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Factors Affecting the Quality of Design and Contractual Documents in Gaza Strip

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بسم الله الرحمن الرحيم

"قل إن صلاتي ونسكي ومحياي ومماتي لله رب العالمين"

صدق الله العظيم

الأنعام- آية 162

Dedication

I would like to dedicate this work to

My beloved parents

for their prayers to me,

My wife

for her inspiration and encouragements

and

*Lovely kids (**Khalil and Mohanad**) with hope for bright future*

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Abstract

The quality of the design and contractual documents has a major influence on the overall performance and efficiency of construction projects implementation. Declining standard of design quality has contributed significantly to a similar decline in construction efficiency. This thesis discusses the main factors affecting design and contractual documents quality in construction industry in Gaza Strip. The aim of this research is to assist all stakeholders to plan effectively before starting a project beginning with the design phase by creating awareness and paying enough attention to minimize the problems and eliminate extra costs incurred to make corrective actions to amend the defective design. Forty different factors affecting design quality were extracted from the literature review and interviews with experts were assessed by 6 consultants and 14 clients according to their severity and occurrence, and then were analyzed and ranked according to their frequency for consultants, owners and a combination of all respondents. A test for correlation agreement on the ranking of the factors between different project participants "consultants and owners" was also calculated using Mann-Whitney Test. It was found that there is no significant difference among the respondents on the ranking of severe and frequent factors.

It was concluded that, the designer related factors are the most severe factors on design quality while the client related factors are the most occurred factors. With regard to the ranking of the individual factors it has been found that the most severe factors were: Lack of qualified consultant's staff, Lack of time available for checking and correlating all the information on all design documents, Lack of experience on similar projects, Designer's unfamiliarity with construction materials and techniques that will be used in the project and Absence of an experienced overall design manager. On the other hand it has been found that the most occurred factors-causes of design deficiency were: Reduced design fees levels, Selection of designers on the basis of lowest price selection strategy, Allocation of staff to more than one project in the same time, Unstable client's requirements, Last minute changes by the client and Unwillingness of clients to pay fees commensurate with the design of high-quality services. Similarly, the results of the case studies have revealed the same occurred factors (causes of the design deficiency).

The questionnaire and case studies results proved that public construction projects suffer delays and cost overruns because of design deficiencies, but not significantly, because of the design staff experience and sufficient cooperation between the client and consultant. Finally, set of recommendations and actions through the framework were developed in order to improve the design and contractual documents quality in the construction industry.

ملخص الدراسة

جودة التصميم و وثائق العطاء لها تأثير كبير على أداء و كفاءة المشروع بشكل عام . تدني مستوى جودة التصميم ساهم بشكل ملحوظ في تدني مماثل في كفاءة صناعة الإنشاءات في الأونة الأخيرة . تناقش هذه الدراسة العوامل الرئيسية التي تؤثر على جودة وثائق التصميم في صناعة الإنشاءات في قطاع غزة. كما تهدف هذه الدراسة إلى مساعدة جميع المشاركين في المشروع للتخطيط بشكل عملي قبل البدء بمرحلة تصميم المشروع عن طريق خلق الوعي و الانتباه الكافيين للحد من مشاكل التصميم و تقليل التكلفة الإضافية الناجمة عن الأخطاء التصميمية من خلال عمل إجراءات تصحيحية لإكمال النقص في التصميم . أربعون من العوامل المختلفة التي تؤثر على جودة وثائق التصميم تم استخلاصها من خلال الدراسات السابقة و المقابلات مع خبراء في مجال التصميم ، هذه العوامل تم تقييمها من قبل 6 استشاريين و 14 مالك من خلال شدة التأثير السلبي و درجة الحدوث في المشاريع . و قد تم تحليل و ترتيب هذه العوامل بالنسبة إلى المالك و الاستشاري و أيضاً بالنسبة لمجموع المستجيبين . لحساب مدى التوافق في ترتيب العوامل بين المالك و ا لاستشاري تم استخدام اختبار Mann-Whitney، حيث تبين عدم وجود فروق ذات دلالة إحصائية في ترتيب العوامل تبعاً لشدة التأثير السلبي و درجة الحدوث.

خلصت الدراسة إلى أن العوامل المتعلقة بالمصمم هي الأكثر تأثيراً على جودة وثائق العطاء بينما كانت العوامل المتعلقة بالمالك هي الأكثر حدوثاً. فيما يتعلق بتصنيف و ترتيب تلك العوامل فقد وجد أن : قلة خبرة وكفاءة طاقم التصميم، عدم توفر الوقت اللازم للزيارات الموقعية و جمع البيانات اللازمة للتصميم ، قلة خبرة المصمم في مشاريع مشابهة، عدم معرفة المصمم الكافية بمواد البناء المتوفـرة و تقنيات البناء المستخدمة في المشروع و عدم وجود مدير عام لفريق التصميم هي العوامل الأكثر تأثيراً ، بينما كانت المستويات المنخفضة لأجور التصميم ، اختيار الاستشاري أو المصمم بناءا على إستراتيجية السعر الأقل، إشغال طاقم التصميم في أكثر من مشروع في نفس الوقت، المتطلبات و التغييرات المتكرر ة من قبل المالك، التغييرات التي يطلبها المالك في اللحظة الأخيرة أو قبيل الانتهاء من التصميم و إصرار المالك على عدم دفع أجور متناسبة مع خدمات تصميمية عالية الجودة هي العوامل الأكثر حدوثاً. بنفس الطريقة، فقد تبين من خلال الحالات الدراسية أن أكثر العوامل حدوثا هي نفس العوامل سابقة الذكر.

تم دراسة مدى تأثير النقص في جودة وثائق العطاء على تكلفة و وقت المشروع، أولاً من خلال الاستبانة و بعد ذلك التحقق من خلال الحالات الدراسية . و قد أثبتت النتائج بأن مشاريع البناء العامة تعاني من التأخير و التكلفة الزائدة بسبب النقص في جودة وثائق العطاء و لكن ليس بدرجة كبيرة و ذلك نظرا لخبرة طاقم التصميم و التعاون الكافي بين المالك و الاستشاري . و أخيراً قام الباحث بعمل إطار عام يشمل مجموعة من التوصيات و الإجراءات للتحسين من جودة و نوعية وثائق التصميم في مشاريع البناء.

CHAPTER 1: INTRODUCTION

Designers provide the graphic and written representations that allow construction and trade contractors to transform concepts and ideas into physical reality. How effectively and efficiently this transformation occurs, depends largely on the quality of the design and contractual documents provided. And while good design needs to be "effective" and ensure fitness for purpose, it also needs to be communicated effectively through the documentation (i.e. drawings, specifications, etc.). Unfortunately, a perceived decline in project documentation quality over the past few years is considered to be causing increased delays, disruption and costs to all parties involved in the construction process (Tilley et al, 1999).

As the quality of the design and contractual documents provided has a major influence on the overall performance and efficiency of construction projects (Burati et al. 1992; Lutz et al. 1990), any improvements in design quality can only lead to corresponding improvements in the efficiency of the construction process (Tilley et al, 1999). Where designers are selected based on low design fees, then the level and quality of the service provided is likely to be limited and generally translates into additional project costs to the owner (Abolnour, 1994).

Based on the above, the quality of the design and contractual documents process can be simply defined as: "The ability to provide the contractor with all the information needed to enable construction to be carried out as required efficiently and without hindrance." (Tilley, 1998).

1.1 Problem Statement

Concerns have been expressed in the building and construction industry that a declining standard of design quality has contributed significantly to a similar decline in construction efficiency.

