in materials, plant and workmanship as contractor's behavioural risk implied from clause 7.1. The consequences of this risk may include demolishing and rework.

Implied Risk

§ Defects in contractor's manufacturing or production.

- **Clause 7.4 Testing**

"...If these varied or additional tests show that tested plant, materials or workmanship is not in accordance with the contract, the cost of carrying out this variation shall be borne by the contractor..."

Under clause 7.4, the contractor shall bear the consequences of failure of the additional tests requested by the engineer. If this failure occurs, then the contractor shall be liable for the consequences of this risk which may include cost overrun and delay.

Implied risk:

§ Additional tests fail.

- **Clause 7.5 Rejection**

"If as a result of an examination, inspection, measurement or testing any plant, materials or workmanship is found to be defective or otherwise not in accordance with the contract, the engineer may reject the plant, materials or workmanship....,if the rejection and retesting cause the employer to incur additional costs, the contractor shall pay these costs to the employer"

Zhang (2006) specifies defects in materials, plant and workmanship as contractor's behavioural risk implied from clause 7.5. The contractor shall be liable for the consequences of rejection of plant, materials or workmanship. These consequences may include rework, delay and additional cost.

Implied risk:

§ Rejection of plant, materials or workmanship.

- **Clause 7.6 Remedial work**

"If the contractor fails to comply with the instructions, the employer shall be entitled to employ and pay other person to carry out the works....the contractor shall pay the employer all costs arising from this failure"

Contractor's failure to comply with engineer's instructions is a risk implied from the clause 7.6. The contractor shall bear the consequences which may include adverse attitude against the contractor and poor cooperation and coordination between the contracting parties.

Implied risk:

§ Failure to comply with engineer's instructions.

4.2.1.6 Chapter 8 (Commencement, Delays and Suspension)

- **Clause 8.4 Extension of time for completion**

"The contractor shall be entitled to an extension of time for completion by exceptionally adverse climatic conditions, unforeseeable shortages in the availability of personnel or goods caused by epidemic or governmental actions or any delay, impediment or prevention caused by or attributable to the employer"

Clause 8.4 specifies in express terms, that risks concerning the climatic conditions are shared between the employer and contractor, in that the employer shall allow an extension of time if adverse climatic conditions affect the contractor's construction progress. This also implies that the contractor shall bear relevant costs incurred by him due to such risk.

It is the contractor obligation to provide all contractor's personnel, goods, etc. and the contractor shall make arrangements for the engagement of all staff and labour (Zhang, 2006).

Implied Risks

§ Exceptional adverse climatic conditions;

§ Non-availability of personnel or goods caused by epidemic;

§ Non-availability of personnel or goods caused by governmental actions;

§ Delay, impediment or prevention caused by employer.

- **Clause 8.5 Delay caused by authorities**

"If the authorities delay or disrupt the contractor's work and the delay or disrupt was unforeseeable, then this delay will be considered as a cause of delay under paragraph (b) of clause 8.4"

Paragraph (b) of clause 8.4:

“A cause of delay giving an entitlement of extension of time”

Under clause 8.5, Zhang (2006) describes the delay caused by authorities as a risk caused by third party's behaviour. Despite of obtaining extension of time, the contractor shall not be entitled for cost recovery as a result of delay or disruption caused by authorities.

Implied Risk

§ Unforeseen disruption or delay by authorities

- **Clause 8.7 Delay damages**

"If the contractor fails to comply with clause 8.2 (time for completion), the contractor shall pay delay damages to the employer for this default"

Clause 8.2: "The contractor shall complete the whole of the works and each section within the time of completion for the works or sections including: i) achieving the passing of tests on completion and ii) complete all works which stated in the contract".

The contractor is obliged to pay the employer delay damages as a result of delay to pass tests on completion or delay to complete work stated in the contract.

Implied risks:

§ Delay to pass tests on completion;

§ Delay to complete works stated in the contract.

- **Clause 8.8 Suspension of work**

"The engineer may notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the contractor, the clauses 8.9, 8.10 and 8.11 shall not apply".

- *Clause 8.9* –Entitlement to extension of time.

- *Clause 8.10* – Entitlement to payment of the value of plant and/or materials which have been delivered to the site.

- *Clause 8.11* – Entitlement to give notice of termination.

Under clause 8.8, the contractor shall be liable for consequences of the work suspension if this suspension is a responsibility of the contractor. These consequences may include late payment, delay and cost of idle labour and equipment.

Implied risk:

§ Work suspension is a responsibility of the contractor.

- **Clause 8.9 Consequences of suspension**

"The contractor shall not be entitled to an extension of time for or to payment of the cost incurred in making good the consequences of contractor's faulty design, workmanship or materials or of the contractor's failure to protect, store or secure"

Under clause 8.9, the contractor shall bear the consequences of his failure to protect, store and secure works during suspension. These consequences may include works loss or damage during suspension.

Implied risks:

- § Contractor's design, workmanship or materials failure during suspension;
- § Failure to protect, store or secure works during suspension.

4.2.1.7 Chapter 9 (Tests on Completion)

- **Clause 9.2 Delayed tests**

"If the contractor fails to carry out the tests on completion within the period of 21 days, the employer's personnel may proceed with the tests at the risk and cost of contractor"

Under clause 9.2, the contractor shall bear the consequences of his failure to carry out tests on completion. These consequences may include contract termination, rights expropriation, tests failure and schedule delay.

Implied risk:

- § Failure to carry out tests on completion.

- **Clause 9.4 Failure to pass tests on completion**

"If the failure deprives the employer of substantially the whole benefit of the works or sections, reject the work or sections, the employer shall have same remedies as in subparagraph (C) of clause 11.4...., the contractor price shall be reduced by such amount as shall be appropriate to cover the reduced value to the employer as a result of this failure"

Subparagraph (C) of clause 11.4:

"...terminate the contract as whole..."

Implied risks:

- § Contract price reduction due to failure to pass tests on completion;
- § Contract termination by employer.

4.2.1.8 Chapter 11 (Defects Liability)

- **Clause 11.2 Cost of remedying defects**

"All works referred to subparagraph (b) of clause 11.1 shall be executed at the risk and cost of the contractor, if and to the extent that the work is attributable to a) any design for which the contractor is responsible, b) plant, materials or workmanship not being in accordance with the contract, or c) failure by the contractor to comply with any other obligation..."

Subparagraph (b) in clause 11.1:

"Execute all work required to remedy defects or damages, as may be notified by employer on or before the expiry date of the defects notification period for the works or section".

Implied risks:

§ Failure of contractor's design;

§ Plant, materials or workmanship not being in accordance with the contract.

- **Clause 11.4 Failure to remedy defects**

"If the contractor fails to remedy the defect or damage by this notified date and this remedial work was to be executed at the cost of the contractor, the employer may: a) carry out the work himself or by others in a reasonable manner and at the contractor's cost, but contractor shall pay the costs reasonably incurred by the employer in remedying the defect or damage, b) require the engineer to agree or determine a reasonable reduction in the contract price, or c) if the defect or damage deprives the employer of substantially the whole benefit of the works or any major parts of the works, terminate the contract as a whole"

Under clause 11.4, the contractor shall be liable for his failure to remedy defects by this notified date. The consequences of this risk may include contract price reduction, severe impact on reputation and contract termination.

Implied risk:

§ Failure to remedy a defect.

- **Clause 11.5 Removal of defective work**

"If the defect or damage cannot be remedied expeditiously on the site and the employer gives consent, the contractor may remove from the site for the purpose of repair such items of plant as are defective or damaged. This consent may require the contractor to increase the amount of the performance security by the full replacement cost of these items, or provide other appropriate security"

Under clause 11.5, if the defective work remedial is impossible on site, the contractor has to remove this work outside the site, but this requires the contractor to increase the amount of performance security or provide appropriate security.

Implied risk:

§ Increase the amount of performance security due to removal of defective works.

- **Clause 11.6 Further tests**

"If the work of remedying of any defect or damage may affect the performance of the works, the engineer may require the repetition of any of the tests described in the contract".

Under clause 11.6, the contractor shall bear the risks incurred with the repetition of tests after remedying of defects, the consequences of such risk may include tests failure and delays

Implied risk:

§ Repetition of tests after remedying of defects.

4.2.1.9 Chapter 13 Variations and Adjustments

- **Clause 13.1 Right to vary**

"The contractor shall execute and be bound by each variation"

Under clause 13.1, the contractor is bound to perform the variations. It is true that the contractor is compensated for costs incurred due to variations, but variations are still disturbing the contractor's work and cause delay to schedule.

Implied risk:

§ Work interruption due to variations.

4.2.1.10 Chapter 14 (Contract Price and Payments)

- **Clause 14.6 Issue of interim payment certificates**

"No amount will be certified or paid until the employer has received and approved the performance security"

As a result of performance security delay, the contractor may suffer from suspension of the issuing of interim payment certificate. Such suspension may results in contractor's inability to commit his obligations due to interruptions in his cash flow.

Implied risk:

§ Interim payment certificate with-held.

4.2.1.11 Chapter 15 (Termination by Employer)

- **Clause 15.2 Termination by employer**

"The employer shall be entitled to terminate the contract if the contractor a) fails to comply with clause 4.2, b) abandons the works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the contract, c) fails without a reasonable excuse to proceed with works"

As a result of contractor's failure to comply with responsibilities mentioned in clause 4.2 related to performance security, abandons the work or otherwise plainly demonstrates his intention not to continue performance of his obligations or fails without a reasonable

excuse to proceed with works, the contractor is subjected to contract termination by the employer.

Implied risk:

§ Contract termination by employer.

4.2.1.12 Chapter 17 (Risks and Responsibilities)

- **Clause 17.1 Indemnities**

"The contractor shall indemnify and hold harmless the employer, the employer's personnel and their respective agents against and from all claims, damages, losses and expenses in respect of a) bodily injury, sickness, disease or death of any person whatsoever arising out of or in the course of or by reason of the contractor's design, the execution and completion of the works and remedying of any defects, b) damage to or loss of any property, real or personal"

Under clause 17.1, the contractor shall bear all claims, damages, losses and expenses in respect to bodily injury, sickness or death of any involved person and damage or loss of any property which was defected or lost as a result of execution of works.

Implied risk:

§ Bodily injury, sickness, disease or death;

§ Property (real or personal) damage or loss during execution of works.

- **Clause 17.2 Contractor's care of work**

"The contractor shall take full responsibility for the care of the works and goods from the commencement date until the taking over certificate is issued,...if any loss or damage happens to the works, goods or contractor's documents during the period when the contractor is responsible for their care, the contractor shall rectify the loss or damage at the contractor's risk and cost"

From clause 17.2 Contractor's care of works, the contractor shall take the responsibility for the care of the works and the goods during the construction period and that the contractor shall rectify the loss or damage at his own cost and risk (Zhang, 2006).

Implied risk:

§ Contractor's document loss or damage;

§ Works or goods loss or damage.

- **Clause 17.5 Intellectual and industrial property rights**

"The contractor shall indemnify and hold the employer harmless against and from any other claims which arises out of or in relation to i) the manufacture, use, sale or import of any goods, or ii) any design for which the contractor is responsible"

Under clause 17.5, the contractor shall bear and hold harmless the employer against any claim arisen as a result of contractor's breach of law regarding to intellectual and industrial property rights.

Implied risk:

§ Infringement of intellectual and industrial property rights.

4.2.1.13 Chapter 19 (Force Majeure)

- **Clause 19.4 Consequences of force majeure**

"If the event or circumstance is of the kind described in subparagraph 1 to 4 of clause 19.1,....the contractor will be entitled to payment of any such cost"

The term of "unforeseeable conditions" which are of an ambiguous nature, blurs the division of risks between the employer and the contractor. It can be seen that the nature risks are basically shared by the two parties under FIDIC form.

The contractor takes most of the consequences, i.e. additional cost uncompensated and loss of profit with the employer taking the risk of extension of time as for "normally" adverse climatic and geological conditions, the contractor takes almost all the consequences except for that ones that are justified to be "reasonably unforeseeable" by the contractor by the date for the submission of the tender (Zhang, 2006).

Implied risk:

§ Natural catastrophes.

4.2.1.14 Chapter 20 (Claims, Disputes and Arbitration)

- **Clause 20.1 Contractor's claims**

"If the contractor fails to give notice of a claim within such period of 28 days, the time for the completion shall not be extended, the contractor shall not be entitled to additional payment and the employer shall be discharged from all liability in connection with the claim"

Under Clause 20.1, the Contractor must give notice of any claim, whether for time or money, not later than 28 days after the Contractor became aware, or should have become aware, of the circumstances giving rise to the claim. If he does not comply with this rule, he will not receive an extension of time, and he will not be entitled to additional payment, and the employer's discharged from all liability in connection with the claim (Frics, 2004). Under clause 20.1, the contractor shall bear the risk of his failure to give claim notice within the specified period (28 days). The consequences of such risk may include loss of extension of time and additional payment.

Implied risk:

§ Failure to give claim notice within 28 days.

- **Clause 20.3 Failure to agree dispute adjudication board**

"If any of the following conditions apply, namely: a) the parties fail to agree the appointment of the sole member of DAB, b) either party fails to nominate a member of the DAB, c) the parties fail to agree upon the appointment a third member, or d) the parties fail to agree upon the appointment of a replacement person, then the appointing entity appoints this member of DAB. This appointment shall be final and conclusive. Each party shall be responsible for paying one-half of the remuneration of the appointing entity"

Remuneration of the DAB is mutually agreed upon by the owner, the contractor, and the members of the board. If an agreement cannot be reached regarding remuneration of the DAB members, remuneration shall be consistent with the administrative and financial regulations of the International Center for Settlement of Investment Disputes. In most cases, the owner and the contractor (Seifert, 2005).

Implied risk:

§ Failure to appoint a member of DAB.

Table 4.1 shows the contractor's risks which are included in the conditions of contract for construction (FIDIC 99) with the reference clauses in which the risk could be implied.

Table 4.1: Conditions of contract for construction (FIDIC 99) risk clauses and their extracted risk factors

No.	Clause		Risk Factor
1	1.9	Delayed drawings or instructions	Delayed Drawings or instructions due to contractor's fault
2	2.1	Rights of access to the site	Employer's failure (caused by contractor) to give right of access or possession of site
3	4.1	Contractor's general obligations	Contractor's documents loss or damage
			Temporary works loss or damage
			Non-availability of goods, consumables, etc.
			Failure of permanent works designed by contractor
4	4.2	Performance security	Failure to remedy a default
			Failure to extend the validity of performance security
			Failure to pay the employer a due amount

Table 4.1 (Cont'd): Conditions of contract for construction (FIDIC 99) risk clauses and their extracted risk factors

No.	Clause		Risk factor
5	4.4	Subcontractors	Faults or mis-act of the subcontractor
			Deficiency of the suppliers
6	4.7	Setting out	Errors in the positions, levels, dimensions or alignments
7	4.8	Safety procedures	Failure to comply with safety regulations
8	4.10	Site data	Miss of site related data
9	4.14	Avoidance of interference	Interference in the convenience of public
10	4.16	Transport of goods	Goods loss or damage during transportation
			Roads or bridges Damage during transportation
11	4.17	Contractor's equipment	Contractor's equipment loss or damage
12	4.18	Protection of the environment	Failure to protect the environment
13	4.20	Employer's equipment and free materials	Employer's equipment loss or damage while under contractor's control
14	4.22	Security of the site	Unauthorized entry to site
15	4.24	Fossils	Fossils loss or damage.
16	6.1	Engagement of staff and labor	Non-availability of labor, personnel or equipment
17	6.11	Disorderly conduct	unlawful, riotous or disorderly conduct by contractor's personnel
18	7.1	Manner of execution	Defects in contractor's manufacturing or production
19	7.4	Testing	Additional tests fail
20	7.5	Rejection	Rejection of plant, materials or workmanship
21	7.6	Remedial work	Failure to comply with Engineer's instructions
22	8.4	Extension of time for completion	Exceptional adverse climatic conditions
			Non-availability of personnel or goods caused by epidemic
			Non-availability of personnel or goods caused by government actions
			Delay, impediment or prevention caused by the employer
23	8.5	Delay caused by authorities	Unforeseen disruption or delay by authorities
24	8.7	Delay Damages	Delay to pass tests on completion
			Delay to complete works stated in the contract
25	8.8	Suspension of work	Work suspension is a responsibility of contractor

Table 4.1 (Cont'd): Conditions of contract for construction (FIDIC 99) risk clauses and their extracted risk factors

No.	Clause		Risk factor
26	8.9	Consequences of suspension	Contractor's design, workmanship or materials failure during suspension
			Failure to protect, store or secure works during suspension
27	9.2	Delayed tests	Failure to carry out tests on completion
28	9.4	Failure to pass tests on completion	Contract price reduction due to failure to pass tests on completion
29	11.2	Cost of remedying defects	Failure of contractor's design
			Plant, material or workmanship not being in accordance with the contract
			Failure to comply with obligations
30	11.4	Failure to remedy defects	Failure to remedy defects
31	11.5	Removal of defective work	Increase the amount of performance security due to removal of defective works
32	11.6	Further Tests	Repetition of tests after remedying of defects
33	13.1	Right to vary	Work Interruption due to variations
34	14.6	Issue of interim payment certificates	Interim payment certificate with-held
35	15.2	Termination by employer	Contract termination by the employer
36	17.1	Indemnities	Bodily injuries, sickness, diseases or death
			Any property (real or personal) damage or loss
37	17.2	Contractor's care of work	Contractor's documents loss or damage
			Works or goods loss or damage
38	17.5	Intellectual and industrial property rights	Infringement of intellectual and industrial property rights
39	19.4	Consequences of force majeure	Natural catastrophes
40	20.1	Contractor's claims	Failure to give claim notice within 28 days
41	20.3	Failure to agree DAB	Failure to appoint a member of DAB

4.2.2 Risk Factors Classifications

The risks contained in the conditions of contract for construction (FIDIC 99) are classified according to Panthi (2007) into five groups as shown in Table 4.2:

1. Construction related risks.
2. Performance related risks.

3. Contractual and legal risks.
4. Physical risks.
5. Political and social.

This classification was used to give the contractor more flexibility to deal with conditions of contract for construction (FIDIC 99) risks. Each level of the contractor's company structure deals with corresponding risk class. Performance related risks could be identified and well understood by the site engineer, but political and social risks are usually dealt with by higher managerial level. Contractual and legal risks would be adopted by legal section and construction related and physical risks might be adopted by construction chief engineer or site manager.

Table 4.2: Categories of Risks (Panthi, 2007)

<p style="text-align: center;">Construction Related</p> <ul style="list-style-type: none"> • Changes in the work. • Construction delay. • Delay in site access. • Late drawing or instructions. • Availability of resources. • Damage to persons or property. • Defective design. • Cost of tests and samples. • Actual quantities of work. 	<p style="text-align: center;">Contractual and Legal</p> <ul style="list-style-type: none"> • Delayed dispute resolution. • Delayed payment on contract and extras. • Change order negotiation. • Insolvency of contractor or owner.
<p style="text-align: center;">. Political and Social</p> <ul style="list-style-type: none"> • Environmental issues. • Regulations (e.g. safety or labor law). • Public disorder. 	<p style="text-align: center;">Physical</p> <ul style="list-style-type: none"> • Subsurface conditions of geology. • Surface conditions of ground water. • Acts of god (earthquake, fire, etc.).
<p style="text-align: center;">Performance Related</p> <ul style="list-style-type: none"> • Productivity of labor. • Productivity of equipment. • Suitability of materials. • Defective work. • Conduct hindering performance of the work. • Labor disputes. • Accidents. 	

Having identified the risks which have cost impact, it was then necessary to approximate how much the influence each of these risks has on contractor's cost estimation.

Each risk clause is analyzed and risk factors extracted, the risk factors consolidate the base of the risk categorization into the above risk categories.

4.2.2.1 Construction Related Risks

The quality problems, poor productivity, changes, and delays are predictable, which suggests that they can be anticipated, but their magnitude and cost are very difficult to forecast (Smith, 1999). Construction related risk factors implied from the conditions of contract for construction (FIDIC 99) are listed in Table 4.3.

Table 4.3: Construction related risk clauses

No.	Clause		Risk factor
1	1.9	Delayed drawings or instructions	Delayed Drawings or instructions due to contractor's fault
2	2.1	Rights of access to the site	Employer's failure (caused by contractor) to give right of access or possession of site.
3	4.1	Contractor's general obligations	Contractor's documents loss or damage
			Temporary works loss or damage
			Failure of permanent works designed by contractor
4	4.2	Performance security	Failure to remedy a default
5	4.7	Setting out	Errors in the positions, levels, dimensions or alignments
6	4.16	Transport of goods	Goods loss or damage during suspension
			Roads or bridges Damage during suspension
7	4.17	Contractor's equipment	Contractor's equipment loss or damage
8	4.20	Employer's equipment and free materials	Employer's equipment loss or damage while under contractor's control
9	7.4	Testing	Additional tests fail
10	7.5	Rejection	Rejection of plant, materials or workmanship
11	8.4	Extension of time for completion	Delay, impediment or prevention caused by employer
12	8.7	Delay Damages	Delay to pass tests on completion
			Delay to complete works stated in the contract

Table 4.3 (Cont'd): Construction related risk clauses

No.	Clause		Risk factor
13	9.2	Delayed tests	Failure to carry out tests on completion
14	9.4	Failure to pass tests on completion	Contract price reduction due to failure to pass tests on completion
15	11.2	Cost of remedying defects	Failure of contractor's design
16	11.5	Removal of defective work	Increase the amount of performance security due to removal of defective work
17	11.6	Further Tests	Repetition of tests after remedying of defects
18	13.1	Right to vary	Work Interruption due to variations
19	17.2	Contractor's care of work	Contractor's documents loss or damage

4.2.2.2 Performance Related Risks

Performance related risks are those risks which could occur while executing the works by people involved in the project. This results from mistakes or misact by the people, equipment, machines, etc. The performance related risks including labor, material and equipment, scope of work defining, coordination with subcontractors, resources management, information and communication. Contractor's performance related risk factors implied from conditions of contract for construction (FIDIC 99) are listed in Table 4.4.

Table 4.4: Performance related risk clauses

No.	Clause		Risk factor
1	4.4	Subcontractors	Faults or mis-act of the subcontractor
			Deficiency of the suppliers
2	4.8	Safety procedures	Failure to comply with safety procedures
3	6.11	Disorderly conduct	unlawful, riotous or disorderly conduct by contractor's personnel
4	7.1	Manner of execution	Defects in contractor's manufacturing or production
5	7.6	Remedial work	Failure to comply with Engineer's instructions

Table 4.4 (Cont'd): Performance related risk clauses

No.	Clause		Risk factor
6	8.9	Consequences of suspension	Contractor's design, workmanship or materials failure during suspension
			Failure to protect, store or secure works during suspension
7	11.2	Cost of remedying defects	Plant, material or workmanship not being in accordance with the contract
			Failure to comply with obligations
8	11.4	Failure to remedy defects	Failure to remedy defects
9	14.6	Issue of interim payment certificates	Interim payment certificate with-held
10	17.1	Indemnities	Bodily injuries, sickness, diseases or death
			Property (real or personal) damage or loss
11	17.2	Contractor's care of work	Works or goods loss or damage

4.2.2.3 Contractual and Legal Risks

Contractor's contractual and legal risk factors implied from the conditions of contract for construction (FIDIC 99) are listed in Table 4.5.

Table 4.5: Contractual and legal risk clauses

No.	Clause		Risk factor
1	4.1	Contractor's general obligations	Non-availability of goods, consumables, etc.
2	4.2	Performance security	Failure to extend the validity of performance security
			Failure to pay the employer a due amount
3	6.1	Engagement of staff and labour	Non-availability of labour, personnel or equipment
4	8.8	Suspension of work	Work suspension is a responsibility of contractor
5	15.2	Termination by employer	Contract termination by the employer
6	20.1	Contractor's claims	Failure to give claim notice within 28 days
7	20.3	Failure to agree DAB	Failure to appoint a member of DAB

4.2.2.4 Physical Risks

Force Majeure Risk describes the circumstances beyond a project developer's or government's control such as natural disasters, war, hostilities, embargo, import or export restrictions (Wang, 1999). Contractor's physical risk factors implied from conditions of contract for construction (FIDIC 99) are listed in Table 4.6.