The problem in Gaza Strip is in the inadequate design, which has a major influence on projects - leading directly to delays, reworks and variations and contributes to increases in project time and cost.

Based on previous studies and interviews, this research will develop a list of factors affecting design and contractual documents quality. The research will focus on governmental public projects in Gaza Strip to investigate who is responsible for bad design quality and the impacts of design deficiency on construction process.

1.2 Aim of the Study

To assist construction stakeholders to plan effectively before starting project design phase. This can be done by creating awareness and paying enough attention to this important phase to minimize the problems and eliminate extra costs incurred.

1.3 Research Objectives

The aim of this study was achieved through a number of objectives which are:

1. Identifying main factors that may influence design and contractual documents quality in Gaza Strip construction industry.
2. Investigating the nature and extent of the impacts of design and contractual documents deficiencies on project cost and time.
3. Investigating the conflict between the documents (specifications, drawings, bill of quantities).
4. Establishing a framework for managing design deficiency.

1.4 Scope and Limitations

The proposed research will be limited to the following assumptions:

1. Experts from each group (consultant and owner); with more than 10 years experience in construction projects were interviewed and focus on contracting companies (Building classification only) classified as first class and second class.
2. The focus of this study is on projects from the Public sector.
3. The focus of this study is on drawings and bill of quantities only as a part of contractual documents.

1.5 Significance of the Study

As the quality of the design and contractual documents produced has a major influence on the overall performance and efficiency of construction projects, it is vitally important and useful that issues affecting design quality be identified and discussed.

There is no study that has dealt with the subject of the relationship between design documents quality and construction deficiencies in the local construction industry in Gaza Strip. The results of the research shall benefit the following parties: owners, designers, consultants and public agencies. The benefits would be more projects being completed on time, within budget and with a reduced likelihood of legal action due to contractual disputes. Consequently, it is to the benefit of construction parties to recognize the situation and identify the causes of design deficiencies in the early stages of the project (Design Phase). This will help to take the necessary precautions to control these causes before construction phase.

1.6 Thesis Organization

This thesis is divided into five chapters, as follows:

Chapter One: Gives background information of design deficiency. It also presents a statement of the problem, the aim, objectives of the study, its scope and its limitations and significance of the study.

Chapter Two: Summarizes the literature related to the factors affecting design and contractual documents quality in the construction industry and the identification of its impacts on the construction process efficiency.

Chapter Three: Presents the research methodology, which explains how the investigation was done, and the methods of collecting and analyzing data through questionnaire survey case studies. An explanation was given to each method in terms of their relation to the study, selection criteria and the anticipated result of each method.

Chapter Four: Presents and analyzes the data from the questionnaire survey and case studies. From the results of the questionnaire survey, the significant level of the design

deficiency causes and most frequent causes were identified. The importance degree and relative use of remedial methods of design deficiency were determined.

Chapter Five: Identify the main problems of design deficiency as well as their sources and impacts on the projects' cost and schedule through ten case studies.

Chapter Six: Presents the development of a framework to assist in identifying solutions for the various causes of the design deficiency in all design phases.

Finally, the last chapter contains summary of the study, conclusion, and suggested recommendations.

CHAPTER 2: LITERATURE REVIEW

In order to fully understand design and contractual documents quality and to achieve the research objectives, firstly this chapter presents the available literature review for:

1. Design quality
2. Design deficiency in construction industry
3. Causes of design deficiency
4. Impacts of design deficiency
5. Influence of fees on quality
6. Methods of design quality measurement
7. Improving design and contractual documents quality

This will lead to better identifying the factors influencing the design quality which can be minimized and better monitored because it cannot be avoided. So this chapter reviews in depth and up to date the available research work.

2.1 Terminology

"Quality" is defined by Abolnour (1994) as "conformance to established requirements" by avoiding dealing with degree of goodness or satisfaction. This definition provides a basis for measurement, i.e., the requirements are either met or not met.

Quality is also defined as "the fulfillment of project responsibilities in the delivery of products and services in a manner that meets or exceeds the stated requirements and expectations of the owner, design professional, and constructors". Responsibilities refer to the tasks that a participant is expected to perform to accomplish the project objectives as specified by contractual agreement and applicable laws, codes, standards and regulatory guidelines. Requirements are what a team member expects or needs to receive during and after his or her participation in a project (ASCE, 2000).

Therefore, the quality of the design process can simply be defined by Tilley et al. (1997) as: the ability to provide the contractor with all the information needed to enable construction to be carried out as required, efficiently and without hindrance.

2.2 Design Quality

There is a common perception in the building and construction industry that the quality of design and project contractual documents has declined significantly over the last 15 to 20 years (Queensland, 2005). Designers provide the graphic and written representations which allow contractors and subcontractors to transform concepts and ideas into physical reality. How effectively and efficiently this transformation occurs, depends largely on the quality of the design and contractual documents provided (Tilley and Barton, 1997).

According to Tilley et al. (1997), the quality of the design and contractual documents provided has a major influence on the overall performance and efficiency of construction projects. Currently, the quality of design being produced in Australia is of major concern to many parties within the construction industry (Syam, 1995).

Queensland (2005) presented the following characteristics of proper project design documentation:

1. Fit for purpose.
2. Unambiguous and coherent.
3. Timely, accurate and complete.
4. Easily communicated and constructed, with the best possible economy and safety.
5. Aligned with the owner's requirements as set out in a project brief.

One of the researches carried out by Bubshait and Abdulrazzak (1996) shows that documentation and control of documents is an important element in any quality system. Control of documents is very important to design offices since it is concerned with precision and accuracy of review as well as issuance and revision of all documents related to the design.

2.3 Design Deficiency in Construction Industry

Lutz et al. (1990) defined design deficiency as "any deficiency in the drawings and / or the specifications which results in a facility which will not adequately perform its intended mission". He also categorized most design deficiencies as one of the following three types:

1. Contract documents conflict: discrepancies between drawings and specifications.
2. Interdisciplinary coordination errors: conflicts or interference problems between structural, mechanical and electrical.
3. Technical compliance discrepancies: non adherence to the appropriate design guidelines, technical specifications and building codes.

Ideally, if there is no design deficiency, four parties are satisfied which are: owner, building codes and regulations, contractor and design professional.

According to Tilley (2005b), inadequate and deficient design impacts directly on the efficiency of the construction process. Unfortunately, contractors are often supplied with project design documents that are considered to be substandard or deficient due to incomplete, conflicting or erroneous information. Also Tilley (2005b) stated that projects that run over time and budget are often underpinned by faulty contractual documents but in fact does not properly specify or describe the built solution.

Burati et al. (1992) found that on average 78% of the total numbers of contract deviations identified were design related and that these deviations made up 79% of the total deviation costs. Similarly, a national survey of Australian contractors by Tilley & McFallan (2000a, b&c) found that design documents deficiencies were directly responsible for approximately 50% of all variations, contract disputes and cost overruns (Cited in Tilley, 2005b).

According to Love et al. (2006), a large proportion of rework and non-conformance costs are also directly due to deficiencies in design and contractual documents and in the transfer of information during the design process.

2.4 Causes of Design Deficiency

Kirby (1988) and Morgen (1986) have identified the three major causes of contract modifications as being:

- Design deficiencies;
- User requested changes; and
- Unknown site conditions.

These studies have also revealed that 56% of all contract modifications are due to correct design deficiencies.