Table 4.6: Physical risk clauses

No.	Clause		Risk factor
1	4.10	Site data	Miss of site related data
2	4.24	Fossils	Fossils loss or damage
3	8.4	Extension of time for completion	Adverse climatic conditions
4	19.4	Consequences of force majeure	Natural catastrophes

4.2.2.5 Political and Social Risks

Political risks are external to the project and unpredictable in frequency and magnitude. The management method recommended is usually a contingency (Smith, 1999). Political risk has become a big issue after the second intifada and many companies have lost significant amounts of money and some have even filed bankruptcy. Contractor's political risk factors implied from conditions of contract for construction (FIDIC 99) are listed in Table 4.7.

Table 4.7: Political and social risk clauses

No	Clause		Risk factor
1	4.14	Avoidance of interference	Interference in the convenience of public
2	4.18	Protection of the environment	Failure to protect the environment
3	4.22	Security of the site	Unauthorized entry to the site
4	8.4	Extension of time for completion	Non-availability of goods or personnel caused by epidemic
			Non-availability of goods or personnel caused by government actions
5	8.5	Delay caused by authorities	Unforeseen disruption or delay by authorities
6	17.5	Intellectual and industrial property rights	Infringement of intellectual and industrial property rights

4.2.3 Consequences

The main categories of consequences of risk factors implied from conditions of contract for construction (FIDIC 99) clauses are shown in Figure 4.1:

1. Additional cost.
2. Additional time.
3. Additional work.
4. Claims.

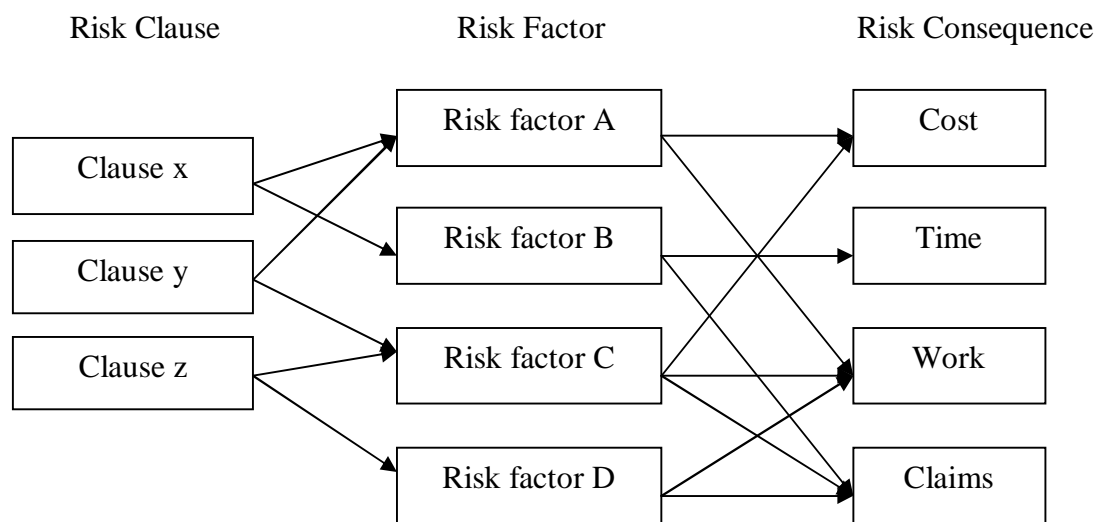


Figure 4.1: Extracted risk factors consequences

Maqousi (2007) summarizes the consequences of risk into 9 categories:

1. Work delay.
2. Equipment damage.
3. Injuries.
4. Poor productivity.
5. Legal disputes.
6. Financial penalties.
7. Increasing of material price.
8. Increasing of material waste.
9. Rework.

Maqousi (2007) risk consequences could be classified as shown in Table 4.8.

Table 4.8: Risk consequences classifications according to Maqousi 2007

No.	Risk consequences	Additional Cost	Additional Time	Additional Work	Claims
1	Work delay		√		
2	Equipment damage	√			
3	Injuries				√
4	Poor productivity	√	√	√	
5	Legal disputes				√
6	Financial penalties				√
7	Increasing of material price	√			
8	Increasing of material waste	√			
9	Rework			√	

Appendix 1 shows the classification of contractor's risk under conditions of contract for construction (FIDIC 99) along with the risk consequences.

4.3 Responsibility Clauses

The conditions of contract for construction (FIDIC 99) have been analyzed in order to find out the impact of the clauses on contractor's cost estimation. The almost deterministic cost items that were implied from conditions of contract for construction (FIDIC 99) clauses are extracted and structured as shown in Table 4.9. The contractor calculates the cost impact of those responsibilities and adds this cost to the total cost estimation. Under FIDIC 99, the contractor has to provide services and take actions to guarantee smooth and effective flow of work and eliminate obstacles.

Table 4.9: Conditions of contract for construction (FIDIC 99) clauses which have deterministic cost impact on contractor

No.	Responsibility Clause		Responsibility Factor
1	1.8	Care and supply of documents	Provide 6 copies of contractor's documents.
2	4.1	Contractor's general obligations	Provide the plants, consumables and services.
3	4.2	Performance security	Obtain performance security.
4	4.6	Cooperation	Use the contractor's equipment.
			Use of contractor's temporary works.
			Use of access arrangement.

Table 4.9 (Cont'd): Conditions of contract for construction (FIDIC 99) clauses which have deterministic cost impact on contractor

No.	Responsibility Clause		Responsibility Factor
5	4.8	Safety procedures	Comply with all applicable safety regulations.
			Take care of the safety of all persons.
			Keep the site and works clear of unnecessary obstructions.
			Provide fencing, lighting, guarding, watching of the works.
			Provide temporary works for work execution.
			Provide temporary works for protection of public, owner and occupiers of adjacent lands
6	4.13	Rights of way and facilities	Cost and charges for special and/or temporary right-of-way.
			Obtain additional facilities outside the site.
7	4.15	Access routes	Maintenance required for access routes.
			Provide necessary signs and directions.
			Obtain permissions to use routes, signs and directions.
			Cost due to non-suitability or non-availability of access routes.
8	4.16	Transport of goods	Packing, loading, transporting, receiving, unloading, storing and protection of goods
9	4.19	Electricity, water and gas	Supply electricity, water, gas and other services.
10	4.23	Contractor's operations on site	Keep the site and works clear of unnecessary obstructions.
11	6.1	Engagement of staff and labor	Payment, housing, feeding and transporting of contractor's staff.
12	6.2	Rates of wages and conditions of labor	Staff rates and wages not lower than wages and conditions at local market.
14	6.4	Labor laws	Comply with labor law.
15	6.6	Facilities for staff and labor	Provide necessary accommodation and welfare facilities for contractor's and employer's staff.

Table 4.9 (Cont'd): Conditions of contract for construction (FIDIC 99) clauses which have deterministic cost impact on contractor

No.	Responsibility Clause		Responsibility Factor
16	6.7	Health and safety	Take reasonable precautions to maintain the health and safety of contractor's staff.
			Provide medical staff and first aid.
			Provide sick bay and ambulance services.
			Appointment of accident prevention officer.
17	7.2	samples	Provide standard samples.
18	7.4	Testing	Provide testing apparatus, assistance, electricity, equipment, fuel, consumables, instruments, materials, and qualified staff.
19	7.8	Royalties	Pay for natural materials obtained from outside the site.
			Disposal of materials from demolition, excavation or surplus.
20	11.11	Clearance of site	Remove the remaining contractor's equipment, surplus materials, rubbish and temporary works.
21	14.1	The contract price	Obtain necessary permits
22	14.2	Advance payment	Provide advance payment guarantee.
23	18.2	Insurance for work and contractor's equipment	Provide insurance for works and contractor's equipment.
24	18.3	Insurance against injury to persons and damage to property	Provide insurance against persons injury and property damage.
25	18.4	Insurance for contractor's personnel	Provide insurance against sickness, disease or death of any of the contractor's personnel.

4.3.1 Categories of Responsibility factors

The responsibilities which the contractor bears under conditions of contract for construction (FIDIC99) are divided into two main categories:

4.3.1.1 TO PROVIDE: these are the responsibilities in which the contractor provides products or services, and those are divided into the subcategories of staff welfare, services and contractual as shown in Table 4.10.

- a- Staff welfare: The most important factor in the construction industry is the human factor, so conditions of contract for construction (FIDIC 99) obliges the contractor to take care of the labor involved in the project according to local standards.
- b- Security, safety and services: Logistic services are vital for execution of work on site. The contractor bears the security responsibility in the site, and shall protect the people from injury, riot or violence and properties from damage or loss.
- c- Contractual: for smooth running of work and elimination of any contradiction in responsibilities and liabilities among the project parties, some contractual responsibilities are allocated on the contractor.

4.3.1.2 TO DO: When studying conditions of contract for construction (FIDIC 99) thoroughly, it is implied that the contractor has to take some action or avoid taking some actions which eventually lead to smooth work execution throughout the project life cycle.

The responsibilities that the contractor shall do according to conditions of contract for construction (FIDIC 99) are listed in Table 4.11.

Table 4.10: The items that should be provided by the contractor according to FIDIC 99

TO PROVIDE		
Staff welfare	Security, safety, and services	Contractual
Housing	Electricity	Necessary permits
Feeding	Water	6 copies of contractor's documents
Transporting	Gas	Plant, consumables and services
Wages not lower than local market	Natural materials	Performance security
Health	Fencing	Contractor's representative
Safety	Lighting	Temporary works for work execution
Immigration	Guarding and watching	Additional facilities outside the site
Accommodation and welfare for employer's staff	Temporary works to protect public, owner and occupiers of adjacent lands	Standard samples

Table 4.10 (Cont'd): The items that should be provided by the contractor according to FIDIC 99

Staff welfare	Security, safety, and services	Contractual
Legal rights	Maintenance required for access routes	Testing arrangements
Medical staff and first aid	Necessary signs and directions	Advance payment guarantee
Sick pay and ambulance services	Permissions to use routes, signs and directions	Insurance for works and contractor's equipment
	Accident prevention officer	Insurance against persons injury and property damage
		Insurance for contractor's personnel

Table 4.11: The items that should be performed by the contractor according to FIDIC 99

TO DO
Allow to use contractor's equipment
Allow to use contractor's temporary works
Allow to use access arrangement
Comply with all applicable safety regulations
Take care of the safety of persons
Keep the site and works clear of unnecessary obstructions
Avoid interference with convenience of public
Packing, loading, transporting, receiving, unloading, storing and protecting of goods
Contractor's equipment deemed exclusively intended for execution of works
Take all steps to protect the environment
Store and dispose of contractor's equipment or surplus materials
Keep the site clean and safe
Collaborate with local health authorities
Employ qualified, skilled and experienced staff
Properly dispose of materials from demolition, excavation or surplus
Comply with labor law (employment)

4.4 Conclusion

This chapter was mainly prepared to review conditions of contract for construction (FIDIC 99) in order to extract the cost factors which the contractor bears under FIDIC 99. Thirty nine responsibility factors were extracted from different clauses of FIDIC 99. Those responsibility factors were divided into two groups, “To provide” and “To do”. “To provide” group was subdivided into subgroups of “Staff welfare”, “security, safety and services” and “Contractual”. Fifty four risk factors were also extracted. Those factors were categorized as “Construction related”, “Performance related”, “Contractual and legal”, “Physical” and “Political and social”.

These extracted factors are to be evaluated by local contractors in order to revise and prioritize them. Afterwards these factors are to represent the cost factors which the researcher uses in system development.

Chapter Five

Results Analysis and Discussions

5.1 Introduction

The field survey was conducted in the Gaza Strip. The purpose of this survey is to prioritize the risk and responsibility factors which are implied from the conditions of contract for construction (FIDIC 99), and to study the contractor's evaluation of FIDIC 99 as well as their practice regarding to this topic. Another important purpose of this survey is to enable the respondents to add, modify or delete any illustrated responsibility or risk factor.

5.2 Questionnaire part 1: Contractor Organization Profile

The contractor profile part was designed to show the population properties in terms of position of the respondent, executed projects, experience of the contractor's organization and the status of the contractor in the past 5 years.

5.2.1 Position of the Respondent

It is shown in Table 5.1 that 56.9% of the respondents were directors, 28.1% were deputy directors, and 25% were project managers. None of the respondents was a site engineer.

Table 5.1: Position of respondents

Position of the respondents	Frequency	Percentage %
Director	15	56.9
Deputy Director	9	28.1
Project Manager	8	25
Site Engineer	0	0
Total	32	100

5.2.2 Experience of the Organization in Construction Industry

Table 5.2 shows that 37.5% of the respondent's organizations have 6 to 10 years of experience in the construction industry in the Gaza Strip and 62.5% of them have more than 10 years of experience.

It is observed that all the respondents have more than 5 years of experience in the construction industry and the majority of them have more than 10 years of experience. This is because the target group was the contractors whom are classified in the first and second classes according to Palestinian Contractors Union (PCU) requirements.

Table 5.2: Experience of the organization in construction industry

Experience of the organization	Frequency	Percentage %
Less than 3 years	0	0
3 to 5 years	0	0
6 to 10 years	12	37.5
More than 10 years	20	62.5
Total	32	100.0

5.2.3 Type of Executed Project

Table 5.3 shows that 90.6% of responding companies dealt with building projects, 75% built roads projects, 75% executed water and sewage projects while only 15.6% of companies built industrial projects. This result reflects the involvement of the respondents in the construction business in the Gaza Strip.

Table 5.3: Types of executed projects

Type of executed project	Frequency	Percentage %
Buildings	29	90.6
Roads	25	75
Water and sewage systems	25	75
Industrial	5	15.6

5.2.4 Number of Projects Executed in the Last 5 Years

Table 5.4 shows that in the last 5 years, 37.5% of the companies executed 5 projects or less, 37.5% executed 6 to 10 projects, 18.8% executed 11 to 20 projects and 6.3% of respondents executed more than 20 projects.

It is obvious that the majority of contractors executed less than 10 projects in the last five years.

Table 5.4: Number of projects executed in the last 5 years

Number of projects executed in the last 5 years	Frequency	Percentage %
5 and less	12	37.5
6 to 10	12	37.5
11 to 20	6	18.8
more than 20	2	6.3
Total	32	100.0

5.2.5 Work Monetary Volume in the Last 5 Years

Table 5.5 shows that in the last 5 years, 18.8% of the companies executed projects with monetary volume of \$0.5 million or less, 25% executed projects with monetary volume of \$0.6 to \$1 million, 28.1% executed projects with monetary volume of \$1.1 to \$5 million, 18.8% executed projects with monetary volume of \$5.1 to \$10 million and 9.5% of responding companies executed projects with monetary volume of more than \$10 million.

Table 5.5: Work monetary volume in the last 5 years

Work monetary volume in the last 5 years	Frequency	Percentage %
0.5 million dollars and less	6	18.8
0.6 to 1 million dollars	8	25
1.1 to 5 million dollars	9	28.1
5.1 to 10 million dollars	6	18.8
More than 10 million dollars	3	9.5
Total	32	100.0

It is observed that the majority of projects executed in the last 5 years in the Gaza Strip were of small size. This result was also observed by Maqousi (2007).

5.3 Questionnaire part 2: Contracting General Information

The contracting issues part was designed to show the extent of perceiving the conditions of contracts for construction FIDIC 99, the history of contractor regarding to contracting and evaluating of the features of conditions of contract for construction (FIDIC 99).

5.3.1 Using a Formalized Technique for Estimating Cost Contingencies

This survey reveals that minority of respondents are using a formalized technique for estimating contingencies when preparing tenders. Only 15.6% of respondents mentioned that their companies use formalized techniques for estimating contingencies.

This result shows that the local contractors rely on their experience in cost estimation process, usually one man experience, particularly when estimating the contingencies and cost impact of risks associated with a specific project. Moreover, most of local contracting companies are considered as sole proprietorship companies, where the owner of the company is the main decision taker.

5.3.2 Use of Computer Tools to Deal with Unforeseen Liabilities and Risks

This survey also reveals that 78.1% of respondents do not use computer tools to deal with liabilities and risks associated with the construction projects, because the local contractors do not have suitable software or computerized tools to be used in this issue. There is no commitment to employ an experienced person or team to deal with liabilities and risks. Maqousi (2007) also obtained similar results.

5.3.3 Use of Special Tools to Calculate the Cost Impact of Adopting Conditions of Contract for Construction (FIDIC 99)

This survey reveals that the majority of respondents (93.8%) do not have any tool to calculate the impact of adoption of conditions of contract for construction (FIDIC 99). Conditions of contract for construction (FIDIC 99) was recently ratified by the Palestinian cabinet, so a special tool is required to deal with liabilities and risks associated with the FIDIC 99 for future construction works.

5.3.4 Standard Contract that have been Used by the Responding Companies

Table 5.6 shows that UNRWA and UNDP forms of contract are the most used contracts by local contractors, because the UNRWA and the UNDP are the major employers in the Gaza Strip construction business. SMDM form of contract is the least used contract by local contractors.

Table 5.6: Standard contracts that have been used

Standard form of contracts	Frequency	Percentage %
FIDIC 87 Form of Contract	9	28.1
FIDIC 99 Form of Contract	12	37.5
UNRWA Form of Contract	21	65.6
UNDP Form of Contract	21	65.6
PECDAR Form of Contract	18	56.3
World Bank Form of Contract	12	37.5
European Union Form of Contract	9	28.1
SMDM Form of Contract	3	9.4
Ministry of Public Works Form of Contract	18	56.3
Palestinian Water Authority Form of Contract	15	46.9
Others	5	15.6

It is also observed that 37.5% of respondents mentioned that they have used FIDIC 99 forms of contracts before. It is well known that conditions of contract for construction (FIDIC 99) was officially introduced to Palestinian construction industry in October 2006, accordingly this result could be explained by that some respondents used other forms of contract which are mainly based on conditions of contract for construction (FIDIC 99) such as World Bank form of contract and UNDP form of contract. Those respondents might assume that they have used FIDIC 99 form of contract and answered accordingly.

5.3.5 Number of Projects in which FIDIC 99 has been used as Standard Conditions of Contract

The respondents were asked to show the number of executed projects in which the FIDIC 99 was used as standard conditions of contract. It is shown in Table 5.7 that 81.3% of respondents used FIDIC 99 as standard conditions of contract 5 time or less, while 9.5% used FIDIC 99 for 6 to 10 times and 9.5% of respondents used FIDIC 99 for more than 10 times.

The conditions of contract for construction (FIDIC 99) have been ratified by the Palestinian cabinet in October 2006 which means that it is newly adopted as Palestinian unified conditions of contract for construction and even, through this period, the number of projects

executed in the Gaza Strip was very limited. It seems that the respondents who mentioned that they executed projects under FIDIC 99 got confused. They may assume that the contracts which are based on FIDIC 99 are typically FIDIC 99 forms of contract.

Table 5.7: Number of projects executed under FIDIC 99

Number of projects	Frequency	Percentage %
0 to 5	26	81.3
6 to 10	3	9.5
more than 10	3	9.5

5.3.6 Usual Responses for the Unforeseen Liabilities and Risks

Table 5.8 shows that the responding companies used to transfer their risks to insuring companies, while some of them used to mitigate or avoid the risks and none used to keep the risks.

Table 5.8: Responses for the unforeseen liabilities and risks

Response	Frequency	Percentage %
Avoidance	10	31.2
Transfer	26	81.2
Mitigation	15	56.9
Retention	0	0

This result shows that the contractors have their own strategy to deal with unforeseen liabilities and risks. This result coincides with the result of question 2.7 of this part. Local contractors used to mitigate their risks or transfer them to insuring companies. It is observed that none of the respondents used to keep the risk. The adoption of risk acceptance may be conscious or unconscious. Conscious risk retention takes place when the risk is perceived and not transferred or reduced. On the other hand, when risk is not recognized, unconscious risk is retained. Risk is involuntarily retained when it is unconscious risk and also it cannot be avoided, transferred, or reduced (Pipattanapiwong, 2004).

No doubt that all risks can not be avoided, transferred, or mitigated. It was observed that there is no systematic technique for calculating and managing the risks and responsibilities

used by contractors of the Gaza Strip. Accordingly risks are unconsciously retained, so the respondents abstained from voting for the risk retention strategy.

5.3.7 Use of Mitigation Actions to Mitigate Risks and Responsibilities

Table 5.9 shows that "Insurance against accidents" is the most mitigation action used by respondents. The contractors of the Gaza Strip prefer to transfer their risks to a third party, so they resort to transfer the risk to insuring companies. "Improve the quantity and quality of the staff" is the second prominent mitigation action used by respondents.

"Buy and store material" was ranked as third mitigation action used by respondents. This mitigation action should be used intensively in the Gaza Strip due to borders closures, accordingly, contractors could protect themselves against construction materials shortage which is the most prominent factor that affects the performance of the project (Alnajjar, 2008) and hence acts as the most prominent risk against the contractor (Maqousi, 2007). The main obstacle which faces implementation of this action is the shortage of cash in the contractor's hands at the early stage of the project.

It should also be mentioned that "increase work hours" has a low rank in the mitigation actions ranking. The contractors always avoid paying any extra for the overtime, so the contractors try not to extend the working hours.

"Assign the risk to the suppliers" is the least mitigation action used by respondents. The suppliers in the Gaza Strip are usually not involved as main players in the projects. They provide materials according to specifications provided by the contractor without holding any responsibility except those related to the specifications of the materials.

Table 5.9: The used mitigation actions

No.	Statement	Usually	Often	Sometimes	Seldom	Never	RII	Rank
a	Insurance against accidents	23	6	2	1	0	0.92	1
b	Increase safety measures and tools	11	10	8	2	1	0.78	4
c	Buy and store material	9	15	7	1	0	0.80	3
d	Increase working hours	3	10	10	7	2	0.63	9

Table 5.9 (Cont'd): The used mitigation actions

No.	Statement	Usually	Often	Sometimes	Seldom	Never	RII	Rank
e	Increase subcontract works as much as possible	5	10	9	5	3	0.66	8
f	Closer supervision to subordinates	5	12	11	4	0	0.71	6
g	Assign the risk to the suppliers	2	5	9	10	6	0.52	10
h	Improve the quantity and quality of the staff	16	9	6	1	0	0.85	2
i	Increase the quantity of equipments	8	13	7	3	1	0.75	5
j	Include time allowance	7	10	8	5	2	0.69	7

5.3.8 The Advantages of the Conditions of Contract for Construction (FIDIC 99)

Table 5.10 shows that "Adopting of Dispute Adjudication Board (DAB) instead of courts" is the most appreciated feature of the conditions of contract for construction (FIDIC 99) and "FIDIC 99 discouraging disputes and maintaining positive relationship between parties" is the second advantage of the conditions of contract for construction (FIDIC 99).

It is obvious that conditions of contract for construction (FIDIC 99) meets the desire of contractors to eliminate the disputes, and also this result reflects the need of local contractors to such DAB to solve the disputes. It also reflects that the local contractors are suffering from disputes, because other forms of contracts were unfair against the contractors regarding to disputes (Murtaja, 2007).

Respondents ranked "Reasonably balanced and fair" and "FIDIC 99 allocates liability precisely" as third and fourth advantages of conditions of contract for construction (FIDIC 99). Conditions of contract for construction (FIDIC 99) is generally known as being well balanced because both parties bear parts of the risks arising from the project (Pipattanapiwong, 2004).

Respondents also think that "FIDIC 99 easy to understand" and "Standardized" are also good features of the conditions of contract for construction (FIDIC 99). FIDIC general conditions of contract are intended to be used unchanged for every project. The Particular conditions are prepared for the particular project taking account of any changes or additional clauses to suit the local and project requirements (Owen, 2003).

Table 5.10: The advantages of the conditions of contract for construction (FIDIC 99)

No.	Statement	Strongly agree	Agree	I don't know	Disagree	Strongly disagree	RII	Rank
a	Easy to understand	10	14	6	1	1	0.79	5
b	Non applicable provisions could be simply deleted	8	7	9	6	2	0.68	8
c	Availability of commentaries and literature	5	9	12	6	0	0.68	8
d	Availability of specific legal interpretations	10	6	10	6	0	0.73	7
e	Standardized	9	11	10	2	0	0.77	6
f	Reasonably balanced and fair	10	14	7	1	0	0.81	3
g	Allocates liabilities precisely	8	16	8	0	0	0.80	4
h	Discouraging disputes and maintaining positive relationship between parties	12	12	8	0	0	0.83	2
i	Adopting of Dispute Adjudication Board instead of courts	14	12	6	0	0	0.85	1

5.3.9 The Disadvantages of the Conditions of Contract for Construction (FIDIC 99)

Table 5.11 shows that "Assumes that project is well defined prior to contract signature" is the most disadvantage of the FIDIC 99. Conditions of contract for construction (Red Book) is recommended for building or engineering works designed by the employer or by his representative, the engineer. Under the usual arrangements for this type of contract, the contractor constructs the works in accordance with a design provided by the employer. "Not well adopted to cope with large number of changes" is the second disadvantage of the FIDIC 99. Unfortunately FIDIC 99 is not so well adapted to cope with the large number of changes that have arisen (Watson, 2001).