In addition, a study by Queensland (2005) summarized that the root causes of design and contractual documents deficiency were identified as:

1. Poor project briefs based on unrealistic expectations.
2. Lack of integration along supply chain linking service providers and between project phases.
3. Devaluing of professional ethics and standards in business practices.
4. Service providers chosen on a lowest bid basis, rather than "Value for Money".
5. Poor understanding of risk assessment and management processes and lack of risk management knowledge and skills.
6. Absence of client appointed overall design manager.
7. Poor understanding of what is required to optimize designs and provide quality documentation.
8. Inadequate numbers of skilled and experienced people.
9. Inadequate/ineffective use of technology (e.g. poor application of CAD techniques; technical specifications drawn from an organization's data base but not tailored to the project).
10. Poor communication practices.

Ballard (2000), in his case study identified "waiting for prerequisite work", "insufficient time" and "conflicting work demands" as being the most common causes identified by designers for the non-completion of planned project design tasks.

2.5 Impacts of Design Deficiency

Over the years, various case studies have identified design deficiency as the major contributor to causes of contract variations. According to Hibberd (1982), 60% of the variations were directly design and contractual documents related, whilst Kirby et al. (1988) found that design deficiencies were responsible for 56% of all contract modifications. Hibberd (1982) carried out a research work into building contracts changes. His finding as derived from the United Kingdom (UK) construction industry is presented in Table 2.1.

Table (2.1): Causes of changes in the UK (Hibberd, 1982)

	Source of Change	Percentage
Design Management (Design members)	Defect in design	9%
	Inadequate consideration of design	25%
	Incorrect assessment of project briefing	6%
	Defects in documentation	16%

Researchers and practitioners have acknowledged defective design as a major cause of contract claims and change orders during construction (Tilley et al, 1997). It is known that design error is the single most common cause for a contract claim and it is also found in some studies that more than 50% of change orders are attributable to defective design (Gallo et al, 2002).

Burati et al. (1992) collected data on quality deviation from nine completed construction projects. The data were collected to identify the direct costs associated with work re-design, repair, and replacement. The data indicated that deviations in the project accounted for an average of 12.4% of the total project costs. Furthermore, design deviations averaged 78% of the total number of deviations, 79% of the total deviation costs, and 9.5% of the total project cost. The construction deviations averaged 16% of the total number of deviations, 17% of the total deviation costs, and 2.5% of the total project cost.

Similarly, a national survey of Australian contractors by Tilley and McFallan (2000a, b) found that design and contractual documents deficiencies were directly

responsible for approximately 50% of all variations, contract disputes and cost overruns (Cited in Tilley, 2005b). When considering the problem of rework, Love et al. (1997) pointed that a large proportion of rework and non-conformance costs are due to deficiencies in design and contractual documents and in the transfer of information during the design process.

According to Gallo et al. (2002) a lot of the quality and efficiency problems experienced during the design process are due to inadequate design management and poor quality control of the end product. Whilst modern construction projects range in their level of complexity, they all still require the skills of many diverse individuals to be brought together, coordinated and effectively managed as a team, to ensure the realization of the client's objective.

Design from a construction perspective is a complex process and therefore difficult to manage at the best of times. From identifying and determining customer and end user needs to visualizing and developing construction solutions that meet those needs, design requires the input and collaboration from a large and diverse group of individuals and organizations. Managing the design process therefore has as much to do with managing people and the flow of information between the various project participants, as it has to do with managing specific activities and tasks (Tilley, 2005b).

According to Tilley (2005b), the poor design management contributes significantly to poor design process performance, with the following being the main problem areas:

- Poor communication.
- Unbalanced resource allocation.
- Lack of adequate documentation.
- Lack of coordination between disciplines.
- Deficient or missing input information.
- Erratic decision making.

McLennan and Parminter (2004) summarized below the aspects which lead to inequitable outcomes from the project delivery

- Delayed completion of projects;
- Increased costs and;

- Reduced quality of built infrastructure and/or level of service.

A study conducted by Tupicoff (2005) focused on the Queensland industry, but considered to be representative of a national problem, the study showed that:

1. 60 to 90% of all variations are due to poor design and documentation, poor documentation is contributing an additional 7 to 15% to project costs in Australia.
2. Standards continue to decline, and
3. There is strong industry wide support for a solution to the problem.

Based on Queensland (2005) inadequate and deficient design documents impacts directly the efficiency of the construction process by leading to:

- An inefficient, non-competitive industry.
- Cost overruns, rework and extensions of time.
- High stress levels, loss of morale and reduced personal output.
- Adversarial behavior and diminished reputations.

2.6 Influence of Fees on Quality

A study of the relationship between fee structure and design deficiency, showed that design deficiency had a non-linear inverse relationship with project design fees. Project and the project's costs increase when design fees are reduced (Abolnour, 1994); also project costs due to design deficiency increase sharply when design fees are reduced below their optimal level (Bubshait et al. 1998).

This was also confirmed by an Australian study which showed that there was a causal link between an overall reduction in design fees over a 12 to 15 year period and a corresponding decline in both design quality and construction process efficiency (Tilley and McFallan 2000a cited in Tilley, 2005b). Unfortunately however, there is a worrying perception by some sectors of the client population that low price or "cheapness" relates to good value (Tilley, 2005b).

When investigating the decline in fee recovery for professional services, Lowry (1996) concluded that the decline in fees was not the result of efficiency or productivity

gains in the provision of professional services, but was due to: "simple cost-cutting measures undertaken for organizational survival." Thankfully, over the last few years, there have been a number of reports highlighting this problem and whilst a growing number of clients are recognizing the differences between "cost" and "value", it would appear that further education is still necessary (Tilley, 2005b).

Tilley et al. (2002) found that not only had the availability of design time declined by 37% over the previous 12–15 year period, but that designers generally spend around 20% more time on a project, than was budgeted for initially. Results from these surveys also indicated industry's perception that if more time was allowed for the design documents process, then quality would improve.

In an extensive research into the quality of project design backed by the broad industry experience, Queensland (2005) shows that:

a) An industry survey found that 68% of designers and 88% of contractors felt that documents quality had declined over the past 12 to 15 years and that real design fee income had declined approximately 24%.
b) Design efficiency has a nonlinear inverse relationship with project design fees.
c) Project costs due to design inefficiency increase sharply when design fees are reduced below the cost of doing work properly.
d) The concept of reducing total project costs by increasing expenditure on the design process has been well-documented through principles of value engineering and value management.

Tilley (2005) in his study revealed that, inadequate design fees, inadequate design time allowances and inadequate/changing design briefs, were considered to be the most important due to the direct impact they have on all aspects of the design process from the consultant's point of view. Interestingly, contractors also considered these issues to have the most influence on design and contractual documents quality".

2.7 Design Quality Measurement

The most comprehensive approach tries to measure issues directly related to quality is outlined as follows (ASCE, 2000):

1. Meeting the requirements of the owner as to: function and appearance; completion on time and within budget; life cycle cost and maintainability.

2. Meeting the requirements of the design professional as to: defined scope, adequate budget, reasonable schedule, timely decisions by owner, interesting work for the staff, realistic risk sharing, reasonable profit, a satisfied client and finished project which result in positive recognition and recommendation for future work.

3. Meeting the requirements of the contractor as to: a well-defined set of plans, specifications, and other contract documents, a reasonable schedule, timely decisions by the owner and design professional, fair treatment, realistic risk sharing, reasonable profit, a satisfied owner, and positive recommendation for future work.

4. Meeting the requirements of regulatory agencies as to: public health and safety; environmental consideration; protection of public property, including utilities; and conformance with applicable laws, regulation, codes, standards, and policies.