The respondents ranked "Presence of some biased clauses against contractor" as the third disadvantage of the FIDIC 99. Some clauses are biased against the contractor often to the point of injustice if they are strictly applied. Where the negotiations are on a "take-it-or-leave-it" basis and these are not uncommon in contracts where owners rely on their "strength" and advantage during negotiations, the consequences can be quite serious (Matter, 2001).

Respondents also think that "Low contractor involvement in decisions related to design" is a disadvantage of the conditions of contract for construction (FIDIC 99). Under FIDIC 99, the contractor is expected to carry out the construction work in accordance with the drawings, specifications, planning, etc as was presented to the contractor when he compiled his offer (Watson, 2001).

Table 5.11: The disadvantages of conditions of contract for construction (FIDIC 99)

No.	Statement	Strongly agree	Agree	I don't know	Disagree	Strongly disagree	RII	Rank
a	Not well adopted to cope with large number of changes	11	9	6	4	2	0.74	2
b	Assumes that project is well defined prior to contract signature	12	12	4	2	2	0.79	1
c	Assumes unit prices remain valid	6	10	8	5	3	0.67	4
d	Low contractor involvement in decisions related to design	7	9	7	5	4	0.66	5
e	Presence of some biased clauses against contractor	9	9	7	4	3	0.71	3
f	Not applicable in Gaza Strip	3	4	13	10	2	0.58	6

5.4 The third part: Responsibility and Risk Factors

The third part of the questionnaire was designed to prioritize the responsibilities and risks extracted from the conditions of contracts for construction (FIDIC 99) on contractor's cost estimation.

5.4.1 Responsibility Factors

In this part, the respondents were asked to show the impact of the responsibility factors implied from the conditions of contract for construction (FIDIC 99). The responsibility factors were then prioritized according to respondent's answers.

Table 5.12 shows that the respondents have ranked insurance as the most important factor that they should consider when pricing a bid, "Insurance against persons injury and property damage" implied from clause 18.3 had the first rank with RII equals to 0.83, while "Insurance against sickness, disease or death of any of contractor's personnel" implied from

clause 18.5 and "insurance for works and contractor's equipment" implied form clause 18.2 had the second and third ranks with RII equal to 0.79 and 0.78 respectively. This result shows that the local contractors used to transfer risks to an insuring company. This result matches the result of question number 7 of the second part in which insurance was the most favorable mitigation action used by contractors.

The conditions of contract for construction (FIDIC 99) assigns the responsibility of complying with safety regulations to the contractor. Commitment to safety regulations requires the contractor to provide safety apparatus and tools, safety signs, appoint safety officer and promote safety culture among the employees and even everybody involved.

"Comply with all applicable safety regulations" was ranked as the fourth serious responsibility which the contractor bears under the conditions of contract for construction (FIDIC 99) with RII equals to 0.77.

The conditions of contract for construction (FIDIC 99) makes the contractor responsible for keeping the site clean from any unnecessary obstructions, rubbish, temporary works, equipments or surplus materials. The responsibility is continuous along the lifetime of the project and if the contractor does not comply with this responsibility, the contractor will be exposed to penalties. So there is no way to escape this responsibility, while keeping the site clean and clear from such obstructions is a costly task. Due to that, respondents ranked this responsibility "Keep the site and works clear of unnecessary obstructions, rubbish, temporary works, equipments or surplus materials" as the fourth serious responsibility factor of the conditions of contract for construction (FIDIC 99) with RII equals to 0.77. It could also be observed that the conditions of contracts for construction (FIDIC 99) mentioned such responsibility in many clauses e.g. 5.8, 5.23 and 11.11.

"Provide advanced payment guarantee" was also ranked in the fourth position. It is well known that advanced payment is very important for the contractor, which enables him to implement his commitments and proceed the work. It is mentioned in the conditions of contract for construction (FIDIC 99) that the contractor has to provide advanced payment guarantee, otherwise, he shall not be owed to obtain the advanced payment.

"Provide testing apparatus, assistance, electricity, equipment, fuel, consumables, instruments, materials, and qualified staff" was ranked in the seventh position under the conditions of contract for construction (FIDIC 99) with RII equals to 0.74. It is known that the testing of works is a responsibility of the contractor, so the contractor is to provide all testing auxiliaries such as apparatus, consumables, electricity, laboratories, etc.

Table 5.12: Responsibility factors ranking

No.	Responsibility Factors	Clause	Cost Impact					RII	Rank
			V. Big	Big	Medium	Weak	V. Weak		
1	Provide 6 copies of contractor's documents.	1.8	3	5	10	9	5	0.55	35
2	Provide the plants, consumables and services.	5.1	4	7	9	10	2	0.61	22
3	Obtain performance security.	5.2	9	8	10	4	1	0.73	8
4	Use of the contractor's equipment.	5.6	4	7	12	7	2	0.63	18
5	Use of contractor's temporary works.	5.6	5	7	8	11	1	0.63	18
6	Use of access arrangement.	5.6	6	4	5	14	3	0.58	29
7	Comply with all applicable safety regulations.	5.8	12	9	5	6	0	0.77	4
8	Take care of the safety of all persons.	5.8	8	9	5	5	5	0.66	15
9	Keep the site and works clear of unnecessary obstructions, rubbish, temporary works, equipments or surplus materials	5.8 5.23 11.11	13	10	3	3	3	0.77	4
10	Provide fencing, lighting, guarding, watching of the works.	5.8	5	7	9	9	2	0.63	18
11	Provide temporary works for work execution.	5.8	5	5	9	10	3	0.59	27
12	Provide temporary works for protection of public, owner and occupiers of adjacent lands	5.8	10	8	9	2	3	0.73	8
13	Cost and charges for special and/or temporary right-of-way.	5.13	0	5	18	5	4	0.55	35
14	Obtain additional facilities outside the site.	5.13	2	5	11	12	2	0.56	33
15	Maintenance required for access routes.	5.15	3	13	9	5	2	0.66	15
16	Provide necessary signs and directions.	5.15	0	6	12	14	0	0.55	35
17	Obtain permissions to use routes, signs and directions.	5.15	1	8	10	11	2	0.57	32

Table 5.12 (Cont'd): Responsibility factors ranking

No.	Responsibility Factors	Clause	Cost Impact					RII	Rank
			V. Big	Big	Medium	Weak	V. Weak		
18	Cost due to non-suitability or non-availability of access routes.	5.15	8	9	9	4	2	0.71	11
19	Packing, loading, transporting, receiving, unloading, storing and protection of goods	5.16	3	5	10	10	4	0.56	33
20	Supply electricity, water, gas and other services.	5.19	2	4	18	7	1	0.59	27
21	Payment, housing, feeding and transporting of contractor's staff.	6.1	4	8	8	10	2	0.61	22
22	Staff rates and wages not lower than wages and conditions at local market.	6.2	0	10	14	7	1	0.61	22
23	Comply with labour law.	6.5	5	5	10	10	2	0.61	22
24	Provide necessary accommodation and welfare facilities for contractor's and employer's staff.	6.6	1	7	20	4	0	0.63	18
25	Take reasonable precautions to maintain the health and safety of contractor's staff.	6.7	5	6	18	2	1	0.68	14
26	Provide sick bay, ambulance services and first aid.	6.7	0	7	24	1	0	0.64	17
27	Appointment of accident prevention officer.	6.7	6	10	11	2	3	0.69	12
28	Provide standard samples.	7.2	9	8	8	3	4	0.69	12
29	Provide testing apparatus, assistance, electricity, equipment, fuel, consumables, instruments, materials, and qualified staff.	7.5	6	12	12	2	0	0.74	7
30	Pay for natural materials obtained from outside the site.	7.8	4	15	10	2	1	0.72	10
31	Disposal of materials from demolition, excavation or surplus.	7.8	4	5	6	17	0	0.58	29

Table 5.12 (Cont'd): Responsibility factors ranking

No.	Responsibility Factors	Clause	Cost Impact					RII	Rank
			V. Big	Big	Medium	Weak	V. Weak		
32	Remove the remaining contractor's equipment, surplus materials, rubbish and temporary works.	11.11	5	4	7	14	2	0.58	29
33	Obtain necessary permits	15.1	5	7	8	7	5	0.60	26
34	Provide advance payment guarantee.	15.2	7	14	10	1	0	0.77	4
35	Provide insurance for works and contractor's equipment.	18.2	9	15	5	2	0	0.78	3
36	Provide insurance against persons injury and property damage.	18.3	15	12	2	0	3	0.83	1
37	Provide insurance against sickness, disease or death of any of contractor's personnel.	18.5	11	13	5	1	2	0.79	2

5.4.2 Risk Factors

In this section, the researcher has adopted two approaches in order to prioritize the contractor's risk factors extracted from the conditions of contract for construction (FIDIC 99). Those two approaches are based on the probability of risk occurrence and the cost impact of that risk as shown in Table 5.13.

Table 5.13: Risk factors ranking

No.	Risk factor	Clause	Probability							Cost Impact						
			V. Big	Big	Medium	Weak	v. Weak	RII	Rank	V. Big	Big	Medium	Weak	V. Weak	RII	Rank
1	Delayed Drawings or instructions due to contractor's fault	1.9	7	11	10	2	2	0.72	9	8	9	9	5	1	0.71	11
2	Employer's failure (caused by contractor) to give right of access or possession of site	2.1	5	8	12	5	2	0.66	15	9	6	6	6	5	0.65	23
3	Contractor's documents loss or damage	5.1 17.2	2	5	14	5	6	0.55	33	3	4	6	12	7	0.50	52
4	Temporary works loss or damage	5.1	10	9	8	5	0	0.75	7	3	4	11	11	3	0.56	43
5	Non-availability of goods, consumables, etc.	5.1	12	13	6	1	0	0.83	1	15	10	6	1	0	0.84	2
6	Failure of contractor's designed works	5.1 11.2	4	8	7	11	2	0.61	18	5	6	10	7	4	0.61	30
7	Failure to extend the validity of performance security	5.2	2	7	8	15	0	0.58	25	6	10	7	5	4	0.66	20
8	Failure to pay the employer a due amount	5.2	1	8	11	12	0	0.59	22	1	6	10	10	5	0.53	49
9	Faults or mis-act of the subcontractor	5.5	5	9	12	5	1	0.68	11	6	10	5	9	2	0.66	20
10	Errors in the positions, levels, dimensions or alignments	5.7	5	11	10	2	4	0.67	13	11	7	7	5	2	0.73	8
11	Failure of safety precautions	5.8	3	5	15	4	5	0.58	25	3	7	11	9	2	0.60	35

Table 5.13 (Cont'd): Risk factors ranking

No.	Risk factor	Clause	Probability							Cost Impact						
			V. Big	Big	Medium	Weak	v. Weak	RII	Rank	V. Big	Big	Medium	Weak	V. Weak	RII	Rank
12	Miss of site related data	4.10	4	8	8	10	2	0.61	18	8	8	7	8	1	0.69	15
13	Interference in the convenience of public	5.15	5	11	10	6	0	0.69	10	0	2	13	17	0	0.51	51
14	Goods loss or damage during transportation	5.16	2	4	6	18	2	0.51	44	5	5	9	11	2	0.60	35
15	Roads or bridges Damage during transportation	5.16	3	5	8	16	0	0.57	30	2	4	12	12	2	0.55	45
16	Contractor's equipment loss or damage	5.17	10	9	6	7	0	0.74	8	8	10	5	9	0	0.71	11
17	Deficiency of the suppliers	4.4	0	4	12	14	2	0.51	44	3	7	11	9	2	0.60	35
18	Failure to protect the environment	5.18	2	6	3	16	5	0.50	51	2	9	3	15	3	0.55	45
19	Employer's equipment loss or damage while under contractor's control	5.2	4	5	8	10	4	0.55	33	3	7	12	5	5	0.59	39
20	Unauthorized entry to site	5.22	5	7	7	10	3	0.61	18	0	6	7	19	0	0.52	50
21	Fossils loss or damage.	5.25	2	5	13	7	5	0.55	33	2	9	8	10	3	0.58	41
22	Non-availability of labor, personnel or equipment	6.1	2	5	5	15	5	0.50	55	6	8	8	5	5	0.63	27

Table 5.13 (Cont'd): Risk factors ranking

No.	Risk factor	Clause	Probability							Cost Impact						
			V. Big	Big	Medium	Weak	v. Weak	RII	Rank	V. Big	Big	Medium	Weak	V. Weak	RII	Rank
23	Unlawful, riotous or disorderly conduct by contractor's personnel	6.11	4	3	6	12	7	0.51	44	1	7	9	12	3	0.54	48
24	Defects in contractor's manufacturing or production	7.1	3	4	8	10	7	0.51	44	3	8	9	11	1	0.61	30
25	Additional tests fail	7.5	1	8	10	10	3	0.56	32	10	6	7	5	4	0.68	17
26	Rejection of plant, materials or workmanship	7.5	4	11	10	7	0	0.68	11	7	12	6	5	2	0.71	11
27	Failure to comply with engineer's instructions	7.6	1	5	9	12	5	0.51	44	16	5	4	4	3	0.77	6
28	Exceptional adverse climatic conditions	8.5	0	7	14	11	0	0.58	25	5	6	9	9	3	0.61	30
29	Non-availability of personnel or goods caused by epidemic	8.5	2	5	10	8	7	0.52	42	2	2	7	20	1	0.50	52
30	Non-availability of personnel or goods caused by government actions	8.5	4	3	8	10	8	0.53	39	4	5	9	11	3	0.58	41
31	Delay, impediment or prevention caused by the employer	8.5	11	11	6	3	1	0.78	4	11	10	7	4	0	0.78	5
32	Unforeseen disruption or delay by authorities	8.5	6	8	12	3	3	0.67	13	7	13	9	2	1	0.74	7
33	Delay to pass tests on completion	8.7	4	9	5	10	4	0.59	22	4	8	14	3	3	0.64	24
34	Delay to complete works stated in the contract	8.7	12	10	9	1	0	0.81	2	8	11	7	5	1	0.73	8

Table 5.13 (Cont'd): Risk factors ranking

No.	Risk factor	Clause	Probability							Cost Impact						
			V. Big	Big	Medium	Weak	v. Weak	RII	Rank	V. Big	Big	Medium	Weak	V. Weak	RII	Rank
35	Work suspension is a responsibility of contractor	8.8	1	7	9	10	5	0.53	39	12	6	5	7	2	0.72	10
36	Contractor's design, workmanship or materials failure during suspension	8.9	7	14	9	1	1	0.76	6	2	12	10	8	1	0.66	20
37	Failure to protect, store or secure works during suspension	8.9	2	4	12	11	3	0.54	38	5	7	12	6	2	0.64	24
38	Failure to carry out tests on completion	9.2	0	6	6	20	0	0.51	44	1	8	9	11	3	0.56	43
39	Contract price reduction due to failure to pass tests on completion	9.5	2	8	9	10	3	0.58	25	3	6	14	7	2	0.61	30
40	Plant, material or workmanship not being in accordance with the contract	11.2	4	5	11	9	3	0.59	22	6	5	8	10	3	0.61	30
41	Failure to comply with obligations	11.2	3	8	6	13	2	0.58	25	2	8	9	12	1	0.59	39
42	Failure to remedy defects	5.2 11.5	4	7	6	7	8	0.55	33	5	4	11	10	2	0.60	35
43	Increase the amount of performance security due to removal of defective work	11.5	6	10	3	4	9	0.60	21	2	7	16	7	0	0.63	27
44	Repetition of tests after remedying of defects	11.6	5	9	10	4	4	0.64	17	5	9	7	8	3	0.63	27
45	Work Interruption due to variations	13.1	8	18	3	3	0	0.79	3	12	16	4	0	0	0.85	1

Table 5.13 (Cont'd): Risk factors ranking

No.	Risk factor	Clause	Probability							Cost Impact						
			V. Big	Big	Medium	Weak	v. Weak	RII	Rank	V. Big	Big	Medium	Weak	V. Weak	RII	Rank
46	Interim payment certificate with-held	15.6	5	10	8	7	2	0.66	15	13	9	8	2	0	0.81	3
47	Contract termination by the employer	15.2	0	7	8	12	5	0.51	44	11	15	2	4	0	0.81	3
48	Bodily injuries, sickness, diseases or death	17.1	1	5	8	12	7	0.50	51	7	7	11	4	3	0.67	19
49	Property (real or personal) damage or loss	17.1	3	3	9	12	5	0.52	42	6	8	9	5	4	0.64	24
50	Works or goods loss or damage	17.2	10	12	5	5	0	0.77	5	6	13	7	4	2	0.71	11
51	Infringement of intellectual and industrial property rights	17.5	0	1	6	10	15	0.36	54	0	2	2	20	8	0.39	54
52	Natural catastrophes	19.5	0	1	22	8	2	0.55	33	10	6	6	8	2	0.69	15
53	Failure to give claim notice within 28 days	20.1	4	4	7	10	7	0.53	39	5	12	8	4	3	0.68	17
54	Failure to appoint a member of DAB	20.3	0	8	15	5	4	0.57	30	0	6	16	6	4	0.55	45

5.4.2.1 First Approach: Prioritization by Probability of Occurrence

The risk factors implied from conditions of contract for construction (FIDIC 99) were prioritized according to ranking based on probability of occurrence. Table 5.14 shows the highest 10 ranked risk factors based on the probability of occurrence of the risk factor.

It is shown that "Non-availability of goods, consumables, etc." was ranked in the first position with RII equals to 0.83. The local contractors are suffering from lack of materials, consumables, goods, etc. due to continuous border closures and siege which prevent the suppliers from providing the necessary construction materials, consumables, etc. It is not unclear that the construction business is almost completely paralyzed due to this factor.

"Delay to complete work stated in the contract" was ranked in the second position with RII equals to 0.81. This factor is relatively related to the previous factor of "non-availability of goods, consumables, etc." because the current siege has affected the availability of such items and hence the contractors are not able to complete the works stated in the contract due to that shortage of construction materials and other construction goods or consumables.

The cost impact RII value of this factors was also relatively high (0.73) and ranked in the eighth position. It is very common for a project to finish later than scheduled. The cost effect of delay can be significant. If the delay is the contractor's fault, the employer may be entitled to claim liquidated damages from the contractor (Stansbury, 2005).

"Work interruption due to variation" was ranked in the third position with RII equals to 0.79. Today it is difficult to make a detailed planning in the initial phase of the project, since the conditions for the production changes from day to day (Andersson, 2002). It is not strange that the contractors are not involved in the design decisions which lead to variations at the construction phase. Moreover, poor design will definitely lead to huge number of variations. The variations lead to interruption of the contractor's work sequence and this interruption distresses the contractors.

"Delay, impediment or prevention caused by employer" was ranked in the fourth position with RII equals to 0.78. The Palestinian economy is still relying on international donors and the construction business in the Gaza Strip is a part of that system. The employers depend on fund which is donated by foreign bodies. So any disturbance in this system will impede or delay the construction work in a certain project. Further more, employer's staff and work mismanagement always lead to delay. This could happen due to some personal issues of employer's staff.

"Works or goods loss or damage" was ranked in the fifth position with RII equals to 0.77.

As work interruption is the dominant feature of the construction industry in the Gaza Strip, then it is not unusual to lose or to have damaged some of the project's goods or works. Moreover, many construction sites in the Gaza Strip have been exposed to military attacks by Israeli forces. As a result of these attacks, the contractor suffers from damaging and destructing of goods and works.

It is worth to mention that "Infringement of intellectual and industrial property rights" was ranked in the last position with a RII equals to 0.36. Such infringement is not common in the Gaza Strip and there are foggy rules relating to this subject. The local contractors are not familiar to such risk factor.

It is also worth to mention that "Non-availability of labour or personnel" was ranked in the fiftieth position with RII equals to 0.50. The Gaza Strip is currently characterized by a surplus supply of labour, so there will never be a problem to find the required human resources for the execution of any type of work.

On the contrary, Workforce availability and skill occupied a high rank according to Walewski (2005). Of course, risk ranking in any community reflects the circumstances in that community. Walewski (2005) study was conducted in the United States of America (USA) where the human resources availability could be a serious problem, but it is not the case in the Gaza Strip where mobility of people is restricted and local economy generates little job opportunities.

Table 5.14: Prioritization by probability of occurrence

No.	Risk factor	Clause	Probability	
			RII	Rank
1	Non-availability of goods, consumables, etc.	5.1	0.83	1
2	Delay to complete work stated in the contract	8.7	0.81	2
3	Work interruption due to variation	13.1	0.79	3
4	Delay, impediment or prevention caused by employer	8.5	0.78	4
5	Works or goods loss or damage	17.2	0.77	5
6	Contractor's design, workmanship or materials failure during suspension	8.9	0.76	6
7	Temporary works loss or damage	5.1	0.75	7
8	Contractor's equipment loss or damage	5.17	0.74	8
9	Delayed Drawings or instructions due to contractor's fault	1.9	0.72	9
10	Interference in the convenience of public	5.15	0.69	10

5.4.2.2 Second Approach: Prioritization by Cost Impact

The risk factors implied from the conditions of contract for construction (FIDIC 99) were prioritized according to ranking based on cost impact of the risk factors. Table 5.15 shows the highest 10 ranked risk factors based on the cost impact.

It is shown that "Work interruption due to variation" was ranked in the first position with RII equals to 0.85. It is well known that the variations cause reworks, additional works and interruptions of work sequence which lead to mismanagement of contractor's resources and disruption of work and resources schedules which leave eventually a big impact on the contractor's budget. The contractors believe that variations are considered a cause of disputes (Mortaja, 2007). Zeneldin et al (2005) concluded that variation is the major cause for claims in UAE construction sector. According to Yogeswaran (1997), variation is a major cause of claims.

"Non-availability of goods, consumables, etc." seems to be a factor which strongly affects the contractor's cost estimation. The cost impact of this factor was ranked in the second position with RII equals to 0.84, and it should be remembered that this factor was ranked in the first rank according to probability of occurrence.

The environment of business in the Gaza Strip is abnormal due to closures and siege. Absence of construction materials from market suspends or even terminates the majority of the construction projects which in turn leads to more financial burden on the contractor. Closure has a big effect on escalation in the material prices and work delay due to material shortages (Maqousi, 2007).

"Interim payment certificate with-held" was ranked in the third place with RII equals to 0.81. Interim payment certificate with-held disturbs the cash flow of the contractor and hence makes the contractor unable to commit his obligations.

"Contract termination by the employer" was also ranked third with RII equals to 0.81. No doubt that contract termination by employer has a big impact on the contractor. It should be mentioned that most of construction contracts in the Gaza Strip are coercion contracts in which the employer can terminate the contract without indemnifying the contractor for the expected profit and indemnify only the overhead of the termination notification period. The employer is free to terminate the contract at any time for the employer's convenience by giving notice to the contractor of such termination (Osinski, 2002). The probability of occurrence of this factor is low. The employer rarely tends to terminate the contract, but if it occurs, the cost impact will be huge.

"Delay, impediment or prevention caused by employer" was ranked in the fifth place with a RII equals to 0.78. If the contractor exposed to any kind of delay, the time schedule will be defected, and hence the schedule of resources, materials and other goods will also be defected. The eventual result of such delay, impediment or prevention will have a big impact on contractor's budget.

Zeneldin (2005) concluded that delay caused by employer is a main cause for claims in the UAE construction sector. The probability of occurrence of this factor ranked high i.e. fourth rank with RII equals 0.78. This is an important factor with high rank for both cost impact and probability of occurrence.

"Failure to comply with engineer's instructions" was ranked sixth with RII equals to 0.77. If the engineer is dissatisfied, the contractor will then suffer from engineer's reaction and behaviour. The engineer is delegated to determine all issues related to the project and the relationship between the employer and the contractor. Moreover, the engineer acts as a first arbiter of disputes between employer and contractor (Samuel, 1996). Contractor's failure to comply with engineer's instructions may result in adverse attitudes against the contractor and poor cooperation and coordination between the contracting parties.

It is worth to mention that "Infringement of intellectual and industrial property rights" occupied the last rank in both cost impact prioritization and probability of occurrence prioritization. The local contractors suffer from lack of experience and legal background regarding this issue.

Table 5.15: Prioritization by cost impact

No.	Risk factor	Clause	Cost Impact	
			RII	Rank
1	Work interruption due to variation	13.1	0.85	1
2	Non-availability of goods, consumables, etc.	5.1	0.84	2
3	Interim payment certificate with-held	15.6	0.81	3
4	Contract termination by the employer	15.2	0.81	3
5	Delay, impediment or prevention caused by employer	8.5	0.78	5
6	Failure to comply with Engineer's instructions	7.6	0.77	6
7	Unforeseen disruption or delay by authorities	8.5	0.74	7

Table 5.15 (Cont'd): Prioritization by cost impact

No.	Risk factor	Clause	Cost Impact	
			RII	Rank
8	Errors in positions, levels, dimensions or alignments	5.7	0.73	8
9	Delay to complete work stated in the contract	8.7	0.73	8
10	Work suspension is a responsibility of contractor	8.8	0.72	10

Chapter Six

FIDIC 99 Cost Impact Estimating System (FCIES)

6.1 Introduction

Contractors, upon receiving a bid request, evaluate the cost of building the project, and will, consciously or not, add contingencies for risk (Hartman et al, 1996). Since contractors are unable to influence the contract conditions and clauses, contractors should understand which risks and responsibilities they should undertake under contract conditions (Usta, 2005).

The pricing process can be simplified if a computerized estimating system is utilized. There has not, until this moment, been a system that deals with conditions of contract for construction (FIDIC 99) cost impact on the Gaza Strip contractor's cost estimation. Moreover, the field survey reveals that the local contractors suffer from the lack of suitable systems to be used in bid pricing phase, especially those systems dealing with contractor's risks and responsibilities. The researcher believes that having such a system becomes a necessity. Accordingly, he developed a system that deals with the cost impact of applying conditions of contract for construction (FIDIC 99). This chapter describes this system and shows its functions.

6.2 FCIES Concept

FIDIC 99 Cost Impact Estimating System (FCIES) aims at helping the contractors of the Gaza Strip for more accurate cost estimation based on the conditions of contract for construction (FIDIC 99), in terms of responsibilities and risks. It is hoped that FCIES can provide users with an efficient mechanism that helps identifying risks and finding possible ways to minimize their effects and helps to point out the responsibilities and enables the contractors to estimate their cost.

FCIES is built mainly to calculate the cost impact of adopting the conditions of contract for construction (FIDIC 99) on the contractors of the Gaza Strip considering two main issues. The first is the responsibility factors implied from the conditions of contract for construction (FIDIC 99), and the second is the risk factors implied from the conditions of contract for construction (FIDIC 99).

FCIES uses Monte Carlo simulation technique for evaluation of risk factors, while the responsibility factors are considered deterministic factors each has a single value entry.

6.3 FCIES Description

Risk factors are introduced to FCIES into two main divisions, risk factors according to categories and risk factors according to prioritization resulting from the field survey conducted on the contractors of the Gaza Strip. Risk factors are distributed into five categories according to Panthi (2007). They are construction related risks, performance related risks, contractual and legal risks, physical risks and political and social risks.

Responsibility factors are introduced to FCIES into two divisions as well, by categories and by prioritization. Responsibility factors were broken down into items which have been categorized into two main categories, "To provide" and "To do". Further break down is carried out on the "To Provide" into three subcategories "Staff welfare", "Security, safety, and services" and "Contractual".

FCIES was designed using Visual Basic Applications (VBA) in MS Excel. Since 1993, Excel has included Visual Basic for Applications (VBA). It is a programming language based on Visual Basic which adds the ability to automate tasks in Excel and to provide User Defined Functions (UDF) for use in worksheets. VBA is a powerful addition to the application which includes a fully featured Integrated Development Environment (IDE). Macro recording can produce VBA code replicating user actions, thus allowing simple automation of regular tasks. VBA allows the creation of forms and in-worksheet controls to communicate with the user. Later versions add support for class modules allowing the use of basic object-oriented programming techniques.

6.3.1 FCIES Overview

FCIES deals with the cost impact of conditions of contract (FIDIC 99) in two relatively separate partitions. The cost of each responsibility factor (C_{Si}) is estimated directly. FCIES sums up the cost of all responsibility factors through a simple summation formula as shown in Equation 6.1.

$$\sum_{i=1}^{i=n} C_{Si} = C_{S1} + C_{S2} + C_{S3} + \dots + C_{Sn} \dots\dots\dots \text{Equation 6.1}$$

Where;

C_{Si} = Cost of the responsibility factor number i

i = 1, 2, 3, ..., n

FCIES deals with risk factors differently. Each risk factor is expressed in terms of cost estimates corresponding to probability of occurrence. A mitigation action could be introduced to relieve the effect of a risk factor. Each mitigation action has a fixed cost (C_{Mj}) and it hopefully causes a risk reduction (r_{ji}) on the cost of the risk (C_{Ri}) of a risk factor number i .

The Net cost of risk factor (NC_{Ri}) will be calculated according to Equation 6.2.

$$NC_{Ri} = C_{Ri} - (C_{Ri} * r_{ji}) + C_{Mj}$$

$$NC_{Ri} = C_{Ri} (1 - r_{ji}) + C_{Mj} \dots\dots\dots \text{Equation 6.2}$$

Where;

NC_{Ri} = Net cost of the risk factor number i .

C_{Ri} = Cost of the risk factor number i .

r_{ji} = The risk reduction percentage to cost of a risk factor i due to mitigation action j .

C_{Mj} = The cost mitigation action j .

j = 1, 2, 3, ..., m

FCIES compares the risk cost (C_R) with the risk cost with mitigation actions (NC_R) at a cumulative probability value of 50%. FCIES adopts a mitigation action if it produces NC_R value less than the original C_R value.

A single risk factor may adopt many mitigation actions in order to eliminate or relieve the effect of that risk factor. FCIES sums up the mitigation actions costs and reductions and finally calculates the net cost of a risk factor as shown in equation 6.3.

$$NC_{Ri} = C_{Ri} (1 - \sum_{j=m}^{j=1} r_{ji}) + \sum_{j=m}^{j=1} C_{Mj} \dots\dots\dots \text{Equation 6.3}$$

A new, with mitigation actions, probabilistic distribution is produced and hence Monte Carlo simulation process is carried out for both distributions separately. Finally the cost of risk factors will be viewed. FCIES sums up the final cost of responsibility and risk factors. The system is illustrated in Figure 6.1.

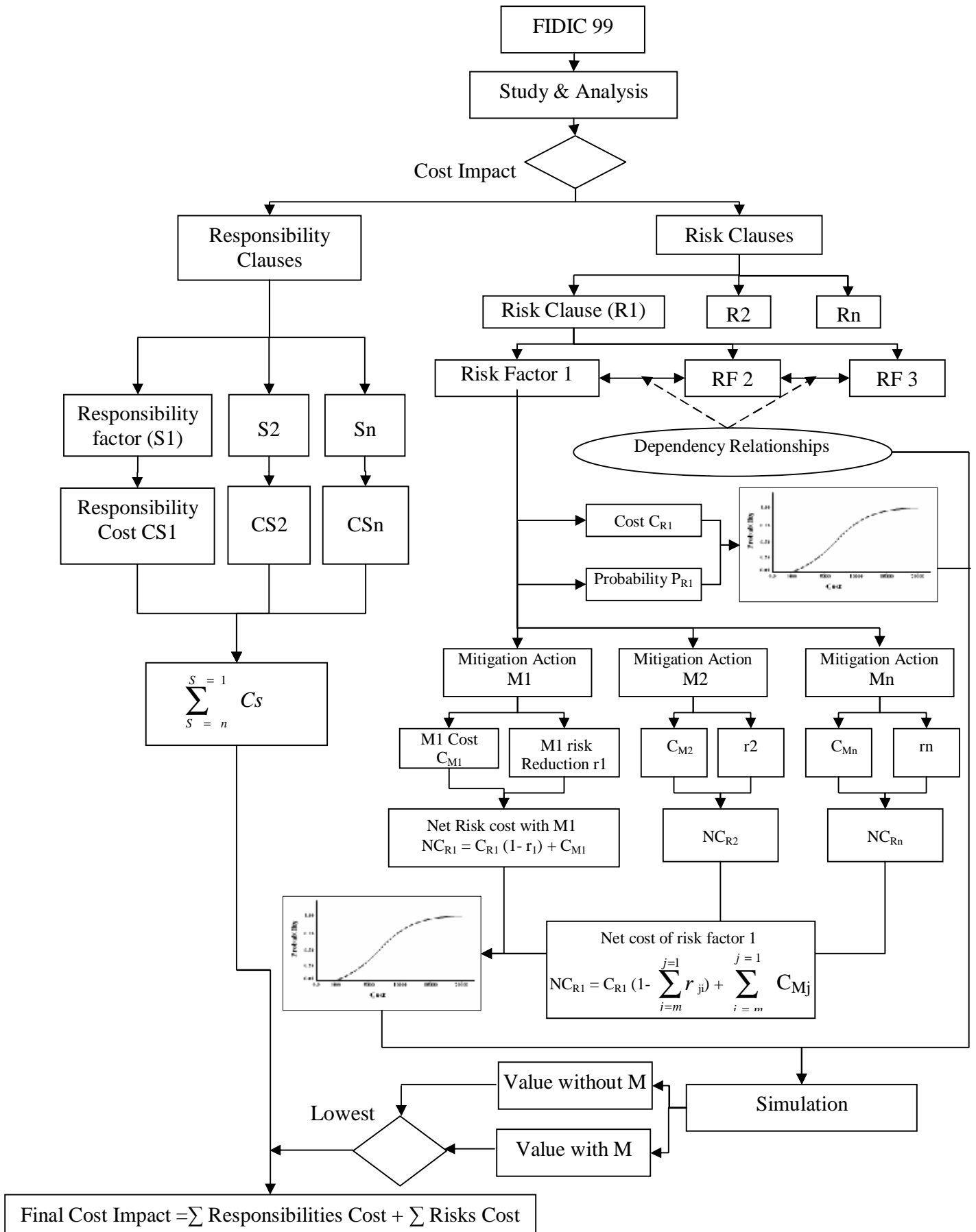


Figure 6.1: FCIES system

6.3.2 FCIES Illustration

FCIES is run by MS Excel with low level of Macro security to allow the user to view the user tabs. By double clicking on the program icon, an introductory screen appears. By clicking on Enter button as shown in Figure 6.2, the main menu will be displayed.

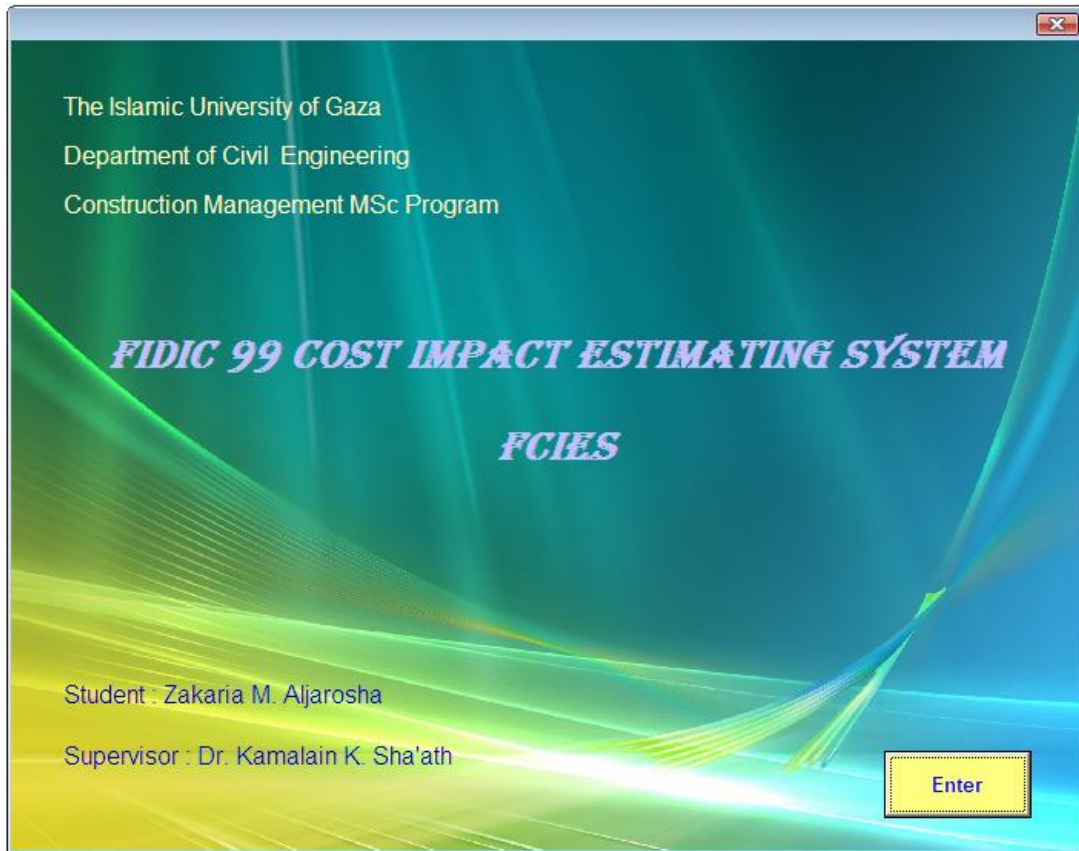


Figure 6.2: Introductory screen

6.3.2.1 First Tab (Main Menu)

Figure 6.3 shows the program main menu. This menu enables the user to display all FCIES tabs. The main menu contains project settings, responsibilities, risk data entry, risk relationships, simulation and results. The user can quit FCIES through clicking on the Exit button.

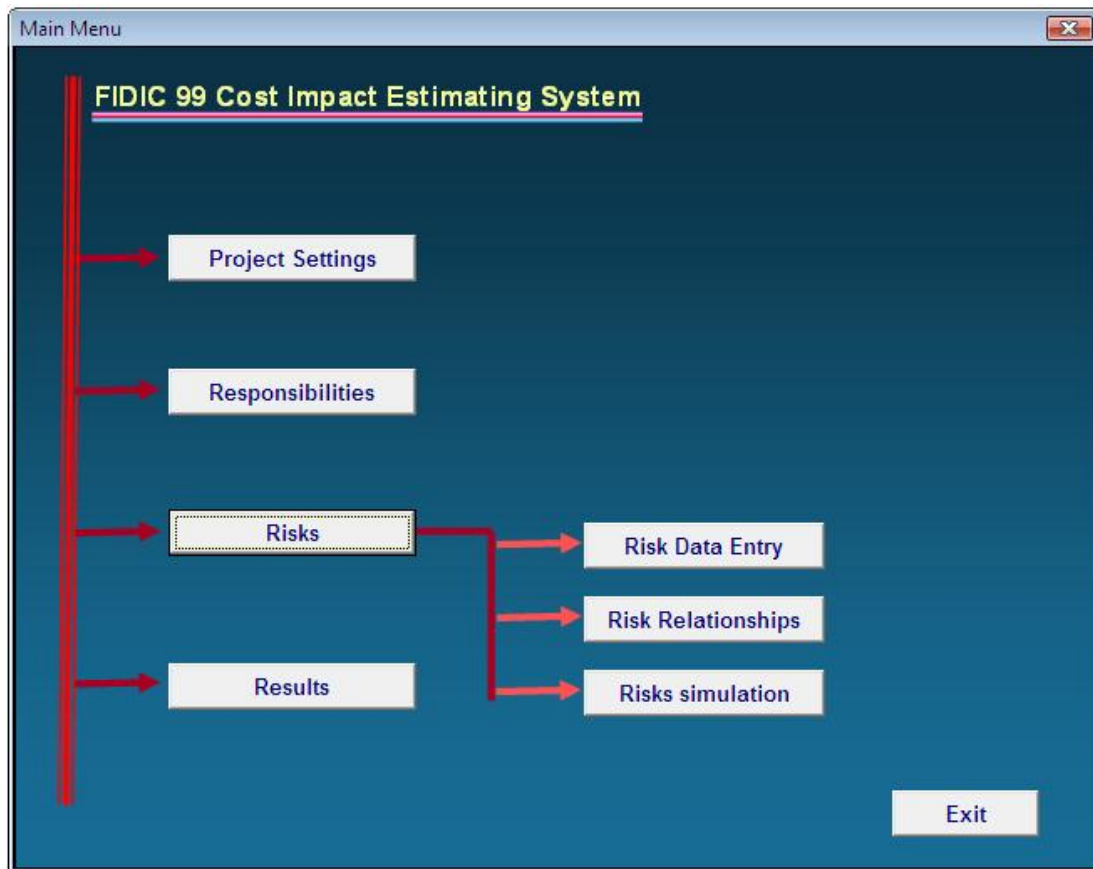


Figure 6.3: Main menu tab

6.3.2.2 Second Tab (Project Settings)

Project settings form, shown in Figure 6.4, is designed to allow the user to define some project characteristics. The needed data is in terms of working hour cost and delay cost.

The diagram shows a software window titled "Project Settings" with a dark blue background. The title "Project Settings" is displayed in white at the top. Below the title, there are two input fields. The first is labeled "Working Hour Cost" in white text, followed by a white input box and the unit "\$/Hr" in white text. The second is labeled "Delay Cost" in white text, followed by a white input box and the unit "\$/Day" in white text. At the bottom center, there is a white button with the text "Approve" in blue.

Figure 6.4: Project settings tab

This data is needed when the user uses the option of introducing the risk cost values in Figure 6.9 by evaluating the cost of the risk consequences. FCIES then calculates the risk cost through the consequences with the project settings introduced.

6.3.2.3 Third Tab (Responsibilities)

In this form the user will be able to estimate the cost of the responsibilities incurred from the adoption of the conditions of contract for construction (FIDIC 99) as shown in Figure 6.5. The responsibilities list contains the responsibilities implied from the conditions of contract for construction (FIDIC 99).

The screenshot shows a software window titled "Responsibilities" with a sub-header "Responsibilities By Priority". Below this, a specific responsibility is highlighted: "18.3 Provide insurance against persons injury and property damage." The main area contains a "Responsibilities List" with a scrollable list of items, including "18.3 Provide insurance against persons injury and property damage", "18.2 Provide insurance for works and contractor's equipment", "18.4 Provide insurance against sickness, disease or death", "4.8.4.23, 11.11 Keep the site and works clear of unnecessary obstructions", "14.2 Provide advance payment guarantee", "4.8 Comply with all applicable safety regulations", "7.4 Provide testing apparatus, assistance, electricity, etc.", "7.8 Pay for natural materials obtained from outside the project", "4.2 Obtain performance security", "4.8 Provide temporary works for protection of public, own property and adjacent works", "7.2 Provide standard samples", "4.15 Cost due to non-suitability or non-availability of access routes", "6.7 Appointment of accident prevention officer", "6.7 Take reasonable precautions to maintain the health and safety of all persons", "4.8 Take care of the safety of all persons", "4.15 Maintenance required for access routes", "6.6 Provide necessary accommodation and welfare facilities", "6.7 Provide sick bay and ambulance services", "6.1 Payment, housing, feeding and transporting of contractor's personnel", "4.8 Provide fencing, lighting, guarding, watching of the works", "4.6 Use of contractor's temporary works", "4.6 Use the contractor's equipment", and "4.1 Provide the plants, consumables and services." To the right of the list, there is a checkbox labeled "Included in BOQ" which is currently unchecked. Below this is a "Total Cost" field with a value of "0" and a dollar sign. At the bottom right, there are three buttons: "Approve", "Risk Entry", and "Main Menu". At the bottom left, there are two tabs: "By Priority" (selected) and "By Category".

Figure 6.5: Responsibility factors tab

If the user includes a responsibility cost in pricing of any bill of quantities item, FCIES provides an option to avoid the double estimation of that responsibility. When the responsibility was estimated before, the user shall click the box called "Included in BOQ", then the responsibility will take a cost value of 0 and will be blocked.

The user can view the responsibility factors in two arrangements. The first is by priority according to the opinion of respondents of the questionnaire as shown in Table 5.12. The responsibility factors could also be viewed by categories as shown in Figure 6.6. These categories include either “to do” or “to provide”. “To do” category includes the responsibilities or activities the contractor is entitled to do under conditions of contract for construction (FIDIC 99) as shown in Table 3.11. “To provide” category includes items to be provided by the contractor under conditions of contract for construction (FIDIC 99). This category was divided into subcategories; “Staff welfare”, “Contractual and legal” and “Safety, security and services” as shown in Table 3.10. This versatility gives the user more flexibility in using FCIES.

The screenshot shows a software window titled "Responsibilities". Inside, there's a header for "Staff Welfare" and a sub-header for "Housing". A "Responsibilities List" is displayed on the left, containing items like Feeding, Transporting, Wages not lower than local market, Health, Safety, Welfare, Immigration, Legal rights, Accommodation and welfare for employer's staff, Medical staff and first aid, and Sick pay, ambulance services and first aid. On the right, there's a checkbox labeled "Included in BOQ" which is checked, and a "Total Cost" field showing "0" with a dollar sign. Below this is an "Approve" button. At the bottom, there are navigation buttons: "By Priority", "By Category", "To Do" (highlighted), "To Provide", "Staff Welfare", "Contractual & Legal", and "Safety, Security & Services". On the far right, there are "Risk Entry" and "Main Menu" buttons.

Figure 6.6: Responsibility factors by categories

6.3.2.4 Fourth Tab (Risk Data Entry)

In this form, the user can express his estimation about the risk factors contained in the risk factors list. The risk factors are listed in the risk list as shown in Figure 6.7.

Construction Related Risks

Risks In Probability Order

4.1 Non-availability of goods, consumables, etc.

Risks List

- 4.1 Non-availability of goods, consumables, etc.
- 6.7 Delay to complete work stated in the contract
- 13.1 Work interruption due to variation
- 8.4 Delay, impediment or prevention caused by employer
- 17.2 Works or goods loss or damage
- 8.9 Contractor's design, workmanship or materials failure
- 4.1 Temporary works loss or damage
- 4.17 Contractor's equipment loss or damage
- 1.9 Delayed drawings or instructions due to contractor's
- 4.14 Interference in the convenience of public
- 7.5 Rejection of plant, materials or workmanship
- 4.4 Faults or mis-acts of the subcontractor
- 8.5 Unforeseen disruption or delay by authorities
- 14.6 Interim payment certificate withheld
- 4.7 Errors in positions, levels, dimensions or alignments
- 2.1 Engineer's failure (caused by contractor) to give sign
- 11.6 Repetition of tests after remedying of defects
- 4.10 Miss of site related data
- 8.7 Delay to pass tests on completion
- 7.4 Additional tests fail
- 4.2 Failure to extend the validity of performance security
- 4.8 Failure to comply with safety regulations
- 8.4 Exceptional adverse climatic conditions
- 19.4 Natural catastrophes
- 4.20 Employer's equipment loss or damage while under

Risk Input

Risk Impact

Probability	Corresponding Cost
0 %	0 \$
25 %	0 \$
50 %	0 \$
75 %	0 \$
100 %	0 \$

Approve

Categories

Probability **Cost Impact**

Responsibilities **Main Menu**

Relationships **Simulation**

Figure 6.7: Risk entries by priority form

The user can choose to view the risk factors in priority order or by categories. The risk factors priority order was prepared to give more flexibility. The user can sort the risk factors according to probability of occurrence order or cost impact order. This prioritization was obtained from the field survey results accomplished in chapter Five as shown in Table 5.13.

The risk factors categories could be used as well, as shown in Figure 6.8. The risk categories are construction related risks, performance related risks, contractual and legal risks, physical risks and political and social risks.