According to Abolnour (1994) the above approach covers all aspects of quality, yet the author sees that it has its limitation in practical application such as: although some of the quality elements can be measured with proper scales like conformance to applicable codes, completion on time, and up to standard, completed contract documents, and reasonable profit for the designer; some of the quality elements are subjective and cannot be measured on a reasonable scale like owner satisfaction and appearance.

2.8 Improving Design and Contractual Documents Quality

For the design process to work effectively, a collaborative working environment needs to be in place. By promoting high levels of collaboration and communication within the project team, lean design processes can assist in enabling design solutions to

be more integrated, coordinated and focused on delivering value to the end customer. Based on the above, it would appear that for the dramatic improvements needed in design and contractual documents quality to occur, a change in the way the design process is managed is necessary (Tilley, 2005a).

Australian Construction Industry Forum (2003) improved a guide which establishes a number of principles and protocols to guide practices of both the client and the consultant. So hereinafter sets of protocols that have been developed:

1. Client brief and project establishment by establishment of well defined client brief comprising key drivers and parameters such as: budgets, functions and quality.

2. Consultant selection by making the consultant fees commensurate with the effort required and selection based on non-price and price criteria to establish value and ensure selection assessment practices are ethical and transparent.

3. Team formation and project integration through clear understanding of roles, responsibilities and obligations of all parties, then establish and agree a design review process including review points and agree milestones for client and project team.

4. Quality management incorporating project implementation, design by:

    - Actively consider total cost of project (over the life cycle) as part of the design and contractual documents process.
    - Develop and agree upon a range of Quality Management Tools including checklists, review procedures and audit processes.
    - Use of technology by consultants to assist in documentation control and coordination.

2.9 Identification of the Factors Affecting Design Quality

After studying a number of related research papers through and some interviews with experts in the related subject, the main factors that affect the quality of design and contractual documents were identified. They are categorized and distributed according to their references as shown in Table 2.2.

Table (2.2): Distributing the factors adopted according to their references

	Factor	Source															
		Li and Love (1998)	Gallo et al., (2002)	Tilley et al. (2002)	Queensland (2005)	Bubshait and Abdulrazzak (1996)	Abolnour (1994)	Arditi and Gunaydin, (1997)	ICE (1996)	DeFraites (1989) R1	ASCE (2002)	Love and Edwards (2004)	Love et al. (2006)	Othman et al., (2005)	Tilley, P. (2005a)	Mclennan and Parminter (2004)	Barrett and Stanley (1999)
Designer Related Factors																	
Design process																	
1.	Inadequate/ineffective use of new technology	✓															
2.	Copying and modifying from previous work to minimize time and cost		✓														
3.	Increase in the overall complexity of projects			✓													
4.	Increased statutory regulations, approvals and requirements			✓													
5.	Insufficient and missing input information from the client			✓													
6.	Lack of time available for checking and correlating all the information on all design documents				✓												
7.	Erroneous and Conflicting information from the client			✓													
8.	Lack of qualified consultant's staff			✓													
9.	Leaving design issues to be sorted out in the construction process				✓												
10.	Insufficient design reviews with relevant parties					✓											
11.	Lack of time for design reviews					✓											
12.	Lack of owner reviewers for each project					✓											
13.	Increase of current workload of the designer						✓										

	Factor	Source														
		Li and Love (1998)	Gallo et al., (2002)	Tilley et al. (2002)	Queensland (2005)	Bubshait and Abdulrazzak (1996)	Abolnour (1994)	Arditi and Gunaydin, (1997)	ICE (1996)	DeFraites (1989) R1	ASCE (2002)	Love and Edwards (2004)	Love et al. (2006)	Othman et al., (2005)	Tilley, P. (2005a)	Mclennan and Parminter (2004)	Barrett and Stanley (1999)
14.	Change in project requirements by stakeholders at later stages															✓
15.	Lack of experience on similar projects								✓							
16.	Number of staff in each specialization (architect, structural… etc.)						✓									
17.	Slow of payments' system for design services						✓									
18.	Designer's unfamiliarity with construction materials and techniques that will be used in the project							✓								
Time and cost of design																
19.	Tight design schedule or Inaccurate time estimates			✓												
20.	Reduced design fees levels			✓												
Coordination (poor coordination)																
21.	Lack of data integration across design disciplines			✓												
22.	Inadequate design coordination between design disciplines			✓												
Selection strategy and bidding philosophy																
23.	Selection of designers on the basis of lowest price selection strategy (Lowest bid approach)									✓						
24.	Selection of designers on the basis of reputation instead efficiency		✓													
Design management																
25.	Absence of high cost experienced design team to projects										✓					
26.	Absence of an experienced overall design manager										✓					
27.	Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time												✓			
28.	Lack of funds for stuff job training				✓											
29.	Lack of time available for continuous				✓											

	Factor	Source															
		Li and Love (1998)	Gallo et al., (2002)	Tilley et al. (2002)	Queensland (2005)	Bubshait and Abdulrazzak (1996)	Abolnour (1994)	Arditi and Gunaydin, (1997)	ICE (1996)	DeFraites (1989) R1	ASCE (2002)	Love and Edwards (2004)	Love et al. (2006)	Othman et al., (2005)	Tilley, P. (2005a)	Mclennan and Parminter (2004)	Barrett and Stanley (1999)
	and effective communication between parties																
30.	Allocation of staff to more than one project in the same time												✓				
31.	Poor planning of workload												✓				
	Client Related Factors																
32.	Unstable client's requirements													✓			
33.	Long waiting for client decision														✓		
34.	Last minute changes by the client														✓		
35.	Inadequate client's communication/relationship with design team members											✓					
36.	Defensive approach to variations and claims for additional costs or time		✓														
37.	Unwillingness of clients to pay fees commensurate with the design of high-quality services											✓					
	Tendering Procedures																
38.	Multiple "notices to tenderers" and question/answer steps and short time for amendment															✓	
39.	Reluctance by tenderers to ask questions that might reveal competitive edge															✓	
40.	Tight tender times															✓	

CHAPTER 3: RESEARCH METHODOLOGY

This chapter explains how the problem was investigated and describes the tools used to undertake the investigation. The chapter also presents the methods of data collection which includes questionnaire survey and case studies. It also describes the characteristics of the research sample and the method of analysis. Figure 3.1 summarizes the methodology flowchart and how it leads to achieve the research objectives.

3.1 Literature Review

To achieve research objectives, related previous studies were collected from books through the university main library, journals, dissertations, conference papers and internet. As a result, a comprehensive background was conducted to explain design quality, determine the sources of design deficiency, determine the impacts of design deficiency on cost and time of the projects and identify factors/causes affecting design and contractual documents quality.

3.2 Questionnaire Survey

Questionnaire was designed for this research work taken into consideration the aim and objectives of the study. The questionnaire survey is aiming to collect representative data from the industry to verify the findings of the previous work on the subject, to update the existing knowledge and to re-evaluate the extent of the problem as it stands to date. Hence, the questionnaire was set up to obtain professional opinions on the following aspects:

- Factors affecting the quality of design and contractual documents and its impacts on project cost and time; and
- The possible remedial methods to minimize the design deficiency.