Construction Related Risks

1.9 Delayed Drawings or instructions

Risks List

- 1.9 Delayed Drawings or instructions
- 2.1 Engineer's failure (caused by contractor) to give right of
- 4.1 Contractor's document loss or damage
- 4.1 Temporary works loss or damage
- 4.1 Permanent works designed by contractor failure
- 4.7 Errors in positions, levels, dimensions or alignments
- 4.16 Goods loss or damage during transportation
- 4.16 Roads or bridges damage during transportation
- 4.17 Contractor's equipment loss or damage
- 4.17 Contractor's inability to engage another project because
- 4.20 Employer's equipment loss or damage while under contract
- 7.4 Additional tests fail
- 7.5 Rejection of plant, materials or workmanship
- 8.4 Delay, impediment or prevention caused by employer
- 8.7 Delay to pass tests on completion
- 8.7 Delay to complete work stated in the contract
- 9.2 Failure to carry out tests on completion
- 9.4 Contract price reduction due to failure to pass tests on
- 11.5 Increase the amount of performance security due to re
- 11.6 Repetition of tests after remedying of defects
- 13.1 Work interruption due to variation

Risk Input

Risk Impact

Probability	Corresponding Cost
0 %	<input type="text"/> \$
25 %	<input type="text"/> \$
50 %	<input type="text"/> \$
75 %	<input type="text"/> \$
100 %	<input type="text"/> \$

Approve

Categories

- Construction
- Performance
- Contractual & Legal
- Physical
- Political & Social

Priorities

Responsibilities

Main Menu

Relationships

Simulation

Figure 6.8: Risk entries by categories

The data to be entered is in form of risk costs corresponding to a given cumulative probability distribution at 0%, 25%, 50%, 75% and 100% according to Sha'ath (1993). The data to be entered in the entry boxes are the cost values being less than indicated cumulative probability.

In construction risk management, some risks are difficult to be directly estimated, so FCIES was designed to cope with this difficulty. The user can estimate the risk factors cost according to their consequences. The consequences are categorized as additional cost, additional work, delay and claims as shown in Figure 6.9.

The additional cost is the cost which the contractor bears due to the occurrence of such risk. The additional work is the work to be carried out by the contractor as a consequence of the risk. The delay is the delay incurred by the occurrence of the risk while the claims are the probable successful claims raised against the contractor as a result of the risk occurrence.

If the risk factor is too general, FCIES has the option of viewing the risk consequences or further break down risk consequences in comment box located at the lowest part of the risk entry form as shown in Figure 6.9.

Construction Related Risks

1.9 Delayed drawings or instructions due to contractor's fault

Risks List

- 1.9 Delayed drawings or instructions due to contractor's fault
- 2.1 Employer's failure (caused by contractor) to give right of
- 4.1 Contractor's document loss or damage
- 4.1 Temporary works loss or damage
- 4.1 Permanent works designed by contractor failure
- 4.7 Errors in positions, levels, dimensions or alignments
- 4.16 Goods loss or damage during transportation
- 4.16 Roads or bridges damage during transportation
- 4.17 Contractor's equipment loss or damage
- 4.4 Deficiency of suppliers
- 4.20 Employer's equipment loss or damage while under con
- 7.4 Additional tests fail
- 7.5 Rejection of plant, materials or workmanship
- 8.4 Delay, impediment or prevention caused by employer
- 8.7 Delay to pass tests on completion
- 8.7 Delay to complete work stated in the contract
- 9.2 Failure to carry out tests on completion
- 9.4 Contract price reduction due to failure to pass tests on
- 11.5 Increase the amount of performance security due to re
- 11.6 Repetition of tests after remedying of defects
- 13.1 Work interruption due to variation

Risk Input

Risk Impact

Probability	Corresponding Cost
0 %	0 \$
25 %	0 \$
50 %	0 \$
75 %	0 \$
100 %	0 \$

Consequences

Additional Cost: 0 \$

Delay: 0 Days

Additional Work: 0 Hours

Claims: 0 \$

Approve

Categories: Construction, Performance, Contractual & Legal, Physical, Political & Social

Priorities:

Comments: 1- Planning errors, 2- Delay in approvals, 3- Late payment, 4- Scheduling errors

Responsibilities, Main Menu, Relationships, Simulation

Figure 6.9: Risk entries by consequences

If risk estimation by consequences is chosen, then FCIES calculates the risk cost according to the project settings that earlier entered by the user as shown in Figure 6.4.

6.3.2.5 Fifth Tab (Mitigation Actions)

FCIES was designed in a shape that allows the user to introduce mitigation actions to relieve the effect of the risk factors in terms of cost. It was designed to accept, theoretically, unlimited number of mitigation actions. Each mitigation action has its own fixed cost and in return it eliminates or reduces risk cost. In other words, the cost of a feasible mitigation action should be less than the cost reduction it affects on a risk. The user adds a mitigation action or chooses from a drop down list that was previously prepared by the user as shown in Figure 6.10. For better utilization of mitigation actions, a mitigation action used by a risk factor may be used to mitigate other risk factors.

The screenshot displays the 'Construction Related Risks' application window. The title bar reads 'Construction Related Risks'. Below the title bar, the main header is 'Construction Related Risks' and the sub-header is '1.9 Delayed Drawings or instructions'. The interface is divided into several sections:

- Risks List:** A scrollable list of risk factors, including '1.9 Delayed Drawings or instructions', '2.1 Engineer's failure (caused by contractor) to give right of', '4.1 Contractor's document loss or damage', '4.1 Temporary works loss or damage', '4.1 Permanent works designed by contractor failure', '4.7 Errors in positions, levels, dimensions or alignments', '4.16 Goods loss or damage during transportation', '4.16 Roads or bridges damage during transportation', '4.17 Contractor's equipment loss or damage', '4.17 Contractor's inability to engage another project because', '4.20 Employer's equipment loss or damage while under con', '7.4 Additional tests fail', '7.5 Rejection of plant, materials or workmanship', '8.4 Delay, impediment or prevention caused by employer', '8.7 Delay to pass tests on completion', '8.7 Delay to complete work stated in the contract', '9.2 Failure to carry out tests on completion', '9.4 Contract price reduction due to failure to pass tests on', '11.5 Increase the amount of performance security due to re', '11.6 Repetition of tests after remedying of defects', and '13.1 Work interruption due to variation'.
- Mitigation Risk Form:**
 - Mitigation Actions List:** A section with an 'Add / Edit' button and a dropdown menu.
 - Cost:** A text input field followed by a '\$' symbol.
 - Reduction:** A text input field followed by a '%' symbol.
 - Buttons:** 'Remove' and 'Approve' buttons are located at the bottom of the form.
- Navigation Bar:**
 - Categories:** A button that is currently selected.
 - Construction:** A button.
 - Performance:** A button.
 - Contractual & Legal:** A button.
 - Physical:** A button.
 - Political & Social:** A button.
 - Priorities:** A button.
 - Responsibilities:** A button.
 - Main Menu:** A button.
 - Relationships:** A button.
 - Simulation:** A button.

Figure 6.10: Mitigation actions entries

FCIES primarily checks the selected mitigation action with its introduced fixed cost and risk reduction percentage to cost of risk factor. This check is done by comparing the value of cost with and without the mitigation action considering the values corresponding to 50% cumulative probability of occurrence. If the cost value of the risk with mitigation action is higher than without mitigation action, FCIES will not accept this mitigation action and a message box appears showing this rejection. As the user proceeds in data entry, the previously entered mitigation actions will be displayed in the succeeding factors. By this option, the user can use the same mitigation action for a number of risk factors.

After the introduction of mitigation actions for one risk factor, FCIES sums up the mitigation actions costs and the reductions, and hence a new probability distribution is obtained with new values. The data will be saved for simulation.

6.3.2.6 Sixth Tab (Risks Relationships)

Although Monte Carlo simulation is a proven tool for risk estimation, it has some disadvantages. Monte Carlo simulation can not predict or introduce dependency relationships between risk factors. It assumes that all risk factors are independent, but this is not always the case especially in the construction industry. Some risk factors could be dependent on others. FCIES was

designed to overcome this phenomenon. The user can build up multilevel risk relationship trees as shown in Figure 6.11.

Relationships between risk factors could be identified. The Monte Carlo simulation model is able to understand these relationship trees and assign a relative random number according to the identified relationships. The generated random number for a dependent risk factor is a function of the random number assigned to independent risk factor according to relationships identified by the user.

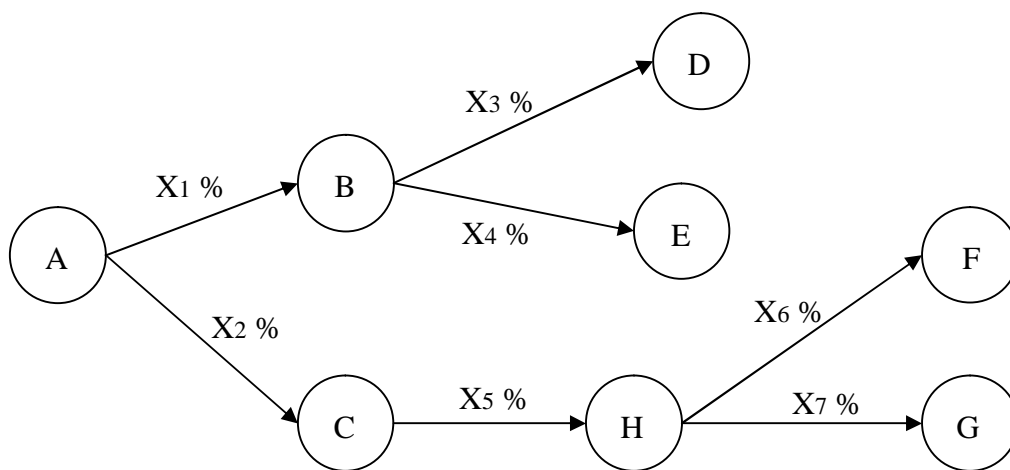


Figure 6.11: Dependency relationships tree

Figure 6.12 shows the risk relationships entry form, where the user has the ability to make the relationship trees. The left side risk list is the parent risk list, while the right side risk list is the child risk list. Any contradiction in relationships is detected and FCIES will not accept and a message is displayed showing this rejection.

FCIES deals with these relationships by a built in algorithm. The generated random number RN is not randomly generated for a dependent risk factor. The root of the relationship tree has a generated random number, but the branches have the same RN multiplied by the dependency value.

This process was tested by the researcher. Dependency relationships were introduced, the simulation process was carried out with single number of iterations, and then the random numbers of the risk factors with dependency relationships were viewed in temporary boxes.

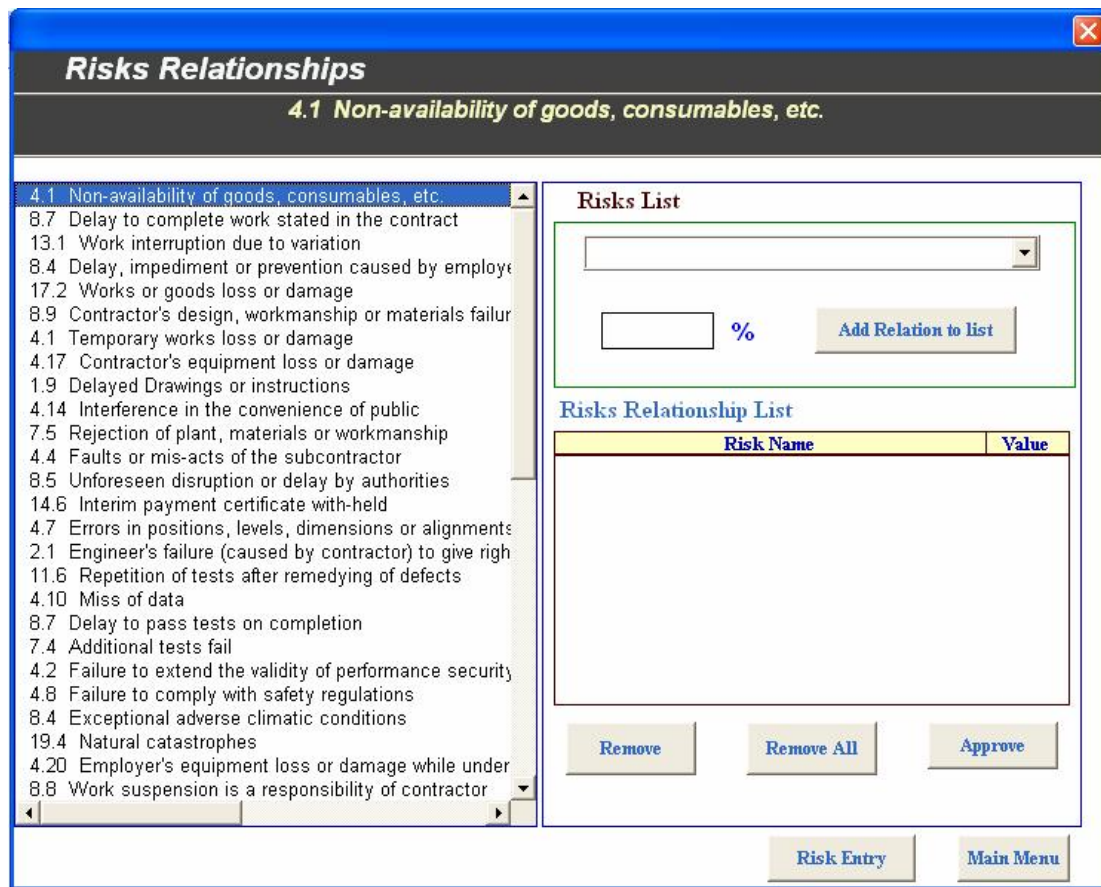


Figure 6.12: Risk dependency relationships

The random number values appeared in the temporary boxes were calculated correctly according to the introduced relationships. By this technique the simulation runs in more realistic environment and more adequate results could be obtained.

6.3.2.7 Seventh Tab (Simulation)

Simulation is the last stage of the risk estimation process. Monte Carlo simulation technique is used for this purpose. Monte Carlo simulation is non physical in nature and often employs a mathematical model with an objective governed by variables. Monte Carlo simulation is a proven probabilistic method based on the random behavior which is a game of chance.

The higher the number of iterations, the better and more accurate results could be obtained. The user is asked to identify the number of iterations between 100 and 5000. FCIES starts generating random number to each independent risk factor at once and the same random number is generated for all dependent risk factors multiplied by the percentage of the dependency.

As mentioned before, there are two probability distributions for each risk factor, one without mitigation actions and the other is with mitigation actions. The Monte Carlo simulation will treat both distributions separately. Clicking on "RUN" button starts the simulation process, then the

X-Y chart appears with two cumulative "S" curves, one in dark blue color represents the risk cost without considering mitigation actions, while the other curve is in pink color represents the risk cost considering mitigation actions as shown in Figure 6.13.

This display was designed to give more flexibility to the user. The user can see the results in terms of cost at different probability values on the curve itself. The cost values are displayed on the curves with probability scroll bar to point out the acceptable probability value.

The image shows a software window titled "Simulation". Inside the window, there is a dark blue background. At the top, the title "Simulation" is centered in white. Below the title, there is a white rectangular area containing a text label "Number of Iterations" followed by a white input field. To the right of this input field is a blue button labeled "Run". Below the "Number of Iterations" section is a long white horizontal bar. In the center of the window is a large white rectangular area representing an X-Y chart. The vertical axis is labeled "Y" and the horizontal axis is labeled "X". Below the horizontal axis, there is a probability scroll bar with the label "Probability" on the left and a percentage symbol "%" on the right. To the right of the chart area, there is a legend box with two entries: "Without Mitigations" next to a dark blue square and "With Mitigations" next to a pink square. Below the legend box are three buttons: "Capture", "Results", and "Main Menu".

Figure 6.13: Simulation form

6.3.2.8 Eighth Tab (Results)

This is the last form in FCIES where the results are displayed. After the user has introduced the responsibility factors cost values, risk factors cost values and simulation process completed, the user can now view the results as shown in Figure 6.14.

The risk cost is displayed in both components; risk cost without mitigation actions and risk cost with mitigation actions. The responsibilities cost is also displayed. The user can choose whether to adopt risk factors regardless of mitigation actions or with mitigation actions.

When the choice is settled, the final result appears. This final result is the cost incurred by the contractor when adopting the conditions of contract for construction (FIDIC 99).

The screenshot shows a software window titled "Results". The window has a dark blue background with a light blue header bar containing the word "Results". Below the header, there are two main panels. The left panel is titled "Risks" and contains two radio buttons: "Without Mitigations" (which is selected) and "With Mitigations". Each radio button is followed by a text input field and a dollar sign. The right panel is titled "Responsibilities" and contains a single text input field and a dollar sign. Below these two panels is a button labeled "Approve". At the bottom of the window, there is a label "Final Cost" followed by a text input field and a dollar sign. At the very bottom, there is a navigation bar with five buttons: "Main Menu", "Risk Entry", "Responsibilities", "Simulation", and "Exit".

Figure 6.14: Results form

6.4 FCIES Implementation

The best way to explain the program is by applying it to an example and explains it step by step. The main menu form is neglected because it is only a menu enables the user to view the different forms of FCIES.

6.4.1 Second Tab (Project Settings)

The project settings related to additional work hourly cost or delay daily cost could be introduced as shown in Figure 6.15, then click the "Approve" button to save these settings.

The work hour cost is the average hour cost of a normal activity, where the delay cost is the daily cost incurred by the contractor as a result of a delay plus the delay damages cost.



The image shows a software window titled "Project Settings" with a blue header bar and a close button in the top right corner. The main area has a dark blue background. It contains two input fields: "Working Hour Cost" with the value "50" and "\$/Hr" unit, and "Delay Cost" with the value "200" and "\$/Day" unit. Below these is a light blue "Approve" button.

Figure 6.15: Project settings

6.4.2 Third Tab (Responsibilities)

The user can enter the responsibility factor cost directly in the entry box for each responsibility factor indicated in the list as shown in Figure 6.16.



The image shows a software window titled "Responsibilities" with a light blue header bar and a close button in the top right corner. The main area has a dark grey header with the text "Security, safety, and services" and "Fencing". Below this is a "Responsibilities List" with a scrollable list of items: Electricity, Water, Gas, Natural materials, Fencing (highlighted in blue), Lighting, Guarding and watching, Temporary works to protect public, owner and occupiers of, Maintenance required for access routes, Necessary signs and directions, Permissions to use routes, signs and directions, and Accident prevention officer. To the right of the list is a "Total Cost" input field with the value "10000" and a "\$" symbol. Above this field is a checkbox labeled "Included in BOQ". Below the "Total Cost" field is a light blue "Approve" button. At the bottom right are two buttons: "Risk Entry" and "Main Menu". At the bottom left are three buttons: "By Priority", "By Category", and "To Do". At the bottom center are four buttons: "To Provide", "Staff Welfare", "Contractual & Legal", and "Safety, Security & Services".

Figure 6.16: Responsibility factors data entry

The user can use responsibility factors sorted by priority or by categories. If the user has already included the cost of a certain responsibility in the estimated price of any bill of quantities item, he can simply click "Included in BOQ" button.

6.4.3 Fourth Tab (Risk Data Entry)

The risk data could be entered using risk factors listed according to their probability order or cost impact order. All lists have one data storage system, which means a risk factor included in a list has the same code of the same risk factor included in any other list.

The cost data is entered in the entry boxes as shown in Figure 6.17 against a given cumulative probability values of 0%, 25%, 50%, 75% and 100%. If the risk factor is too general, the comment box appears showing the proposed consequences of that risk as shown in Figure 6.17. Then the user can better understand that risk factor and estimate its cost.

Construction Related Risks
Risks In Probability Order
 4.18 Failure to protect the environment

Risks List

- 6.8 Work suspension is a responsibility of contractor
- 6.9 Failure to protect, store or secure works during susp
- 17.2 Property (real or personal) loss or damage
- 4.16 Goods loss or damage during transportation
- 20.1 Failure to give a claim notice within 28 days
- 9.2 Failure to carry out tests on completion
- 4.4 Deficiency of the suppliers
- 8.4 Non-availability of goods or personnel caused by go
- 7.1 Defects in contractor's manufacturing or production
- 6.1 Non-availability of labour, personnel or equipment
- 4.18 Failure to protect the environment**
- 17.1 Bodily injuries, sickness, diseases or death
- 6.11 Unlawful, riotous or disorderly conduct by contract
- 7.6 Failure to comply with Engineer's instructions
- 15.2 Contract termination by the employer
- 4.22 Unauthorized entry to site
- 4.1 Permanent works designed by contractor failure
- 11.5 Increase the amount of performance security due t
- 11.2 Plant, materials or workmanship not being in accor
- 4.2 Failure to pay the employer a due amount
- 11.2 Failure to comply with obligations
- 9.4 Contract price reduction due to failure to pass tests
- 4.16 Roads or bridges damage during transportation
- 2.24 Fossils loss or damage
- 11.4 Failure to remedy defects

Risk Input

Probability	Corresponding Cost
0 %	100 \$
25 %	1000 \$
50 %	5000 \$
75 %	10000 \$
100 %	50000 \$

Approve

Categories

Comments: 1- Ecological damage, 2- Pollution, 3- Waste treatment.

Responsibilities **Main Menu**

Relationships **Simulation**

Figure 6.17: Risk factors data entry

Another method to enter the cost data is through the consequences as shown in Figure 6.18. FCIES calculates the cost values according to the project settings entered in Figure 6.15. By clicking on "Approve" button, the values will be saved.

Construction Related Risks

Risks In Probability Order

4.1 Non-availability of goods, consumables, etc.

Risks List

- 4.1 Non-availability of goods, consumables, etc.
- 8.7 Delay to complete work stated in the contract
- 13.1 Work interruption due to variation
- 8.4 Delay, impediment or prevention caused by employer
- 17.2 Works or goods loss or damage
- 8.9 Contractor's design, workmanship or materials failure
- 4.1 Temporary works loss or damage
- 4.17 Contractor's equipment loss or damage
- 1.9 Delayed drawings or instructions due to contractor's
- 4.14 Interference in the convenience of public
- 7.5 Rejection of plant, materials or workmanship
- 4.4 Faults or mis-acts of the subcontractor
- 8.5 Unforeseen disruption or delay by authorities
- 14.6 Interim payment certificate with-held
- 4.7 Errors in positions, levels, dimensions or alignments
- 2.1 Engineer's failure (caused by contractor) to give right
- 11.5 Repetition of tests after remedying of defects
- 4.10 Miss of site related data
- 8.7 Delay to pass tests on completion
- 7.4 Additional tests fail
- 4.2 Failure to extend the validity of performance security
- 4.8 Failure to comply with safety regulations
- 8.4 Exceptional adverse climatic conditions
- 19.4 Natural catastrophes
- 4.20 Employer's equipment loss or damage while under

Risk Input

Risk Impact

Probability	Corresponding Cost
0 %	100 \$
25 %	1000 \$
50 %	5000 \$
75 %	10000 \$
100 %	40000 \$

Consequences 100 %

Additional Cost: 5000 \$

Delay: 50 Days

Additional Work: 100 Hours

Claims: 20000 \$

Categories

Priorities: Probability Cost Impact

Mitigation

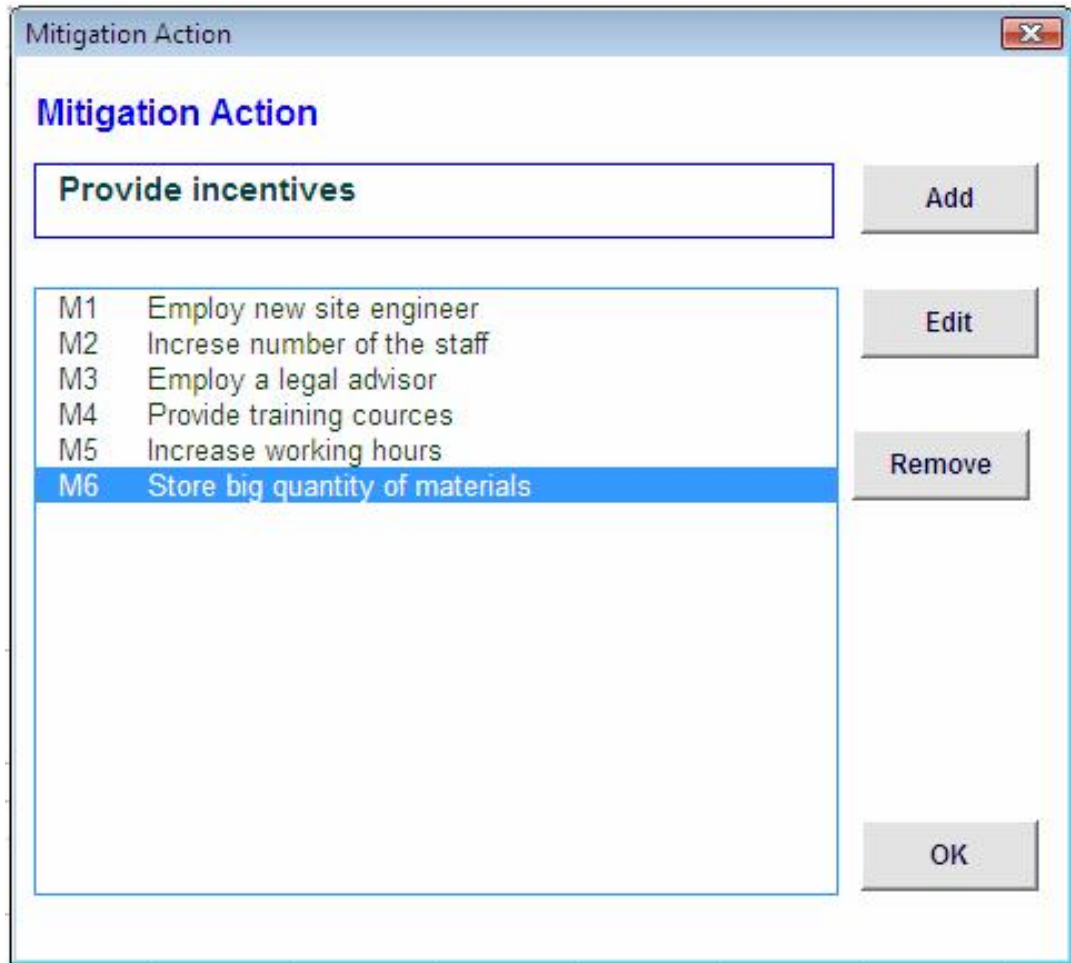
Responsibilities Item Menu

Relationships Simulation

Figure 6.18: Risk factors data entry by consequences

6.4.4 Fifth Tab (Mitigation Actions)

Mitigation actions can be entered manually by the user. The user can choose a previously entered mitigation action or introduce a new mitigation action by clicking on the "Add" button. A form appears as shown in Figure 6.19 to allow the user to introduce a new mitigation action. The user can also edit or delete any previously entered mitigation action.



The image shows a software window titled "Mitigation Action". At the top, there is a text input field containing "Provide incentives" and an "Add" button to its right. Below this is a list box containing six items, each with a code and a description: M1 Employ new site engineer, M2 Increase number of the staff, M3 Employ a legal advisor, M4 Provide training courses, M5 Increase working hours, and M6 Store big quantity of materials. The item M6 is currently selected and highlighted in blue. To the right of the list box are three buttons: "Edit", "Remove", and "OK".

Code	Description
M1	Employ new site engineer
M2	Increase number of the staff
M3	Employ a legal advisor
M4	Provide training courses
M5	Increase working hours
M6	Store big quantity of materials

Figure 6.19: New mitigation actions entry

When a mitigation action is chosen, the user has to define its cost and risk reduction percentage to cost of risk factor he estimates that will result from introducing this mitigation action as shown in Figure 6.20. At clicking the "OK" button, FCIES calculates the risk cost with mitigation at probability of 50% and compare it with the risk cost without mitigation at the same probability. If the mitigation action saves no cost, it will not be accepted. When clicking "Approve" button, new, with mitigation, probability distribution will be recorded.

Construction Related Risks

Risks In Probability Order

4.1 Non-availability of goods, consumables, etc.

Risks List

4.1 Non-availability of goods, consumables, etc.
8.7 Delay to complete work stated in the contract
13.1 Work interruption due to variation
8.4 Delay, impediment or prevention caused by employer
17.2 Works or goods loss or damage
8.9 Contractor's design, workmanship or materials failure
4.1 Temporary works loss or damage
4.17 Contractor's equipment loss or damage
1.9 Delayed drawings or instructions due to contractor's
4.14 Interference in the convenience of public
7.6 Rejection of plant, materials or workmanship
4.4 Faults or mis-acts of the subcontractor
8.5 Unforeseen disruption or delay by authorities
14.6 Interim payment certificate withheld
4.7 Errors in positions, levels, dimensions or alignments
2.1 Engineer's failure (caused by contractor) to give right
11.6 Repetition of tests after remedying of defects
4.10 Miss of site related data
8.7 Delay to pass tests on completion
7.4 Additional tests fail
4.2 Failure to extend the validity of performance security
4.8 Failure to comply with safety regulations
8.4 Exceptional adverse climatic conditions
19.4 Natural catastrophes
4.20 Employer's equipment loss or damage while under

Categories

Priority

Probability

Cost Impact

Risk Input

Mitigation

Mitigation Risk

Mitigation Actions List

Add / Edit

Provide training courses

Cost

5000

\$

Reduction

5

%

OK

M1	Employ a design engineer	15	7000
M2	Increase the number of staff	10	2000

Remove

Approve

Responsibilities

Main Menu

Relationships

Simulation

Figure 6.20: Mitigation actions entries

For better utilization of a mitigation action, FCIES was designed to accept the previously used mitigation action for other risk factors, but without duplicating of the cost. When this mitigation action is chosen for another risk factor, a message of "In Hand Mitigation Action" appears and the cost box becomes blocked and gets a value of zero as shown in Figure 6.21.

Construction Related Risks

Risks In Probability Order

8.7 Delay to complete work stated in the contract

Risks List

- 4.1 Non-availability of goods, consumables, etc.
- 9.7 Delay to complete work stated in the contract
- 13.1 Work interruption due to variation
- 8.4 Delay, impediment or prevention caused by employer
- 17.2 Works or goods loss or damage
- 8.9 Contractor's design, workmanship or materials failure
- 4.1 Temporary works loss or damage
- 4.17 Contractor's equipment loss or damage
- 1.9 Delayed drawings or instructions due to contractor's
- 4.14 Interference in the convenience of public
- 7.0 Rejection of plant, materials or workmanship
- 4.4 Faults or mis-acts of the subcontractor
- 8.5 Unforeseen disruption or delay by authorities
- 14.6 Interim payment certificate with hold
- 4.7 Errors in positions, levels, dimensions or alignments
- 2.1 Engineer's failure (caused by contractor) to give right
- 11.6 Repetition of tests after remedying of defects
- 4.10 Miss of site related data
- 8.7 Delay to pass tests on completion
- 7.4 Additional tests fail
- 4.2 Failure to extend the validity of performance security
- 4.8 Failure to comply with safety regulations
- 0.4 Exceptional adverse climatic conditions
- 19.4 Natural catastrophes
- 4.20 Employer's equipment loss or damage while under
- 8.8 Work suspension is a responsibility of contractor

Categories

Principles Probability Cost Impact

Comments: Delay damages.

Mitigation Risk

Mitigation Actions List Add / Edit

Employ a design engineer **In Hand Mitigation Action**

Cost 0 \$

Reduction %

OK

Remove Approve

Responsibilities Main Menu

Relationships Simulation

Figure 6.21: Mitigation actions entries with a previously used mitigation action

6.4.5 Sixth Tab (Risks Relationships)

When the user chooses a risk factor at the main risk list and then chooses the dependent risk factor from the dependent risk list, he has to define the degree of dependency as shown in Figure 6.22. The dependent (child) risk factors are viewed with the degree of dependency in the box. By clicking "Approve" button, the relationships will be saved.

Risks Relationships

4.1 Non-availability of goods, consumables, etc.

Risks List

17.2 Property (real or personal) loss or damage

55 % Add Relation to list

Risks Relationship List

Risk Name	Value
14.6 Interim payment certificate with-held	70
13.1 Work interruption due to variation	80
1.9 Delayed Drawings or instructions	75

Remove Remove All Approve

Risk Entry Main Menu

Figure 6.22: Dependency relationships

6.4.6 Seventh Tab (Simulation)

As the risk factors data entry is completed, the simulation is now ready to be performed. Any un-entered data takes a value of zero. The user has to choose the number of iterations in the entry box as shown in Figure 6.23. By clicking on "RUN" button, FCIES starts the simulation process and a progress bar appears.

Two cumulative S curves are plotted, without mitigation actions curve with blue color and with mitigation actions curve with pink color.

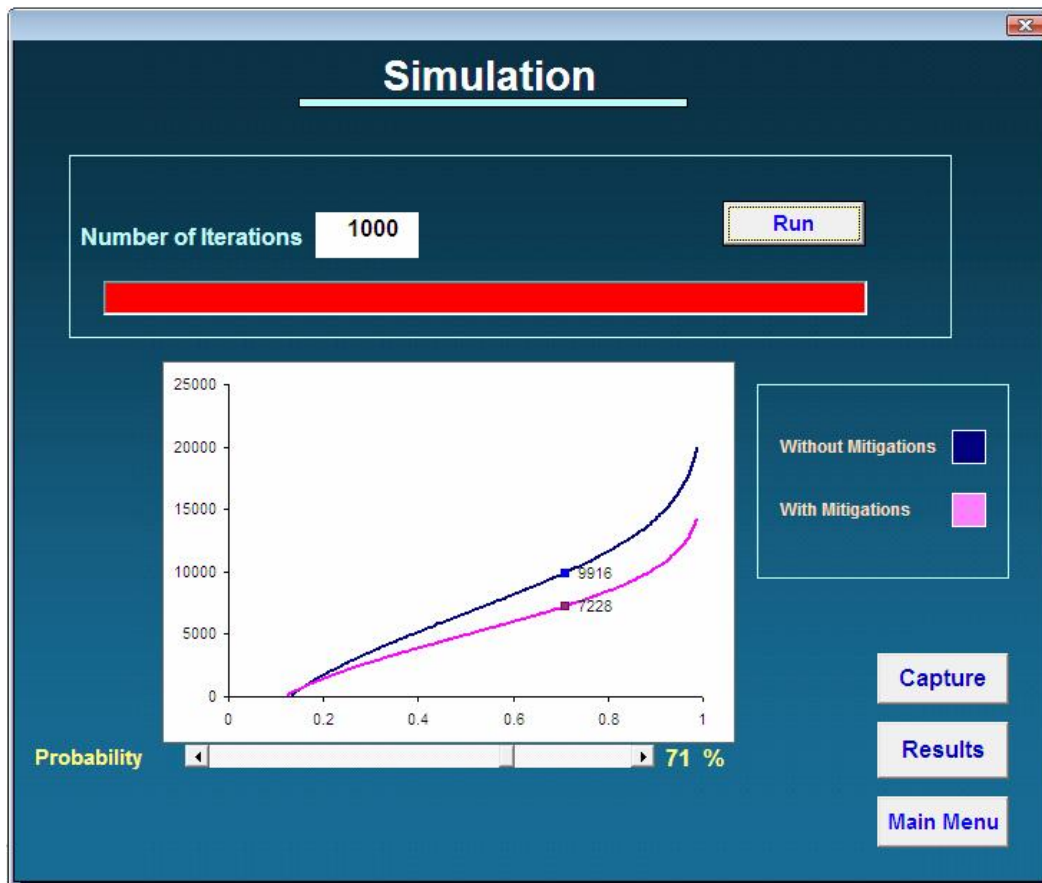


Figure 6.23: Result of simulation

It is observed that the curves are overlapping at the lower corner. The mitigation action curve takes higher cost values at low probability values. This is because the entered mitigation actions have a fixed costs and FCIES accepts the mitigation action if it is efficient at cumulative probability of 50%, but it could not be efficient at lower cumulative probability values such as 10% or 20%. At lower cumulative probability values the risk reduction counts a small value of cost, but the fixed cost remains the same, which eventually leads to formation of this overlap. At the break even point, the risk cost without mitigation actions is equal to the risk cost with mitigation actions.

The accepted probability is pointed out using the below scroll bar. By moving the scroll bar, new cost values shall be loaded on the curve. When the satisfactory values are reached, the user clicks on "Capture" button, and then the values are saved.

6.4.7 Eighth Tab (Results)

The results are viewed in the result form in terms of risks and responsibilities costs. The user clicks option button choosing to adopt either risk cost without mitigation actions or with

mitigation actions. When clicking on "Approve" button, the final cost appears in the lower box as shown in Figure 6.24.

The screenshot shows a software window titled "Results" with a dark blue background. At the top center, the word "Results" is displayed in white. Below it, there are two main sections: "Risks" on the left and "Responsibilities" on the right. The "Risks" section contains two radio buttons: "Without Mitigations" (unselected) and "With Mitigations" (selected). Next to "Without Mitigations" is a text box showing "9828" followed by a "\$" symbol. Next to "With Mitigations" is a text box showing "7723" followed by a "\$" symbol. The "Responsibilities" section contains a single text box showing "10800" followed by a "\$" symbol. Below these sections is a yellow "Approve" button. At the bottom left, the text "Final Cost" is followed by a text box showing "18523" and a "\$" symbol. At the very bottom, there is a navigation bar with five buttons: "Main Menu", "Risk Entry", "Responsibilities", "Simulation", and "Exit".

Category	Option	Value	Unit
Risks	Without Mitigations	9828	\$
	With Mitigations	7723	\$
Responsibilities		10800	\$
Final Cost		18523	\$

Figure 6.24: Final results

6.5 FCIES Testing

To ensure that FCIES provides the expected results and incorporates the functions described earlier, model verification and validation were conducted. The following are the verification and validation tests carried out on FCIES.

6.5.1 Model Verification

Verification is like debugging. It is intended to ensure that the model does what it is intended to do (Hillston 2003). Verification test is performed by executing the program using examples to find errors (Moussa et al, 2006).

6.5.1.1 Antibugging

Antibugging consists of including additional checks and outputs in a model that may be used to capture bugs if they exist (Hillston, 2003). Antibugging was carried out by the modeler at all steps of FCIES programming, temporary boxes were added to the computer program for this purpose. These temporary boxes were designed to show the in-process values and compare those

values to expected ones. MS Excel has the facility of automatic debugging. It detects any wrong entry or wrong process and the modeler can easily locate the bugs and rectify them.

6.5.1.2 Deterministic Models

For simulation models, the presence of random variables can make it hard for the modeler to reason about the behaviour of a model and check that it is as expected or required (Hillston, 2003). The test was carried out by observing the behaviour of the random numbers. The random numbers are generated randomly in the program, but with some control. The developer has introduced risk dependency relationships. For the dependent risk factors, the generated random number must be controlled according to the introduced dependency relationship.

Temporary boxes were introduced in FCIES to show up the behaviour of the random number generation for the dependent risk factors. The system was found running satisfactorily. An example of deterministic test is shown in Figure 6.25, where a certain dependency relationship was introduced. The probability of occurrence of risk factor "Delay to complete work stated in the contract" was defined as 80% of the parent risk factor "Non-availability of goods, consumables, etc.". The two lower temporary boxes show the generated random number by the program. A manual calculation of the relationship gives same value.

Relationships

Risks Relationships

4.1 Non-availability of goods, consumables, etc.

4.1 Non-availability of goods, consumables, etc.
 8.7 Delay to complete work stated in the contract
 13.1 Work interruption due to variation
 8.4 Delay, impediment or prevention caused by employee
 17.2 Works or goods loss or damage
 8.9 Contractor's design, workmanship or materials failure
 4.1 Temporary works loss or damage
 4.17 Contractor's equipment loss or damage
 1.9 Delayed Drawings or instructions
 4.14 Interference in the convenience of public
 7.5 Rejection of plant, materials or workmanship
 4.4 Faults or mis-acts of the subcontractor
 8.5 Unforeseen disruption or delay by authorities
 14.6 Interim payment certificate withheld
 4.7 Errors in positions, levels, dimensions or alignments
 2.1 Engineer's failure (caused by contractor) to give right
 11.6 Repetition of tests after remedying of defects
 4.10 Miss of data
 8.7 Delay to pass tests on completion
 7.4 Additional tests fail
 4.2 Failure to extend the validity of performance security
 4.8 Failure to comply with safety regulations
 8.4 Exceptional adverse climatic conditions
 19.4 Natural catastrophes
 4.20 Employer's equipment loss or damage while under
 8.8 Work suspension is a responsibility of contractor
 8.9 Failure to protect, store or secure works during susp
 17.2 Property (real or personal) loss or damage

Risks List

% **Add Relation to list**

Risks Relationship List

Risk Name	Value
Delay to complete work stated in the contract	80

0.477914 0.382331 **Approve**

Risk Entry **Main Menu**

Figure 6.25: Random number generation test

6.5.1.3 Continuity Testing

Continuity testing consists of running a simulation model several times for slightly different values of input parameters. For any one parameter, a slight change in input should generally produce only a slight change in the output. Any sudden changes in the output are taken to be an indication of a possible error which should be investigated unless this is known behaviour of the system (Hillston, 2003). FCIES was exposed to such test, the risk and responsibility factors cost entries were introduced with slight increase or decrease, the results obtained were reasonable. The simulation was run with different number of iterations. The new curves produced were close to the original curve.

An example of continuity test which is carried out on FCIES is shown in Figure 6.26, where the input values have been slightly changed, the output responded to these changes in reasonable manner.

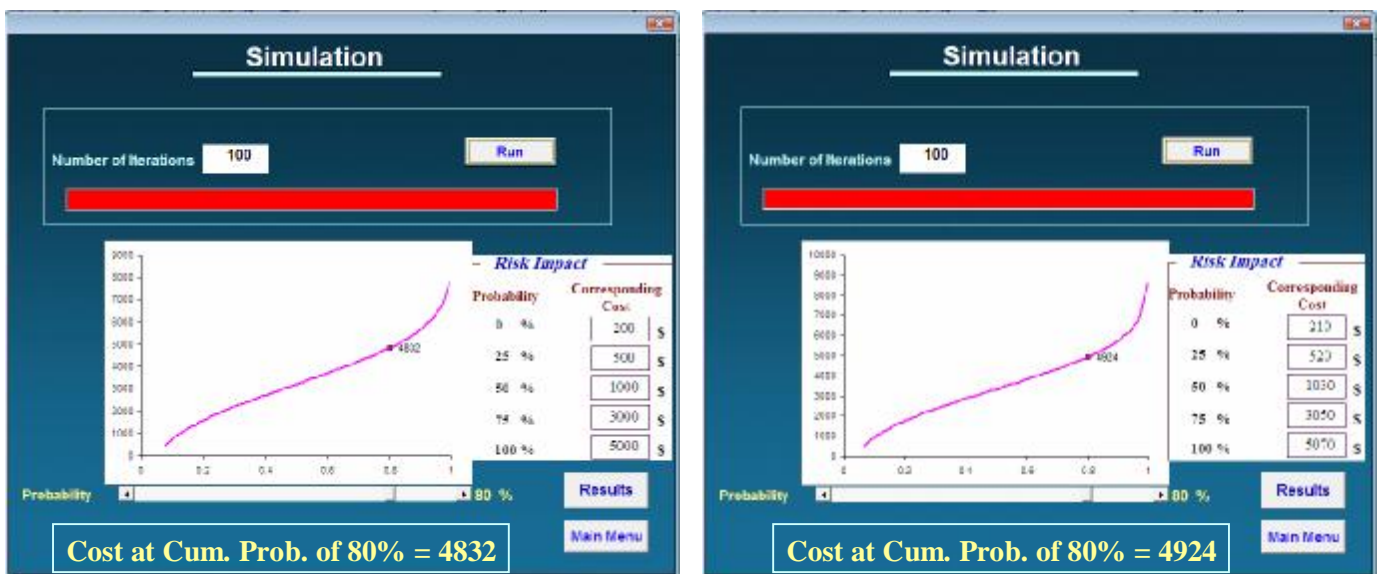


Figure 6.26: Continuity test

6.5.1.4 Degeneracy Testing

Degenerate cases for a model are those values of input parameters which are at the extreme of the model's intended range of presentation. Degeneracy testing consists of checking that the model works for the extreme values of system and work input parameters. Degeneracy testing can help the modeler to find bugs that would not otherwise have been discovered (Hillston, 2003). FCIES simulation was run at its maximum number of iterations (5000). The results were satisfactory. FCIES was tested at maximum capacity, all risk and responsibility factors entries were introduced, and large number of dependency relationship trees was formulated with large path length. The results are reasonable.

6.5.2 Model Validation

Validation is the task of demonstrating that the model is a reasonable representation of the actual system. A proven approach of model validation may be applied as appropriate to the different aspects of a particular model. This approach called expert intuition (Hillston, 2003).

6.5.2.1 Expert Intuition

Essentially using expert intuition to validate a model is similar to use of one-step analysis model verification. Here, however, the examination of the model should ideally be led by someone other than the modeler (Hillston, 2003). This validation technique is applied on FCIES evaluation as shown in section 6.6. The researcher evaluates FCIES by local expert contractors asking them to show their opinion about FCIES.

6.6 FCIES Evaluation

To evaluate FCIES, it was introduced to expert contractors asking them to evaluate it in terms of function, understandability, and friendliness. This technique can be used to determine if the logic in the conceptual model is correct and if the model's input and output relationships are reasonable. This step was accomplished by approaching 5 local contractors whom are classified in the first class according to PCU. They were asked to show their opinion about FCIES. The program was illustrated and explained to them in a way that enables them to use it and read the results. A structured questionnaire was designed to get a feedback about the FCIES performance in addition to respondent's comments (see Annex 4 and Annex 5). This technique could be considered as a part of model validation of expert intuition as shown in section 6.5.2.1.

6.6.1 FCIES Performance

Table 6.1 shows the distribution of responses on FCIES performance. It is observed that the evaluators were generally satisfied with FCIES characteristics. The results show that the overall weighted mean satisfaction of FCIES performance is (88.29 %). This result is considered a very good one. This indicates that FCIES has a very good potential of acceptance amongst contractors in order to enhance and improve construction industry in the Gaza Strip.

According to respondent's opinions, there are many advantages that can be obtained by using FCIES, such as:

- The evaluators find FCIES is very helpful in the proper understanding of the terms of conditions of contract for construction (FIDIC 99).

- FCIES helps in accurate and complete assessment of the financial impact of conditions of contract for construction (FIDIC 99).
- FCIES allays fear of lack of sufficient information and expertise about conditions of contract for construction (FIDIC 99).
- FCIES helps to find creative ways for dealing with risk and preparedness. FCIES was equipped with the facility of using actions to mitigate these risks.
- FCIES saves time and minimize efforts in cost estimation and increase the dependency on computerized systems in cost estimation process.
- FCIES is simple to use and provides sufficient flexibility in order to absorb the facts and alternatives.
- Results obtained can be easily and readily read.
- FCIES is suitable for large projects rather than small projects.

6.6.2 Evaluators Comments and Suggestions

Evaluators, in general, show a high degree of comfort when using FCIES. They mentioned that FCIES is user friendly, specific, illustrative and creative. It is the first software developed to deal with the cost impact of standard conditions of contract in the Gaza Strip; especially it deals with the recently officially adopted standard, FIDIC 99.

They also mentioned that by using FCIES, the estimated cost will be determined more scientifically by using formulas, charts and facts. Evaluators think that FCIES deals with risks and liabilities in a realistic, thoughtful and appropriate way to be practiced in the Gaza Strip. They also mentioned an important point; they are not compelled to study and analyze the conditions of contract for construction (FIDIC 99) every time they estimate a project price, because FCIES includes the items which have cost impact on the contractor from the FIDIC 99.

The evaluators were generally happy with the design of the FCIES. They mentioned that FCIES displays data in attractive and easy to understand way.

Table 6.1: FCIES performance as expressed by evaluators

No.	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree	Weighted mean %
1	FCIES helps in the proper understanding of the terms of the FIDIC 99	5	0	0	0	0	100
2	FCIES helps in the accurate assessment of the financial impact of the FIDIC 99	2	2	1	0	0	84
3	FCIES Reflects the complete financial impact of the FIDIC 99	2	2	1	0	0	84
4	FCIES allays fear of lack of sufficient information and expertise to deal with FIDIC 99	5	0	0	0	0	100
5	FCIES contributes in determining a safe and suitable bid price	3	2	0	0	0	92
6	FCIES helps in bidding with a competitive and suitable price	2	1	1	1	0	76
7	FCIES helps to find creative ways of dealing with risk and preparedness	4	0	1	0	0	92
8	FCIES allows for higher dependency on computers in project management	5	0	0	0	0	100
9	FCIES is simple to use	3	1	1	0	0	88
10	FCIES saves time and minimize efforts in cost estimation	4	1	0	0	0	96
11	FCIES gives sufficient flexibility to absorb the facts and alternatives	2	3	0	0	0	88
12	Results obtained can be readily and clearly read	4	1	0	0	0	96
13	FCIES is suitable for small size projects	0	1	1	2	1	48
14	FCIES is suitable for large size projects	3	2	0	0	0	92
Average Mean %							88.29

There was a criticism about FCIES. The program calculates the cost impact of conditions of contract for construction (FIDIC 99) in terms of responsibilities and risks apart from cost estimating of bill of quantities. Another criticism was raised, the responsibility and risk factors were built in the program, where the user can not modify, add or delete any item, which in turn limits the flexibility of the program

One respondent recommended developing another version of this program in Arabic language. Many respondents recommended providing training courses for the local contractors in order to better understand the conditions of contract for construction (FIDIC 99) and better use of the FCIES.