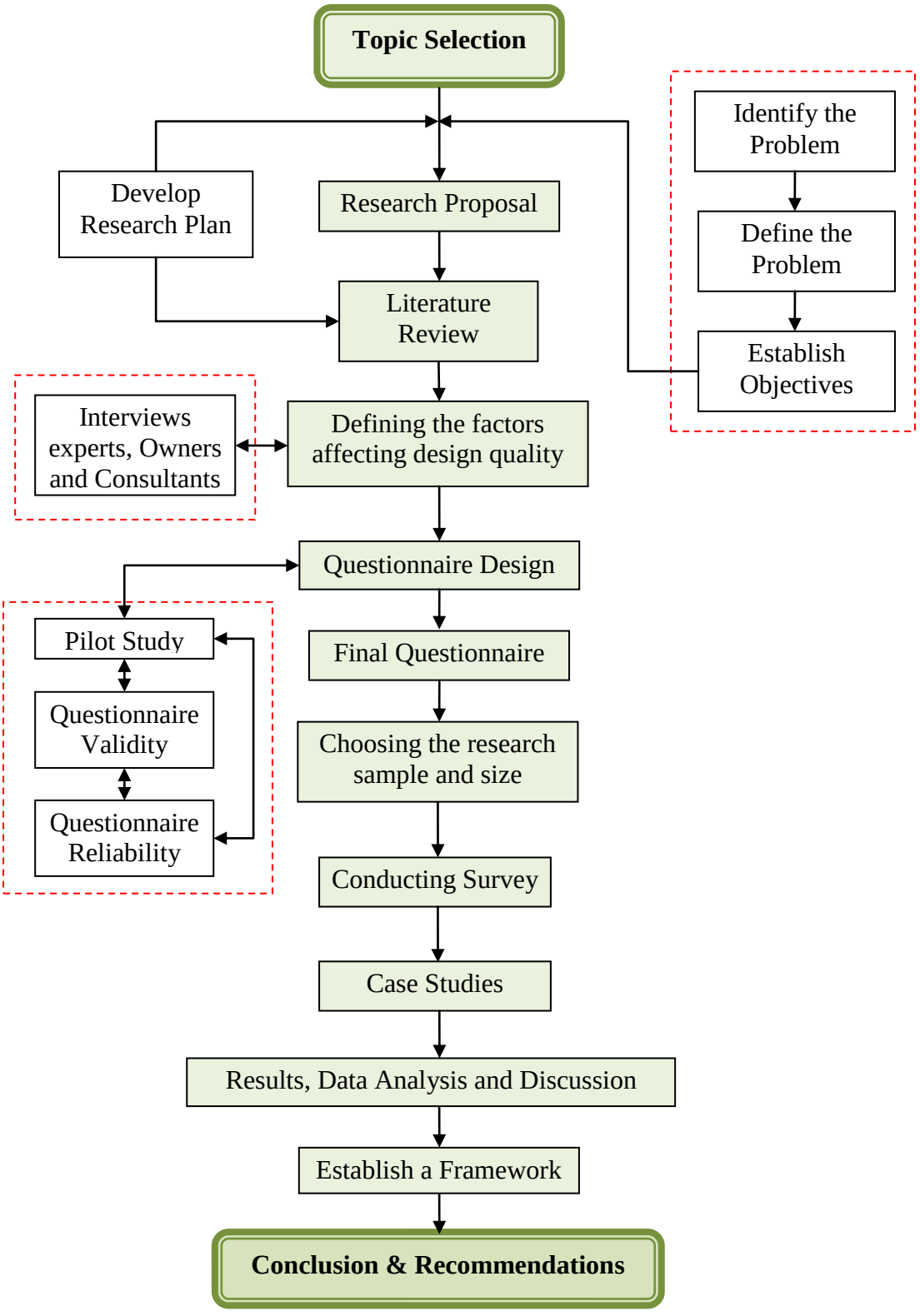

Figure (3.1): Methodology flowchart

3.2.1 Questionnaire design

The questionnaire survey was designed to verify the significant level of the potential factors that affecting the quality of design and contractual documents. While designing the questionnaire, considerations have been taken for the aim and the objectives of the study with an intention to provide sufficient background and to obtain professional opinions from the industry to cover the issues that are within the limitation of this research work. The findings of the literature review and the result of the interviews with professionals in design process were used as a basis for the questionnaire's content and its format.

In order to present the questionnaire in a systematic way, it was decided to divide the questions into four sections to cover the main issues under investigation:

1. Questions concerned with the respondent's experience. This contains general questions about the profession, period of experience, sector, type of work, position and specialty in building construction.
2. Questions cover the performance of projects which the respondents have been involved in.
3. The third section includes the list of 40 factors influencing design and contractual documents quality, or in other meaning causes of design deficiency. The factors were divided into three main groups, which are:
    a. Designer related factors.
        - Design process related factors,
        - Time and cost related factors,
        - Coordination among design team related factors,
        - Selection criteria and bidding philosophy related factors,
        - Design management related factors.
    b. Client related factors.
    c. Tendering procedures related factors.
4. Possible remedial methods to minimize the design deficiency are presented in the last section of the questionnaire. At the end of this section, the respondents were requested to add any other comments that in their opinions are appropriate to the study and this resulted in identifying more factors which have been included in the investigation.

The contractors respondents' were asked only on the first and second sections of the questionnaire but the other respondents, owners and consultants were asked in addition to the first and second sections to indicate the degree of severity and occurrence of the factors in section three, based on Likert scale from 1 – 5, then to indicate the importance and relative use of remedial methods in section four.

3.2.2 Instrument validity

The validity of an instrument is a determination of the extent to which the instrument actually reflects the abstract construct being examined (Grove and Burns, 1993). The validity content of the questionnaire was tested by consulting two groups of experts. The first was requested to evaluate and identify whether the questions agreed with the scope of the items and the extent to which these items reflect the concept of the research problem. The other group (experts in statistics) was asked to identify that the instrument used was valid statistically and that the questionnaire was designed well enough to provide relations and tests among variables.

All additions, omissions and the new factors were discussed and approved by the supervisor and then the questionnaire was finalized to include 40 factors and 11 remedial methods.

3.2.3 Pilot survey

A pilot survey questionnaire was performed to identify the right questions and to present them in a clear format and high-quality presentation. Special care went into phrasing the questions in a language that is easily understood by respondents. The pilot survey was also used as an opportunity to identify any other information, suggestions, comments or factors appropriate to the study that could be included in the second stage main survey. To assess the questionnaire validity, a pilot study was performed with six selected professionals who are closely involved in the building industry and have extensive experience dealing with the issues of design process. The professionals for the pilot study have been chosen as follow:

- Three clients from government organizations.
- Three consultants.

The responses in pilot study illustrated the lack of clarity on some of the questions and factors. As a result, many amendments were made to the questions for the main survey questionnaire that have unsatisfactory responses. Many respondents have added more factors to the ones that have been identified for the pilot study which in turn have been incorporated into the main survey. The questionnaire's format was also improved from that of the pilot study

3.2.4 Instrument reliability

The reliability coefficient of the scale was established by Cronbach's Alfa method using SPSS package, which reflected Alfa coefficient to be in the range from 0.524 to 0.925. This is considerably higher than the modest reliability in the range 0.50 - 0.60 as cited by Akintoye and Fitzgerald (2000). The result ensures that the questionnaire is reliable.

3.3 Main Survey Questionnaire

A copy of the main survey questionnaire in English version is presented in (Annex A). Because the mother tongue of most members of the target population is Arabic, it was necessary to provide an Arabic questionnaire (see Annex B).