Chapter Seven

Conclusions and Recommendations

7.1 Introduction

FCIES has been developed to meet the need of the Gaza Strip contractors to evaluate the cost impact of adoption of conditions of contract for construction (FIDIC 99). After conducting a field survey and FCIES development and evaluation, the researcher provides conclusions and recommendations which emerged from the results and observations of this study.

The conclusions and recommendations aim at improving the capability of contractors in better handling the cost estimation of project under conditions of contract for construction (FIDIC 99).

7.2 Conclusions

- The majority of contractors do not use formalized techniques for estimating contingencies when preparing tenders. They do not use computerized tools to evaluate and manage responsibilities and risks and, in general, there is no commitment to employ an experienced person or team for evaluating and managing responsibilities and risks.
- Local contractors do not have suitable tools to calculate the impact of adoption of conditions of contract for construction (FIDIC 99).
- Insurance, as a risk transfer strategy, is the most favorite mitigation action practiced by local contractors.
- Conditions of contract for construction (FIDIC 99) has introduced a system in dealing with disputes, which is called Dispute Adjudication Board (DAB). Introducing DAB in settling disputes between the contracting parties is the most appreciated feature of FIDIC 99. Contractors look positively at FIDIC 99 as it discourages disputes and maintains positive relationship between contracting parties. The researcher believes that FIDIC 99 meets the desire of local contractors to eliminate or discourage disputes.
- The acceptance of conditions of contract for construction (FIDIC 99) is not, however, without its problems. There are still some disadvantages of FIDIC 99 from contractor's point of view such as:

- It is not well adapted to cope with large number of variations.
- Presence of some biased clauses in favour of the employer.
- Low contractor involvement in decisions related to design.
- The survey revealed that the most prominent responsibility factors are:
 - Providing different types of insurance such as insurance against persons injury and property damage, insurance for works and contractor's equipment and insurance against sickness, disease or death of any contractor's personnel.
 - Keeping the site and works clear from unnecessary obstructions, rubbish, temporary works, equipment or surplus materials.
 - Complying with safety regulations. This obligation requires the contractor to provide safety apparatus and tools, safety signs, appointing of safety officer and promote the safety culture among the workers and everybody involved.
- The survey also revealed that the most prominent risk factors are:
 - Non-availability of goods, consumables and construction materials. This factor is very common in the Gaza Strip due to the siege and border closures.
 - Delay to complete work stated in the contract. This risk is relatively related to the previous risk, where the non-availability of construction materials leads to delay in completing work stated in the contract.
 - Work interruption due to variations.
 - With-holding of Interim payment certificate, which leads to contractor's cash flow disturbances which make the contractor unable to fulfill his obligations.
- FCIES was developed in order to help local contractors to estimate the cost impact of adoption of conditions of contract for construction (FIDIC 99). FCIES had a very good potential of acceptance among contractors.
- FCIES evaluators are generally satisfied with the software performance. They consider that FCIES could play an important role in improving the cost estimation process under conditions of contract for construction (FIDIC 99) as contractors are not yet quite familiar with this standard.
- The main FCIES advantages that observed are:

- It helps contractors in proper understanding the terms of conditions of contract for construction (FIDIC 99).
- FCIES helps in better assessment of the financial impact of conditions of contract for construction (FIDIC 99).
- FCIES saves time and minimizes efforts in cost estimation process.
- FCIES is flexible and easy to use.
- Results obtained can be easily read.

7.3 Recommendations

- As this study revealed that the vast majority of contractors do not pay the required attentions to liabilities and risks when pricing the bid, contractors are advised to ensure that the pricing team is fully supported with the necessary tools and techniques to deal with this matter.
- More time and effort should be provided in the front-end of a project. Experienced staff should be involved to manage or mitigate the risks and administrate the contract.
- Risk documentation is a critical issue. It consumes a lot of efforts and money, but it is very essential in better management of resources. The contractors can benefit by keeping records of their liabilities and risks management results on various projects. Historical risk records will be helpful in pricing future projects more accurately.
- Variations are also a major threat for the contractors which cause work interruption, delays and cost overrun. It is believed that early involvement of contractor reduces the possibility of excessive variations. Of course, this can happen by encouraging other types of contract settings such as design-build and construction management.
- Lack of construction materials occupies the highest rank in any recent research related to construction problems in the Gaza Strip. So, it is recommended to buy and store as much as possible of construction materials at the front-end of the project.
- Contractors are invited to use FCIES in order to get more accurate cost estimation and improve the construction management process.

- Offering training courses about the conditions of contract for construction (FIDIC 99) is an important idea. Such training enables contractors to safely and easily understand the cost impact of this standard. Contractors could be then well prepared for the future where there is a chance of economic recovery in the Gaza Strip.
- Awarding the project to the contractor whose bid is the lowest is not always the right decision. Other criteria are to be considered in order to award the project to the contractor whose bid is the most suitable and professional.

7.4 Recommendations for Further Studies

- The survey was conducted in the Gaza Strip in a period where the construction business was deteriorated or even paralyzed, which in turn was reflected on the results of the research. It is recommended to conduct another survey when the construction industry recovers and make a comparative analysis to the results.
- It is recommended to integrate FCIES with cost estimation software in order to have a comprehensive system which enables the contractors to estimate the cost of the project including all provisions due to conditions of contract.
- It is recommended to study and investigate the probability distribution of different risk factors. Future projects can be estimated utilizing the specific probability distribution for each risk factor.
- It is recommended to extend this research to include the conditions of contract for construction (FIDIC 99) particular conditions.
- It is recommended to add a facility of adding, modifying or removing of any factor included in lists of FCIES.

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Annex 1

Extracted risk factors with their consequences

Table A1-1: Extracted risk factors with their consequences

Clause		Risk factor	Consequence	Cons. Category
Construction Related Risks				
1.9	Delayed drawings or instructions	Delayed Drawings or instructions	Additional Cost	Cost
			Additional Time	Time
2.1	Rights of access to the site	Employer's failure (caused by contractor) to give right of access or possession of site	Additional Cost	Cost
			Additional Time	Time
4.1	Contractor's general obligations	Contractor's documents loss or damage	Claims	Claims
			Rework	Work
		Temporary works loss or damage	Additional Cost	Cost
			Additional Time	Time
			Rework	Work
		Failure of permanent works designed by contractor	Additional Cost	Cost
			Additional Time	Time
			Rework	Work
4.2	Performance security	Failure to remedy a default	Claims under performance security	Claims
4.7	Setting out	Errors in the positions, levels, dimensions or alignments	Additional Cost	Cost
			Additional Time	Time
			Rework	Work
4.16	Transport of goods	Goods loss or damage during transportation	Additional Cost	Cost
			Additional Time	Time
		Roads or bridges Damage during transportation	Additional Cost	Cost
			Claims	Claims
4.17	Contractor's equipment	Contractor's equipment loss or damage	Additional Cost	Cost
4.20	Employer's equipment and free materials	Employer's equipment loss or damage while under contractor's control	Additional Cost	Cost
			Additional Time	Time
			Claims	Claims

Table A1-1 (Cont'd): Extracted risk factors with their consequences

Clause		Risk factor	Consequence	Cons. Category
7.4	Testing	Additional tests fail	Additional Cost	Cost
			Additional Time	Time
			Remedial work	Work
7.5	Rejection	Rejection of plant, materials or workmanship	Additional Cost	Cost
			Additional Time	Time
			Remedial work	Work
			Claims	Claims
8.4	Extension of time for completion	Delay, impediment or prevention caused by employer	Additional cost	Cost
8.7	Delay Damages	delay to pass tests on completion	Delay damages	Cost
		delay to complete works stated in the contract	Delay damages	Cost
9.2	Delayed tests	Failure to carry out tests on completion	Additional work	Work
			Rework	Work
			Retesting	Work
9.4	Failure to pass tests on completion	Contract price reduction due to failure to pass tests on completion	Additional Cost	Cost
			Retesting	Work
11.2	Cost of remedying defects	Failure of contractor's design	Additional Cost	Cost
			Additional Time	Time
			Remedial work	Work
11.5	Removal of defective work	Increase the amount of performance security due to removal of defective work	Increase amount of performance security	Cost
11.6	Further Tests	Repetition of tests after remedying of defects	Additional Cost	Cost
			Remedial work	Work
13.1	Right to vary	Work Interruption due to variations	Additional Cost	Cost
			Additional Time	Time
17.2	Contractor's care of work	Contractor's documents loss or damage	Additional Cost	Cost
			Additional Time	Time
			Remedial work	Work

Table A1-1 (Cont'd): Extracted risk factors with their consequences

Clause		Risk factor	Consequence	Cons. Category
Performance Related Risks				
4.4	Subcontractors	Faults or mis-act of the subcontractor	Claims	Claims
		Deficiency of suppliers	Delay	Time
4.8	Safety procedures	Failure to comply with safety regulations	Injuries	Cost
			Claims by public, owners or occupiers of adjacent lands	Claims
6.11	Disorderly conduct	unlawful, riotous or disorderly conduct by contractor's personnel	claims	claims
7.1	Manner of execution	Defects in contractor's manufacturing or production	Additional cost	Cost
			Additional work	work
			Claims	Claims
7.6	Remedial work	Failure to comply with Engineer's instructions	Claims	Claims
8.9	Consequences of suspension	Contractor's design, workmanship or materials failure during suspension	Additional Cost	Cost
			Additional work	Work
		Failure to protect, store or secure works during suspension	Claims	Claims
11.2	Cost of remedying defects	Plant, material or workmanship not being in accordance with the contract	Additional Cost	Cost
			Additional Time	Time
		Failure to comply with obligations	Remedial work	Work
11.4	Failure to remedy defects	Failure to remedy defects	Indemnify the employer	Cost
			Contract price reduction	Cost
			Additional cost	Cost
			Recover of sum paid	Claims
14.6	Issue of interim payment certificates	Interim payment certificate with-held	Payment with-held	Cost

Table A1-1 (Cont'd): Extracted risk factors with their consequences

Clause		Risk factor	Consequence	Cons. Category
17.1	Indemnities	Bodily injuries, sickness, diseases or death	Claims	Claims
		Property (real or personal) damage		
17.2	Contractor's care of work	Works or goods loss or damage	Additional Cost	Cost
			Additional Time	Time
			Remedial work	Work
Contractual and Legal Risks				
4.1	Contractor's general obligations	Non-availability of goods, consumables, etc.	Additional time	Time
			claims	Claims
4.2	Performance security	Failure to extend the validity of performance security	Claims under performance security	Claims
			Termination by employer	Claims
		Failure to pay the employer a due amount	Claims under performance security	Claims
6.1	Engagement of staff and labor	Non-availability of labor, personnel or equipment	Additional time	Time
			claims	Claims
8.8	Suspension of work	Work suspension is a responsibility of contractor	Storing and preservation cost	Cost
			Additional time	Time
15.2	Termination by employer	Contract termination by the employer	Payment reduction	Cost
			Payment withheld	Cost
			Claims	Claims
20.1	Contractor's claims	Failure to give claim notice within 28 days	Additional cost	Cost
			Additional time	Time
20.3	Failure to agree DAB	Failure to appoint a member of DAB	Remuneration	Cost

Table A1-1 (Cont'd): Extracted risk factors with their consequences

Clause		Risk factor	Consequence	Cons. Category
Physical Risks				
4.10	Site data	Miss of site related data	Additional Cost	Cost
			Additional Time	Time
			Rework	Work
			Claims	Claims
			Additional work	Work
4.24	Fossils	Fossils loss or damage	Claims	Claims
8.4	Extension of time for completion	Adverse climate conditions	Additional cost	Cost
19.4	Consequences of force majeure	Natural catastrophes	Additional cost	Cost
			Additional time	Time
			Work, materials or goods damage	Cost
Political and Social Risks				
4.14	Avoidance of interference	Interference in the convenience of public	Claims	Claims
4.18	Protection of the environment	Failure to protect the environment	Claims	Claims
4.22	Security of the site	Unauthorized entry to site	Claims	Claims
8.4	Extension of time for completion	Non-availability of goods or personnel caused by epidemic	Additional cost	Cost
		Non-availability of goods or personnel caused by government actions	Additional cost	Cost
8.5	Delay caused by authorities	Unforeseen disruption or delay by authorities	Additional cost	Cost
17.5	Intellectual and industrial property rights	Infringement of intellectual and industrial property rights	Claims	Claims

Annex 2

The Questionnaire

(Arabic Version)

بسم الله الرحمن الرحيم

استبيان للمقاولين في قطاع غزة

السلام عليكم ورحمة الله وبركاته و بعد..

أتقدم لكم بجزيل الشكر و الامتنان لمساهمتمكم بجزء من وقتكم للإجابة على هذا الاستبيان ، وأرجو أن ألفت عناية حضراتكم إلى الملاحظات الآتية :

- 1- إن هذا الاستبيان هو جزء من دراسة أشمل للتأثير المالي لبنود عقد الإنشاءات الفلسطيني الموحد (الفيديك 99) على تسعير العطاءات من قبل المقاولين.
- 2- الدراسة هي البحث التكميلي لنيل درجة الماجستير في إدارة التشييد في الجامعة الإسلامية بغزة، و يأمل الباحث أن تسهم الدراسة في تحسين أداء المقاولين في طريقة تسعير المشاريع و بالتالي وضع نسبة ربح آمنة.
- 3- المعلومات التي ستساهمون بها هي لغرض البحث العلمي، مع الالتزام التام بالمحافظة على سرية المعلومات الخاصة بكم.
- 4- يرجو الباحث أن تكون المعلومات دقيقة و صحيحة للوصول إلى النتائج المرجوة من هذا البحث.
- 5- مكونات الاستبيان
 - الجزء الأول : معلومات عامة عن الشركة.
 - الجزء الثاني : معلومات عامة عن كيفية إدارتكم للمخاطر و المسؤوليات عند تسعير العطاءات و كذلك تعاملكم مع عقد المقاول الفلسطيني الموحد (الفيديك 99).
 - الجزء الثالث : تقييم التأثير المالي و احتمالية الحدوث (من وجهة نظر المقاول) لعوامل الخطر و المسؤوليات المترتبة على الالتزام ببند عقد المقاول الفلسطيني للمشاريع الإنشائية (الفيديك 99). و يمكنكم إضافة بنود مخاطرة أو مسؤوليات جديدة (لم يتم ذكرها في الاستبيان).
- 6- لمزيد من التوضيح الرجاء الإطلاع على بنود عقد المقاول الفلسطيني الموحد (الفيديك 99).
- 7- تقديراً لكم على مشاركتكم في هذا الاستبيان فإن الباحث سيطلعكم إن شاء الله على نتائج الدراسة للاستفادة منها قدر الإمكان.

مع الشكر الجزيل

الباحث : زكريا محمد الجاروشة

الجزء الأول : وصف الشركة

1.1 المركز الوظيفي لمن يقوم بتعبئة الاستبيان

☐ مدير الشركة

☐ نائب المدير

☐ مدير مشروع

☐ مهندس موقع

2.1 عدد سنوات خبرة المؤسسة في مجال الإنشاءات

☐ أقل من 3 سنوات

☐ 3 - 5 سنوات

☐ 6 - 10 سنوات

☐ أكثر من 10 سنوات

3.1 نوع المشاريع المنفذة

☐ أبنية

☐ طرق

☐ مياه و صرف صحي

☐ منشآت صناعية

4.1 عدد المشاريع المنفذة خلال الخمس سنوات الماضية

☐ 5 مشاريع فأقل

☐ 6 - 10 مشاريع

☐ 11 - 20 مشروعاً

☐ أكثر من 20 مشروعاً

5.1 الحجم المالي للمشاريع المنفذة خلال الخمس سنوات الأخيرة

☐ 0.5 مليون دولار فأقل

☐ 0.6 - 1 مليون دولار

☐ 1.1 - 5 مليون دولار

☐ 5.1 - 10 مليون دولار أمريكي

☐ أكثر من 10 مليون دولار

الجزء الثاني : معلومات عامة متعلقة بالتعاقد

يرجى الإجابة على الأسئلة التالية موضحاً الممارسات العامة لمؤسستكم في الأمور التعاقدية

1.2 هل يتم وضع تصور للتكاليف غير المنظورة عند إعداد العطاء؟

- ☐ نعم
☐ لا

2.2 هل يتم استخدام برامج الحاسوب للتعامل مع المسئوليات و المخاطر غير المنظورة

- ☐ نعم
☐ لا

3.2 هل يتم استخدام أدوات خاصة لحساب التأثير المالي لالتزامكم بعقد المقابلة الموحد (الفيديك 99)

- ☐ نعم
☐ لا

4.2 أذكر عقود المقاولات القياسية التي استخدمتها في السابق؟

- ☐ الفيديك 87
☐ الفيديك 99
☐ عقد الأونروا
☐ عقد UNDP
☐ عقد بكدار
☐ عقد البنك الدولي
☐ عقد الإتحاد الأوروبي
☐ عقد SMDM
☐ عقد وزارة الأشغال العامة
☐ عقد سلطة المياه
☐ أخرى

5.2 ما هو عدد المشاريع التي قمت بتنفيذها حسب عقد الفيديك 99؟

- ☐ 5 مشاريع فأقل
☐ 6 – 10 مشاريع
☐ أكثر من 10 مشاريع

6.2 ما هي الإستراتيجية التي تتبعونها للتعامل مع المسئوليات و المخاطر

- ☐ التجنب
☐ الترحيل لجهة أخرى
☐ تخفيف التأثير
☐ الإبقاء

7.2 فيما يلي بعض الأعمال للتخفيف من تأثير المسئوليات و المخاطر، يرجى إيضاح درجة استخدامكم لها

الفقرة	كبير جداً	كبير	متوسط	ضعيف	ضعيف جداً
أ					
ب					
ج					
د					
هـ					
و					
ز					
ك					
ل					
م					
أخرى					

8.2 فيما يلي أهم مزايا عقد الفيديو 99، يرجى توضيح مدى موافقتكم على المزايا الآتية

الفقرة	أوافق بشدة	أوافق	لا أدري	لا أوافق بشدة
أ				
ب				
ج				
د				
هـ				
و				
ز				
ك				
ل				
أخرى				

9.2 فيما يلي أهم عيوب عقد الفيديك 99، يرجى توضيح مدى موافقتكم على العيوب الآتية

الفقرة	أوافق بشدة	أوافق	لا أدري	لا أوافق	لا أوافق بشدة
أ					غير مناسب للتعامل مع عدد كبير من التغييرات
ب					يفترض أن المشروع موصّف جيداً قبل توقيع العقد
ج					يفترض أن سعر الوحدة يبقى ثابتاً
د					عدم مشاركة المقاول في القرارات الخاصة بالتصاميم
هـ					وجود بعض العبارات المتحيزة ضد المقاول
و					غير قابل للتطبيق في قطاع غزة
أخرى					

الجزء الثالث : تقييم التأثير المالي

فيما يلي المسؤوليات المستخلصة من بنود عقد المقاوله الموحد الفلسطيني للمشاريع الإنشائية (الفيديك 99)، يرجى توضيح مدى التأثير المالي لكل مسؤولية من المسؤوليات.

التأثير المالي					المسئولية	الفقرة	
منخفض جداً	منخفض	متوسط	كبير	كبير جداً			
					تقديم 6 نسخ من وثائق المقاول	8.1	العناية بالوثائق و التزود بها
					الحصول على التصاريح المطلوبة	13.1	التقيد بالقوانين
					تقديم التجهيزات الآلية و اللوازم و المستهلكات و الخدمات	1.14	قيمة العقد
					استصدار ضمان الأداء	1.4	الالتزامات العامة للمقاول
					أ- استعمال معدات المقاول من قبل المستخدمين أو المقاولين الآخرين	2.4	ضمان الأداء
					ب- استعمال الأشغال المؤقتة من قبل المستخدمين أو المقاولون الآخرين	6.4	التعاون
					ج- استعمال ترتيبات الدخول إلى الموقع من قبل المستخدمين أو المقاولون الآخرين		
					أ- التقيد بجميع تعليمات السلامة		
					ب- العناية بسلامة جميع الأشخاص في الموقع	8.4	إجراءات السلامة
					ج- المحافظة على خلو الموقع و الأشغال من العوائق غير الضرورية		
					د- توفير التسييج و الإنارة و الحراسة و مراقبة الأشغال		
					هـ- توفير أي أشغال مؤقتة لازمة لتنفيذ الأشغال		
					و- توفير أي أشغال مؤقتة لحماية الجمهور و الملاك و المستعملين للأراضي المجاورة للموقع		

التأثير المالي					المسئولية	الفقرة	
منخفض جداً	منخفض	متوسط	كبير	كبير جداً			
					أ- دفع التكاليف و الرسوم المتعلقة بحقوق المرور الخاصة و/أو المؤقتة للطرق اللازمة	13.4	حقوق المرور و التسهيلات
					ب- الحصول على أي تسهيلات إضافية خارج الموقع		
					أ- تقديم أي صيانة لازمة للطرق الموصلة بسبب الاستخدام	15.4	الطرق الموصلة
					ب- توفير الإشارات و الإرشادات التوجيهية على امتداد الطرق الموصلة		
					ج- الحصول على التصاريح المطلوبة لاستعمال الطرق و الإرشادات و الإشارات		
					د- عدم توفر أو ملائمة الطرق الموصلة		
					توضيب و تحميل و نقل و استلام و تنزيل و تخزين و حماية اللوازم	16.4	نقل اللوازم
					توفير ما يلزم من الكهرباء و الماء و الغاز و أي خدمات أخرى	19.4	الكهرباء و الماء و الغاز
					أ- تخزين و إخراج معدات المقاول و المواد الفائضة	23.4	عمليات المقاول في الموقع
					ب- تنظيف الموقع من جميع الأنقاض و النفايات و الأشغال المؤقتة غير اللازمة		
					سداد أجور و سكن و إطعام و نقل مستخدمي و عمال المقاول	1.6	تعيين المستخدمين والعمال
					لا تقل أجور العمال و شروط العمالة عما هو متعارف عليه محلياً	2.6	معدلات الأجور و شروط العمل
					التقيد بقوانين العمل	4.6	قوانين العمل
					توفير المرافق و تجهيزات الإعاشة الضرورية لمستخدمي المقاول و صاحب العمل	6.6	المرافق للمستخدمين و العمال
					أ- اتخاذ التدابير المعقولة للمحافظة على صحة و سلامة مستخدمي المقاول	7.6	الصحة و السلامة
					ب- توفير كادر طبي و مرافق الإسعاف الأولي		
					ج- توفير غرفة منامة للمرضى و سيارة إسعاف		
					د- تعيين ضابط للوقاية من الحوادث		
					تقديم العينات القياسية	2.7	العينات

التأثير المالي					المسئولية	الفقرة	
منخفض جداً	منخفض	متوسط	كبير	كبير جداً			
					تقديم جميع الأدوات و المواد المساعدة و الكهرباء و المعدات و المحروقات و المستهلكات و الأدوات و المواد و كادراً مؤهلاً و خبيراً لتنفيذ الاختبارات	4.7	الاختبارات
					أ- دفع مقابل المواد الطبيعية التي يتم الحصول عليها من خارج الموقع	8.7	عوائد حق الملكية
					ب- التخلص من الأنقاض و ناتج الحفريات و المواد الفائضة خارج الموقع		
					إزالة ما تبقى من معدات المقاول و المواد الفائضة و الحطام و الأشغال المؤقتة عند تسلم المقاول لشهادة الأداء	11.11	إخلاء الموقع
					تقديم كفالة الدفعة المقدمة	2.14	الدفعة المقدمة
					تأمين الأشغال و معدات المقاول	2.18	التأمين على الأشغال و معدات المقاول
					التأمين ضد أي وفاة أو إصابة جسدية أو أي خسارة أو ضرر يمكن أن يلحق بأي ممتلكات مادية	3.18	التأمين ضد إصابة الأشخاص و الإضرار بالممتلكات
					التأمين ضد إصابة أو مرض أو اعتلال أو وفاة أي من مستخدمي المقاول	4.18	التأمين على مستخدمي المقاول
أخرى							

فيما يلي عوامل الخطر المستخلصة من بنود عقد المقاوله الموحد الفلسطيني للمشاريع الإنشائية (الفيديك 99)، يرجى توضيح مدى إمكانية حدوث كل عامل من هذه العوامل و التأثير المالي له.

أولاً أخطار التشييد

الفقرة		عوامل الخطر	احتمالية الحدوث					التأثير على السعر				
			كبير جداً	كبير	متوسط	منخفض	منخفض جداً	كبير جداً	كبير	متوسط	منخفض	منخفض جداً
9.1	تأخر إصدار المخططات و التعليمات	تأخر إصدار المخططات و التعليمات										
1.2	الحق في الدخول إلى الموقع	إخفاق المهندس (يرجع هذا الإخفاق إلى المقاول) في إعطاء الحق في الدخول إلى الموقع أو حيازته										
1.4	الالتزامات العامة للمقاول	أ- فقدان أو تلف وثائق المقاول										
		ب- فقدان أو تلف الأشغال المؤقتة										
		ج- إخفاق جزء من الأشغال الدائمة المصممة بواسطة المقاول										
7.4	تثبيت الأبعاد	أخطاء في أماكن أو مناسيب أو مقاييس أو إستقامات الأشغال										
16.4	نقل اللوازم	أ- فقدان أو تلف اللوازم أثناء النقل										
		ب- تلف الطرق أو الجسور أو غيرها نتيجة النقل										
17.4	معدات المقاول	أ- فقدان أو تلف في معدات المقاول أثناء تنفيذ الأعمال										
20.4	معدات صاحب العمل و المعدات التي يقدمها مجاناً	فقدان أو تلف أي قطعة من "معدات صاحب العمل" أثناء قيام مستخدمي المقاول باستخدامها أو بحيازتها										
4.7	الاختبارات	إخفاق الاختبارات الإضافية										
5.7	الرفض	رفض أي من التجهيزات الآلية أو المواد أو المصنوعات										

الفقرة		عوامل الخطر	احتمالية الحدوث					التأثير على السعر				
			كبير جداً	كبير	متوسط	منخفض	منخفض جداً	كبير جداً	كبير	متوسط	منخفض	منخفض جداً
8.4	تمديد مدة الإنجاز	التأخير أو الإعاقة أو المنع الذي يعزى إلى تصرفات صاحب العمل										
7.8	تعويضات التأخير	أ- التأخر في تحقيق نجاح "الاختبارات عند الانجاز"										
		ب- التأخر في انجاز كل الأشغال المحددة في العقد										
2.9	الاختبارات المتأخرة	إخفاق المقاول في إجراء "الاختبارات عند الإنجاز"										
4.9	الإخفاق في اجتياز الاختبارات عند الانجاز	تخفيض قيمة العقد بسبب الإخفاق في اجتياز "الاختبارات عند الانجاز"										
5.11	إزالة الأشغال المعيبة	زيادة قيمة ضمان الأداء بما يعادل قيمة الاستبدال للأشغال المنقولة										
6.11	الاختبارات اللاحقة (الأخرى)	إعادة إجراء الاختبارات بعد إصلاح العيوب										
1.13	صلاحية إحداث التغيير	عرقلة العمل بسبب التغييرات										
أضف												

ثانياً أخطار الأداء

الفقرة		عوامل الخطر	احتمالية الحدوث					التأثير على السعر				
			كبير جداً	كبير	متوسط	منخفض	منخفض جداً	كبير جداً	كبير	متوسط	منخفض	منخفض جداً
4.4	المقاولون الفرعيون	أخطاء أو أفعال مخلة يقوم بها المقاولون الفرعيون أو مستخدموهم										
		عدم كفاءة الموردون										
8.4	إجراءات السلامة	إخفاق المقاول بالتقيد بتعليمات السلامة										
11.6	السلوك غير المنضبط	حدوث شغب أو تجاوز للقانون أو إخلال بالنظام من قبل مستخدمي المقاول										
1.7	طريقة التنفيذ	الإخفاق في تصنيع التجهيزات الآلية و إنتاج و صناعة المواد										
6.7	إصلاح العيوب	إخفاق المقاول في التقيد بتعليمات المهندس										
9.8	تبعات تعليق العمل	أ- ظهور عيب في تصاميم أو مواد أو مصنعية المقاول أثناء التعليق										
		ب- إخفاق المقاول في حماية أو تخزين أو المحافظة على الأشغال أثناء فترة التعليق										
2.11	كلفة إصلاح العيوب	أ- تقديم تجهيزات آلية أو مواد أو مصنعية غير مطابقة لشروط العقد										
		ب- إخفاق المقاول في التقيد بالالتزامات										
4.11	الإخفاق في إصلاح العيوب	إخفاق المقاول في إصلاح العيوب										
6.14	إصدار شهادات الدفع المرحلية	حجب إصدار شهادات الدفع										

الفقرة		عوامل الخطر	احتمالية الحدوث					التأثير على السعر				
			كبير جداً	كبير	متوسط	منخفض	منخفض جداً	كبير جداً	كبير	متوسط	منخفض	منخفض جداً
1.17	التعويضات	أ- حدوث إصابات جسدية أو مرض أو اعتلال أو وفاة أي شخص بسبب أعمال المقاول										
		ب- حدوث ضرر أو خسارة بالممتلكات العقارية أو الشخصية بسبب أعمال المقاول										
2.17	اعتناء المقاول بالأشغال	تلف أو فقدان الأشغال أو اللوازم										
أضف												

ثالثاً أخطار تعاقدية و قانونية

الفقرة		عوامل الخطر	احتمالية الحدوث					التأثير على السعر				
			كبير جداً	كبير	متوسط	منخفض	منخفض جداً	كبير جداً	كبير	متوسط	منخفض	منخفض جداً
1.4	الالتزامات العامة للمقاول	نقص اللوازم و المستهلكات										
2.4	ضمان الأداء	أ- إخفاق المقاول في تمديد سريان مفعول ضمان الأداء										
		ب- إخفاق المقاول في أن يدفع لصاحب العمل مبلغ مستحق له										
1.6	تعيين المستخدمين و العمال	عدم توفر المستخدمين و العمال										
8.8	تعليق العمل	تعليق العمل لأسباب تتعلق بالمقاول										

التأثير على السعر					احتمالية الحدوث					عوامل الخطر	الفقرة	
منخفض جداً	منخفض	متوسط	كبير	كبير جداً	منخفض جداً	منخفض	متوسط	كبير	كبير جداً			
										إنهاء العقد من قبل صاحب العمل	2.15	إنهاء العقد من قبل صاحب العمل
										إخفاق المقاول في إرسال إشعار المطالبة خلال 28 يوماً	1.20	مطالبات المقاول
										الإخفاق في تعيين أو تسمية عضو ما	3.20	الإخفاق في الاتفاق على تعيين المجلس
أضف												

رابعاً أخطار طبيعية

التأثير على السعر					احتمالية الحدوث					عوامل الخطر	الفقرة	
منخفض جداً	منخفض	متوسط	كبير	كبير جداً	منخفض جداً	منخفض	متوسط	كبير	كبير جداً			
										نقص أو عدم كفاية بيانات الموقع	10.4	بيانات الموقع
										فقدان أو تلف أي من المستكشفات الأثرية	24.4	الأثرية
										الظروف المناخية المعاكسة غير المتوقعة	4.8	تمديد مدة الانجاز
										حدوث الكوارث الطبيعية	4.19	تبعات القوة القاهرة
أضف												

خامساً أخطار سياسية و اجتماعية

الفقرة		عوامل الخطر	احتمالية الحدوث					التأثير على السعر				
			كبير جداً	كبير	متوسط	منخفض	منخفض جداً	كبير جداً	كبير	متوسط	منخفض	منخفض جداً
14.4	تجنب التدخل	التدخل بغير ضرورة أو بشكل غير لائق في راحة الجمهور										
18.4	حماية البيئة	إخفاق المقاول في حماية البيئة										
22.4	الأمن في الموقع	دخول أشخاص غير مخولين إلى الموقع										
4.8	تمديد مدة الانجاز	أ- النقص غير المنظور في توفر المستخدمين أو اللوازم نتيجة انتشار وباء										
		ب- النقص غير المنظور في توفر المستخدمين أو اللوازم نتيجة تغير الإجراءات الحكومية										
5.8	التأخير بواسطة السلطات	التأخير أو الإعاقة غير المتوقعة من قبل السلطات										
5.17	حقوق الملكية الفكرية و الصناعية	تعدي المقاول على حقوق الملكية الفكرية و الصناعية										
أضف												

Annex 3

The questionnaire

(English Version)

Questionnaire for Contractors of Gaza Strip

Dear participants:

I would like to present my deepest appreciation for you for providing a part of your precious time and efforts to answer this questionnaire. I would like to mention the following notes:

1. This questionnaire is a part of an academic research which aims to study of the cost impact of the Palestinian unified construction contract (FIDIC 99) on the local contractor's cost estimation.
2. This study comes in a partial fulfillment of the requirements for the degree of master in the construction management at the Islamic University-Gaza.
3. The data you provide is for confidential, and is used for the academic research only.
4. The researcher wish to provide accurate data in order to achieve the goal of this research.
5. Questionnaire contents:
 - Part 1 : Contractor organization profile.
 - Part 2 : Contracting General Information.
 - Part 3 : Evaluation of cost impact and probability of occurrence of the FIDIC 99 clauses from contractor's point of view. The respondent is allowed to add new (not mentioned in the table) risk or responsibility factors.
6. For more information, please conduct the Palestinian unified construction contract (FIDIC 99).
7. Appreciate you for your participation in this questionnaire, the researcher will provide you the results of the study to take advantage of them as much as possible.

Best Regards

Researcher : Zakaria M. Aljarosha

Part 1: Contractor organization profile

1.1 Position of the respondent

- ☐ Director
- ☐ Deputy Director
- ☐ Project Manager
- ☐ Site Engineer

1.2 Experience of organization in construction industry

- ☐ Less than 3 years
- ☐ 3 to 5 years
- ☐ 6 to 10 years
- ☐ More than 10 years

1.3 Type of executed project

- ☐ Buildings
- ☐ Roads
- ☐ Water and sewage systems
- ☐ Industrial

1.4 Number of projects executed in the last 5 years

- ☐ 5 and less
- ☐ 6 -10
- ☐ 11-20
- ☐ More than 20

1.5 Work monetary volume in the last 5 years

- ☐ 0.5 million dollars and less
- ☐ 0.6 to 1 million dollars
- ☐ 1.1 to 5 million dollars
- ☐ 5.1 to 10 million dollars
- ☐ More than 10 million dollars

Part 2: Contracting General Information

Please answer the following question which show the practice of your company regarding to contracting

2.1 Is there a formalized technique for estimating cost contingencies when prepare tender?

- ☐ Yes
- ☐ No

2.2 Do you usually use computer tools to deal with unforeseen liabilities and risks?

- ☐ Yes
- ☐ No

2.3 Do you use special tools to calculate the cost impact of adopting the Palestinian unified contract for construction (FIDIC 99)?

- ☐ Yes
- ☐ No

2.4 Which standard conditions of contract have been used before?

- ☐ FIDIC 87 Form of Contract
- ☐ FIDIC 99 Form of Contract
- ☐ UNRWA Form of Contract
- ☐ UNDP Form of Contract
- ☐ PECNDAR Form of Contract
- ☐ World Bank Form of Contract
- ☐ European Union Form of Contract
- ☐ SMDM Form of Contract
- ☐ Ministry of public works Form of Contract
- ☐ Palestinian Water Authority Form of Contract
- ☐ Others

2.5 The number of projects in which FIDIC 99 have been used as standard conditions of contract?

- ☐ 5 projects or less
- ☐ 5 to 10 projects
- ☐ More than 10 projects

2.6 What are your usual responses for the unforeseen liabilities and risks

- ☐ Avoidance
- ☐ Transfer
- ☐ Mitigation
- ☐ Retention

2.7 The following are some mitigation actions, please show the intensity of their use to mitigate risks and responsibilities

	Statement	Very high	High	Neutral	Small	Very small
a	Insurance against accidents					
b	Increase safety measures and tools					
c	Buy and store material					
d	Increase work hours					
e	Increase subcontract works as much as possible					
f	Closer supervision to subordinates					
g	Assign the risk to the suppliers					
h	Improve the quantity and quality of the staff					
i	Increase the quantity of equipments					
k	Include time allowance					
Others						

2.8 The following are the best features of the FIDIC 1999 conditions of contract, please show your degree of agreement

	Statement	Strongly agree	Agree	I don't know	Disagree	Strongly disagree
a	Easy to understand and clear enough					
b	Non applicable provisions could be simply deleted					
c	Availability of commentaries and literature					
d	Availability of specific legal interpretations					
e	Standardized					
f	Reasonably balanced and fair					
g	Allocates liabilities precisely					
h	reduces disputes and maintains positive relationship between parties					
i	Presence of Dispute Adjudication Board instead of courts					
Others						

2.9 The following are the worse features of the FIDIC 1999 conditions of contract, please show your degree of agreement

	Statement	Strongly agree	Agree	I don't know	Disagree	Strongly disagree
a	Not well adopted to cope with large number of changes					
b	Assumes that project is well defined prior to contract signature					
c	Assumes unit prices remain valid					
d	Low contractor involvement in decisions related to design					
e	Presence of some biased clauses against contractor					
f	Not applicable in Gaza Strip					
Others						

Part 3: Cost Impact evaluation

The following table includes responsibilities implied from the Palestinian Unified Conditions of Contract for Construction FIDIC 99. Please specify the level of cost impact of corresponding responsibility item.

Responsibility Clause		Responsibility Factor	Cost Impact				
			v. big	big	medium	weak	v. weak
1.8	Care and supply of documents	Provide 6 copies of contractor's documents.					
1.13-b	Compliance with law	Pay all taxes, duties and fees.					
14.1	The contract price						
4.1	Contractor's general obligations	Provide the plants, consumables and services.					
4.2	Performance security	Obtain performance security.					
4.6	Cooperation	a) Use the contractor's equipment.					
		b) Use of contractor's temporary works.					
		c) Use of access arrangement.					

Responsibility Clause		Responsibility Factor	Cost Impact				
			v. big	big	medium	weak	v. weak
4.8	Safety procedures	a) Comply with all applicable safety regulations.					
		b) Take care of the safety of all persons.					
		c) Keep the site and works clear of unnecessary obstructions.					
		d) Provide fencing, lighting, guarding, watching of the works.					
		e) Provide temporary works for work execution.					
		f) Provide temporary works for protection of public, owner and occupiers of adjacent lands					
4.13	Rights of way and facilities	a) Cost and charges for special and/or temporary right-of-way.					
		b) Obtain additional facilities outside the site.					
4.15	Access routes	a) Maintenance required for access routes.					
		b) Provide necessary signs and directions.					
		c) Obtain permissions to use routes, signs and directions.					
		d) Cost due to non-suitability or non-availability of access routes.					

Responsibility Clause		Responsibility Factor	Cost Impact				
			v. big	big	medium	weak	v. weak
4.16	Transport of goods	Packing, loading, transporting, receiving, unloading, storing and protection of goods					
4.19	Electricity, water and gas	Supply electricity, water, gas and other services.					
4.23	Contractor's operations on site	a) Store and dispose of contractor's equipment or surplus materials.					
		b) Clear away rubbish and temporary works.					
6.1	Engagement of staff and labour	Payment, housing, feeding and transporting of contractor's staff.					
6.2	Rates of wages and conditions of labour	Staff rates and wages not lower than wages and conditions at local market.					
6.4	Labour laws	Comply with labour law.					
6.6	Facilities for staff and labour	Provide necessary accommodation and welfare facilities for contractor's and employer's staff.					
6.7	Health and safety	a) Take reasonable precautions to maintain the health and safety of contractor's staff.					
		b) Provide medical staff and first aid.					
		c) Provide sick bay and ambulance services.					
		d) Appointment of accident prevention officer.					
7.2	samples	Provide standard samples.					

Responsibility Clause		Responsibility Factor	Cost Impact				
			v. big	big	medium	weak	v. weak
7.4	Testing	Provide testing apparatus, assistance, electricity, equipment, fuel, consumables, instruments, materials, and qualified staff.					
7.8	Royalties	a) Pay for natural materials obtained from outside the site.					
		b) Disposal of materials from demolition, excavation or surplus.					
11.11	Clearance of site	Remove the remaining contractor's equipment, surplus materials, rubbish and temporary works.					
14.2	Advance payment	Provide advance payment guarantee.					
18.2	Insurance for work and contractor's equipment	Provide insurance for works and contractor's equipment.					
18.3	Insurance against injury to persons and damage to property	Provide insurance against persons injury and property damage.					
18.4	Insurance for contractor's personnel	Provide insurance against sickness, disease or death of any of contractor's personnel.					
Others							

The following table includes risk factors implied from the Palestinian Unified Conditions of Contract for Construction FIDIC 99;
Please specify the level of probability of occurrence and the cost impact of corresponding risk factor.

Construction Related

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
1.9	Delayed drawings or instructions	Delayed Drawings or instructions										
2.1	Rights of access to the site	Engineer's failure (caused by contractor) to give right of access or possession of the site										
4.1	Contractor's general obligations	a) Contractor's document loss or damage										
		b) Temporary works loss or damage										
		c) Failure of permanent works designed by contractor										
4.7	Setting out	Errors in positions, levels, dimensions or alignments										
4.16	Transport of goods	a) Goods loss or damage during transportation										
		b) Roads or bridges damage during transportation										
4.17	Contractor's equipment	A) Contractor's equipment loss or damage										

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
4.20	Employer's equipment and free materials	Employer's equipment loss or damage while under contractor's control										
7.4	Testing	Additional tests fail										
7.5	Rejection	Rejection of plant, materials or workmanship										
8.4	Extension of time for completion	Delay, impediment or prevention caused by employer										
8.7	Delay damages	a) Delay to pass tests on completion										
		b) Delay to complete work stated in the contract										
9.2	Delayed tests	Failure to carry out tests on completion										
9.4	Failure to pass tests on completion	Contract price reduction due to failure to pass tests on completion										
11.5	Removal of defective works	Increase the amount of performance security due to removal of defective work										
11.6	Further tests	Repetition of tests after remedying of defects										
13.1	Right to vary	Work interruption due to variation										
Others												

Performance Related

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
4.4	Subcontractors	Faults or mis-acts of the subcontractor										
		Deficiency of the suppliers										
4.8	Safety procedures	Failure to comply with safety regulations										
6.11	Disorderly conduct	unlawful, riotous or disorderly conduct by contractor's personnel										
7.1	Manner of execution	Defects in contractor's manufacturing or production										
7.6	Remedial work	Failure to comply with Engineer's instructions										
8.9	Consequences of suspension	a) Contractor's design, workmanship or materials failure during suspension										
		b) Failure to protect, store or secure works during suspension										
11.2	Cost of remedying defects	a) Plant, materials or workmanship not being in accordance with the contract										
		b) Failure to comply with obligations										
11.4	Failure to remedy defects	Failure to remedy defects										

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
14.6	Issue of interim payment certificate	Interim payment certificate with-held										
17.1	Indemnities	a) Bodily injuries, sickness, diseases or death										
		b) Property (real or personal) loss or damage										
17.2	Contractor's care of work	Works or goods loss or damage										
Others												

Contractual & Legal

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
4.1	Contractor's general obligations	Non-availability of goods, consumables, etc.										
4.2	Performance security	a) Failure to extend the validity of performance security										
		b) Failure to pay the employer a due amount										

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
6.1	Engagement of staff & labour	Non-availability of labour, personnel or equipment										
8.8	Suspension of work	Work suspension is a responsibility of contractor										
15.2	Termination by employer	Contract termination by the employer										
20.1	Contractor's claims	Failure to file a claim notice within 28 days										
20.2	Appointment of DAB	DAB consults an expert										
20.3	Failure to agree DAB	Failure to appoint a member of DAB										
<i>Others</i>												

Physical

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
4.10	Site of data	Miss of site related data										
2.24	Fossils	Fossils loss or damage										
8.4	Extension of time for completion	Exceptional adverse climatic conditions										
19.4	Consequences of force majeure	Natural catastrophes										
<i>Others</i>												

Political & social

Clause		Risk factor	Probability					Cost Impact				
			v. big	big	medium	weak	v. weak	v. big	big	medium	weak	v. weak
4.14	Avoidance of interference	Interference in the convenience of public										
4.18	Protection of the environment	Failure to protect the environment										
4.22	Security of the site	Unauthorized entry to site										
8.4	Extension of time for completion	Non-availability of goods or personnel caused by epidemic or government actions										
8.5	Delay caused by authorities	Unforeseen disruption or delay by authorities										
17.5	Intellectual and industrial property right	Infringement of intellectual and industrial property rights										
<i>Others</i>												

Annex 4

FCIES Evaluation Questionnaire

(Arabic Version)

استبيان لتقييم (FCIES)

1- يرجى التكرم بتجريب برنامج الحاسوب (FCIES) الخاص بحساب التأثير المالي لعقد الفيديو 99 و الإفادة برأيكم فيما يتعلق بالنقاط الواردة في الجدول التالي لغرض تقييم هذا البرنامج.

الرقم	البيان	موافق بشدة	موافق	لا أدري	غير موافق	غير موافق بشدة
1	يساعد البرنامج في الفهم الصحيح لبنود عقد الفيديو 99					
2	يساعد البرنامج في التقييم الصحيح للتأثير المالي لعقد الفيديو 99					
3	يعكس البرنامج التأثير المالي لعقد الفيديو 99 بشكل كامل					
4	يبذل البرنامج المخاوف من عدم وجود الخبرة و المعلومات الكافية للتعامل مع عقد الفيديو 99					
5	يوفر البرنامج إمكانية لتحديد أسعار آمنة عند تسعير العطاء					
6	يساعد البرنامج في تقييم عروض أسعار منافسة					
7	يساعد البرنامج في إيجاد طرق إبداعية للتعامل مع المخاطر و الاستعداد لها					
8	يساعد في زيادة الاعتماد على الحاسوب في إدارة المشاريع					
9	البرنامج سهل الاستخدام					
10	يوفر البرنامج الوقت و الجهد المبذول من قبل طاقم التسعير					
11	البرنامج يعطي المرونة الكافية لاستيعاب المعطيات و البدائل					
12	يمكن قراءة النتائج بسهولة و وضوح					
13	مناسب للمشاريع الصغيرة					
14	مناسب للمشاريع الكبيرة					

2- يرجى إبداء أي ملاحظات أو انتقادات تجدونها من خلال استخدامكم للبرنامج

3- يرجى تحديد أي مميزات لهذا البرنامج من وجهة نظركم

4- يرجى إبداء أي مقترحات يمكن إدخالها على البرنامج

Annex 5

FCIES Evaluation Questionnaire

(English Version)

Questionnaire for FCIES Evaluation

Dear Participants:

1- You are kindly requested to use FCIES, and show your response about the following statements

No.	Statement	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
1	FCIES helps in the proper understanding of the terms of the FIDIC 99					
2	FCIES helps in the accurate assessment of the financial impact of the FIDIC 99					
3	FCIES Reflects the complete financial impact of the FIDIC 99					
4	FCIES allays fear of lack of sufficient information and expertise to deal with FIDIC 99					
5	FCIES contributes in determining a safe and suitable bid price					
6	FCIES helps in bidding with a competitive and suitable price					
7	FCIES helps to find creative ways of dealing with risk and preparedness					
8	FCIES allows for higher dependency on computers in project management					
9	FCIES is simple to use					
10	FCIES saves time and minimize efforts in cost estimation					
11	FCIES gives sufficient flexibility to absorb the facts and alternatives					
12	Results obtained can be readily and clearly read					
13	FCIES is suitable for small size projects					
14	FCIES is suitable for large size projects					

2- Please make any comments or criticisms be found through your use of the program

3- Please specify any advantages to this program from your point of view

4- Please propose any suitable idea could be made to the program