Three points were considered in order to obtain a high level of response:

1. Providing a covering letter (see Annex A) to do the following:
   - Identify the type of research, sponsoring organization and the researcher's name;
   - Explain the objectives and the benefits of the study;
   - Inform the participants that their name, department, or company name will not appear in the research.
2. Structuring the questionnaire in a smart and attractive design
3. Keeping the questionnaire as short as possible, but comprehensive enough

3.3.1 The population and the distribution of the questionnaire survey

The main population of the questionnaire survey was limited to the following:

1. Consulting office/firms holding an excellent grade. Only (6) consulting firms were approached and responded, that is, those (6) offices were approached by public clients for consultancy services.
2. Owners implementing and managing public projects were approached which are familiar with design process. The owner's institutions were: Municipality of Gaza, Rafah Governorate, Islamic Relief, Rafah Municipality, Khanyounis Municipality, Islamic University of Gaza, Ministry of Local Government, Ministry of Education and Higher Education, PECDAR, UNRWA, Ministry of Housing and Public Works, Ministry of Health, Ministry of Awqaf and Religious Affairs, Middle Area Municipalities, United Nations Development Programme – UNDP and Palestinian Council of Housing.
3. Contractors holding first class (A) and (B) and second class.

The rationale behind limiting the population of the questionnaire survey to the above is that: they usually take on large scale projects in which design deficiency is normally encountered in such projects and hence they are more familiar with the issues of the design documents quality. While smaller consultants and smaller contractors' familiarity of the issues related to design deficiency is very limited, if there is.

3.3.2 Methods of analyzing the questionnaire survey

It is important to consider at early stage the method of analysis before developing any system of data collection. The reason for this being that the method of analysis determines the type of data to be collected and structure of questions. One of the scientific methods that have been widely used to test hypothesis and has been considered for this study is statistical analysis.

Firstly, the significant levels of importance for factors related to design quality that are under the investigation have been ranked using Likert Scale (also called Ordinal Scale). Secondly, appropriate statistical methods, as discussed in the forthcoming paragraphs were used. Lastly, the responses were tested for agreement by using Mann-

Whitney Test. To rate the factors Table 3.1 outlines the assigned values of Likert Scale with its appropriate designation.

Table (3.1): Ranking system using Likert Scale

Scale	Severity	Occurrence
1	No effect	Never
2	Low severe	Rarely
3	Fairly severe	Occasionally
4	Severe	Frequently
5	Very severe	Constantly

The five point Likert Scale described previously was used to determine the relative ranking of different factors influencing design and contractual documents quality by assigning ranks to the mean score, with low mean score assigned low ranks and high mean score allocated high ranks. To determine the relative ranking of the factors, these scores were then transformed to importance indices based on the formula:

$$\text{Relative importance Index (RII)} = \frac{\sum w}{AN} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

Where w is the weighting given to each factor by the respondent, ranging from 1 to 5, (n1 = number of respondents for very unsatisfied ... n5 = number of respondents for very satisfied). A is the highest weight (i.e. 5 in the study) and N is the total number of samples. The relative importance index ranges from 0 to 1 (Tam and Le, 2006).

To achieve the research goal, the Statistical Package for the Social Science (SPSS) was used for analyzing the data. The following statistical analyses were used:

1- Frequencies and Percentile.
2- Alpha-Cronbach Test for measuring reliability of the items.
3- Person correlation coefficients for measuring validity of the items of the questionnaires with respect to each other.
4- Spearman – Brown Coefficient was used for correcting the Person correlation coefficients to assist testing the validity.
5- Relative Importance Index.
6- Mann-Whitney Test.

3.4 Case Studies

Case studies have become particularly useful where one needs to understand some particular problem or situation in great depth, and where one can identify cases rich in information (Patton, 1987). Qualitative analysis through case studies is particularly useful for investigating why a relationship exist (Eisenhardt, 1989).

Ten case studies were investigated in this research. They are all public buildings from Gaza Strip. It is aimed that the selected cases would provide in-depth knowledge and better understanding on the size of the research problem. They were distributed as follows:

- 6 Educational buildings (6 Schools)
- 2 Administrative buildings
- 2 Health buildings

The projects were analyzed through reviewing the drawings and documents to give an overall impression of design and contractual documents quality. These case studies also aimed to identify the effect of design documents deficiencies such as conflicts, discrepancies between documents on project cost and time.

The case studies were limited to public building design within the government projects executed during the last 6 years (due to good documentation records, good filing system and comparatively easy access). Change orders and the design changes were used as a tool to determine the nature and types of design deficiency, consequently the cost of the design deficiency per project cost and time delay due to design deficiency for each case.

CHAPTER 4: RESULTS ANALYSIS AND DISCUSSION

This chapter consists of three major parts. The first part describes and analyzes the data related to the respondents' experience, and the performances of the projects they have participated in. The second focus on the main objective of this survey, which presents and ranks the factors affecting design quality based on the opinions of (Clients and Consultants). Each rank table is ordered according to the importance of the factors affecting design quality. The importance of these factors is based on the integration of their occurrences and severities.

4.1 Respondents' Experience

This section presents general information about the participation of respondents in this survey. The aim of this section is to reflect of the strength of respondents' experience, and therefore indicate the degree of reliability of the data provided by them.

The main survey questionnaire was personally handed over to the respondents. As shown in Table 4.1. It was distributed to 52 carefully selected construction industry professionals representing owners, consulting engineers and contractors who particularly deal with design issues. Completed forms were requested to be collected later. Over a period of time after distributing the questionnaire, 37 responses were received and the composition of the respondents is given in Figure 4.1.

Table (4.1): Sample size classification

Questionnaires	Consultants	Owner	Contractors	Total
Distributed	6	16	30	52
Replied	6	16	17	39
Valid Respondents	6	14	17	37
Percent of valid	100%	87.5%	57%	

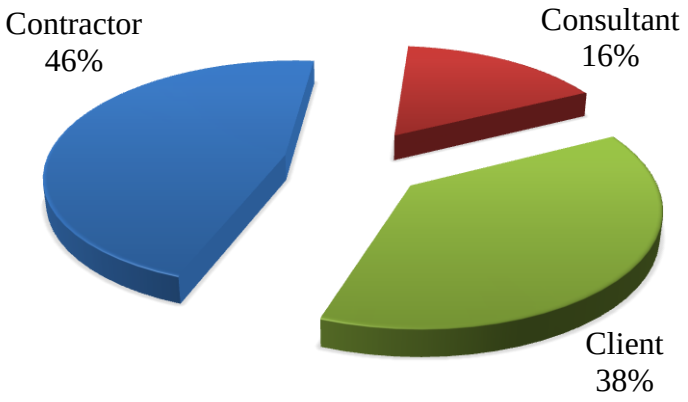

Figure (4.1): Type of organization represented

4.1.1 Classification of contracting company

Three classes of contracting companies were surveyed as shown in Table 4.2. It is noted that 70.6% of the investigated contracting companies are classified as first class that represent the top class of the construction sector.

Table (4.2): Classification of contracting companies

	Classification		
	First class "A"	First class "B"	Second class
Frequency	**7**	**5**	**5**
Percent %	41.2	29.4	29.4

4.1.2 Occupation of the respondent

Figure 4.2 shows the occupation of the respondent; this ensures that the respondent's position will provide accurate responses for the survey questions because of their deep experience and broad knowledge.

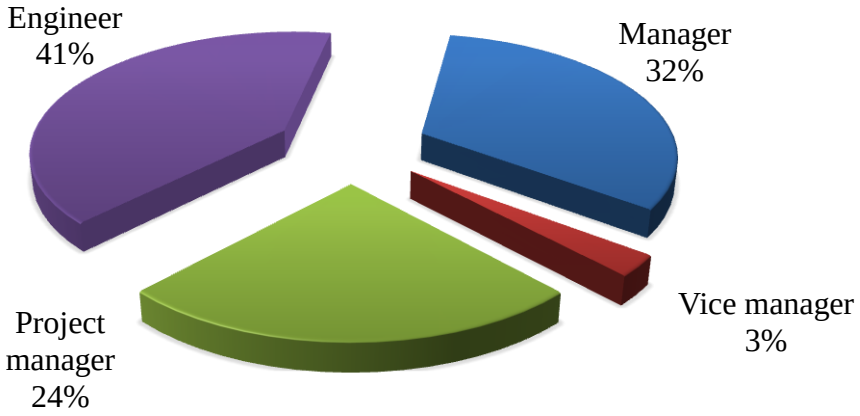

Figure (4.2): Occupation of the respondent

4.1.3 Sector type

Respondents were asked to determine the sector type that they work for. Table 4.3 shows that the vast majority of the respondents are working for both private and public sectors.

Table (4.3): Sector type of work

		Sector Type			Total
		Public	Private	Both	
Respondent	Client	12	0	2	**14**
	Consultant	0	0	6	**6**
	Contractor	0	0	17	**17**

4.1.4 Number of employees

Figure 4.3 indicates that most of respondents have less than 100 employees. This indicates that the contracting and consulting firms are small size companies compared with other regional countries.

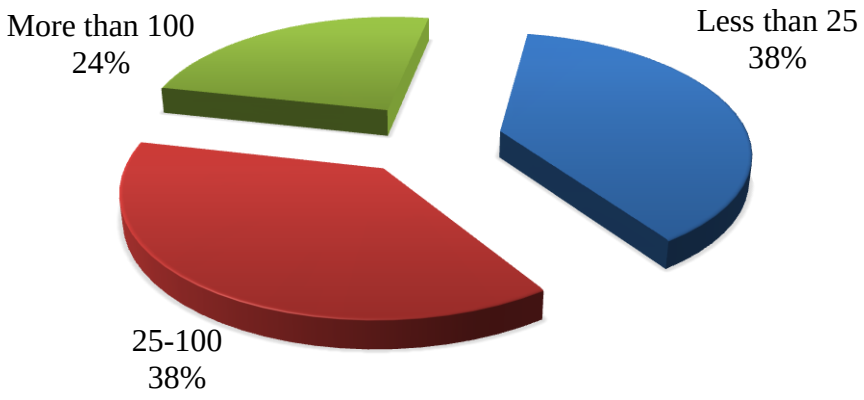

Figure (4.3): Number of employees

4.1.5 Experience in dealing with construction projects

As shown in Table 4.4 most of the professionals who participated in this survey have over 15 years of experience, which in turn raises the reliability of the data collected from the shared knowledge of long years of experience in the building construction field.

Table (4.4): Participants' years of experience

	Years of experience				
	<5 years	5-10 years	10-15 years	>15 years	Total
Frequency	0	0	15	22	37
Percent %	0	0	**40.5**	**59.5**	**100**

4.2 Performance of Projects

The analysis of data concerning the performance of projects that the respondents have been involved in is shown here.

4.2.1 Number of building projects that the respondents have participated in

Table 4.5 indicates that the participation of respondents in this survey is based on being involved in over 10 projects in the last five years. This means that most of the respondents have a broad background about construction projects; also their knowledge leads to better identification of projects performance.

Table (4.5): Number of building projects that the respondents have participated in

	Number of building projects			
	<5	6-10	>10	Total
Frequency	0	15	22	37
Percent %	0	**40.54**	**59.46**	**100**

4.2.2 Projects' minor design deficiency which didn't cause work's suspension

The proportion of projects which contained minor design deficiency and did not cause suspension of the work was classified into 4 categories. Table 4.6 shows that the proportion of projects that contained minor design deficiency is less than 10% of projects for approximately half respondent 45.95%. In general all respondents said that they experienced minor design deficiency in the projects they have participated.

Table (4.6): Projects which contained minor design deficiency that did not cause suspension of work

	Projects (%)				
	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	17	11	8	1	37
Percent %	45.95	29.73	21.62	2.70	**100**

4.2.3 Projects' major design deficiency which caused work's suspension

Four main categories of proportion of projects which contained major design deficiency were identified. Table 4.7 illustrates the percentage of projects which contained major design deficiency and caused a temporary suspension of the work. 83.78% of the respondents said that less than 10% of the projects contained major design deficiency. This indicate that major design deficiency which led to suspension of work occurs in a small number of projects and may be due in the absence of complex projects implemented in Gaza Strip.

Table (4.7): Projects which contained major design deficiency and did not cause suspension of the work

	Projects (%)				
	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	31	6	0	0	37
Percent %	83.78	16.22	0	0	**100**

4.2.4 Projects that exceeded the contract cost because of design deficiencies

Table 4.8 indicates that the percent of respondents who said that less than 10% of projects exceeded the contract cost was 70.27%. This means that most of projects in Gaza Strip increasing the contract cost because of design deficiency.

Table (4.8): Projects that exceeded the contract cost because of design deficiencies

	Projects (%)					
	No	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	4	26	7	0	0	37
Percent %	10.81	70.27	18.92	0	0	100

4.2.5 Projects that decreased the contract cost because of design deficiencies

As shown in Table 4.9, it is clear that a small percentage of projects decreased the contract cost because of design deficiency and approximately 54% of the respondents did not face this problem.

Table (4.9): Projects that decreased the contract cost because of design deficiencies

	Projects (%)					
	No	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	20	15	1	1	0	37
Percent %	54.05	40.54	2.7	2.7	0	100

4.2.6 Average cost overrun because of design deficiencies in the project/s

According to Table 4.10, most of design deficiency cost was less than 10% of the project cost. This is an evidence of the existence of reworks and variations because of design deficiency which lead to cost overrun. McLennan and Parminter (2004), in their study in Australia found that poor design quality is contributing an additional 10-15% or more to project cost.

Table (4.10): Average cost overrun because of design deficiencies

	Projects (%)				
	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	27	10	0	0	37
Percent %	72.97	27.03	0	0	100

4.2.7 Average cost decrease because of design deficiencies in the project/s

Table 4.11 shows that 34 respondents out of 37 have experienced less than 10% decrease in the project cost, which means in general that cost decrease because of design deficiency is rare and does not lead to a marked decrease in the cost.

Table (4.11): Average cost decreasing because of design deficiencies

	Projects (%)				
	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	34	3	0	0	37
Percent %	91.89	5.41	0	0	100

4.2.8 Proportion of projects delayed because of design deficiencies

Table 4.12 indicates that the majority of respondents have experienced delay in projects. 25 out of 37 participants have experienced delay in less than 10% of the projects they have been involved in because of design deficiencies.

Table (4.12): Projects were delayed because of design deficiencies

	Projects (%)				
	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	25	11	1	0	37
Percent %	67.57	29.73	2.70	0	100

It is clear from the results that a large number of projects, on which there is a design deficiency, have an increase in the duration of project's implementation because of variations and reworks.

4.2.9 Average delay time because of design deficiencies

It can be noted from Table 4.13 that the average delay time was less than 10% of project's time for 81.08% of respondents. This might indicate lack of adequate design which leads to redesign due to inappropriate drawing.

Table (4.13): The average delay time of the delayed projects

	Projects (%)				
	Less than 10%	10 to 40 %	41 to 70 %	71 to 100%	Total
Frequency	30	5	2	0	37
Percent %	81.08	13.51	5.41	0	100

Referring to the previous results, it can be seen that small number of projects contains major design deficiency, whereas most of the projects contain minor design deficiency. However, the noteworthy issue is that there is no marked effect of design deficiency on time and cost of the projects. However, the situation of design and contractual documents quality in Gaza Strip projects is not bad, which return to naivety design of building projects.

4.2.10 Responsibility of design deficiency

Based on the total response of respondents, Figure 4.4 indicates that both of clients and consultants are most often responsible for design deficiency.

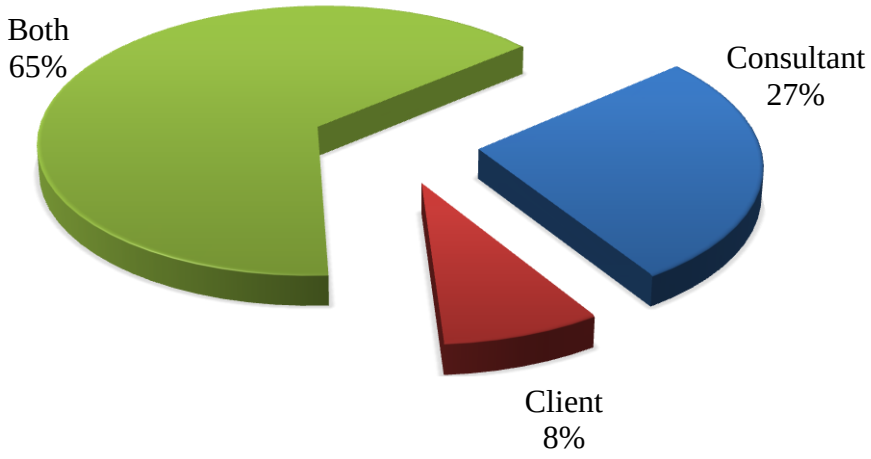

Figure (4.4): Responsibility of design deficiency

4.3 The Inferential Statistics

The inferential statistics method was applied on the survey data collection in section 3 and section 4 of the questionnaire. Frequency distribution and the percentage of different items are presented. Essential statistical tests were used to verify some basic elements in the structure of the questionnaire. These tests are shown below.

4.3.1 Questionnaire validity

Validity refers to the degree to which an instrument measures what is supposed to be measuring. It is important to consider that a measuring device which is not reliable cannot possibly be valid (Polit and Hungler, 1978). Two parts of the questionnaire were considered in testing questionnaire validity. Part one was “Factors Influencing Design and Contractual Documents Quality” and the other part was “Remedial Methods” were considered. To insure the validity of the questionnaire, two statistical tests should be applied:

- Criterion-related validity test
- Structure validity test

4.3.1.1 Criterion related validity

This test measures the correlation coefficient between each paragraph in one field and the whole field. It was found that the correlation coefficients between each item within each group, and the average of the related group denoted significance at the level 0.05. That means a content validity of this group of the questionnaire for measuring, either the severity/occurrence of items. The results of this stage are shown in Annex C.

4.3.1.2 Structure validity of the questionnaire

Structure validity is the second statistical test that used to test the validity of the questionnaire structure by testing the validity of each field and the validity of the whole questionnaire. It measures the correlation coefficient between one filed and all the fields of the questionnaire that have the same level of likert scale. The significance for all categories values were less than 0.05 or 0.01, so the correlation coefficients of all the fields are significant at $\alpha = 0.01$ or $\alpha = 0.05$, (see Annex C). It can be said that the fields are valid to measures what it was set for to achieve the main aim of the study.

4.3.2 Instrument reliability

Reliability analysis allows studying the properties of measurement scales and the items that compose the scales. The Reliability Analysis procedure calculates a number of commonly used measures of scale reliability and also provides information about the relationships between individual items in the scale. Because it is difficult to return the scouting sample of the questionnaire that is used to measure the questionnaire validity to the same respondents due to the different work conditions to this sample. Therefore the following models of reliability analysis were used.

4.3.2.1 Split-Half coefficient method

This method depends on finding Person correlation coefficient between the means of odd questions and even questions of each field of the questionnaire. Then, correcting the Person correlation coefficients can be done by using Spearman Brown correlation coefficient of correction. The corrected correlation coefficient (consistency coefficient) is computed according to the following equation: Consistency coefficient = $2r/(r+1)$ where r is the Person correlation coefficient. The normal range of corrected correlation

coefficient (2r/(r+1)) is between 0.0 and + 1.0. The corrected correlation coefficients values were more than 0.50, so all the corrected correlation coefficients are significant at $\alpha = 0.05$. It can be said that according to the Half Split method the main group factors are reliable.

As shown in Table 4.14, the results were in the range of 0.664 and 0.885 for factors' groups, and 0.962 for remedial methods group. This range is considered high; the result ensures the reliability of the questionnaire.

Table (4.14): Split-Half coefficient method

	Main Factors		Severity		Occurrence in the projects	
			Person coefficient	Spearman-Brown Coefficient	Person coefficient	Spearman-Brown Coefficient
1	**Designer Related Factors**	Design process	0.746	0.854	0.761	0.864
2		Time and cost of design	0.419	0.591	0.660	0.795
3		Coordination among design team	0.466	0.636	0.726	0.841
4		Selection criteria and bidding philosophy	0.501	0.668	0.369	0.539
5		Design Management	0.663	0.664	0.688	0.690
6	**Client Related Factors**		0.477	0.646	0.791	0.833
7	**Tendering Procedures**		0.541	0.539	0.642	0.644
	Total		**0.534**	**0.697**	**0.793**	**0.885**
			Importance		**Relative Use**	
8	**Remedial Methods**		0.771	0.787	0.960	0.962

4.3.2.2 Cronbach's Alpha

Coefficient Alpha or (Cronbach's Alpha) method is one of the most widely used methods for measuring reliability. Cornbach's Alpha is preferable to the split-half procedure because it supports correlation for all possible ways of dividing the measure into two halves (Polit and Hungler, 1978).

As shown in Table 4.15, the reliability coefficient of the scale was established by Cronbach's Alfa using SPSS package, which reflected Alfa coefficient to be in the range from 0.524 to 0.925. This is considerably higher than the modest reliability in the range 0.50 - 0.60 as cited by Akintoye and Fitzgerald (1999). The result ensures that the questionnaire is reliable.

Table (4.15): Reliability Cronbach's Alpha

	Main Factors		Cronbach's Alpha	
			Severity	**Occurrence in the projects**
1	**Designer Related Factors**	Design process	0.794	0.848
2		Time and cost of design	0.783	0.791
3		Coordination among design team	0.845	0.841
4		Selection criteria and bidding philosophy	0.534	0.554
5		Design Management	0.691	0.746
6	**Client Related Factors**		0.672	0.911
7	**Tendering Procedures**		0.667	0.524
	Total		**0.895**	**0.930**
			Importance	**Relative Use**
8	**Remedial Methods**		**0.825**	**0.925**

4.4 Factors Affecting Design and Contractual Documents Quality

40 well-recognized causes of design deficiency were identified and provided in the questionnaire form. Determining the severity degree of each cause was sought as it leads to the main objectives of this survey. The following parts present and discuss the data collected regarding the occurrence and severity of the factors. Different sorts of ranking analysis will be presented and discussed, and importance-based ranks will include a group ranking by the total answers of each professional group (Consultants, Clients). Moreover, three ways of ranking are used; all causes rank, subcategories rank, and main categories rank.

Several abbreviations are introduced in the following tables. The abbreviations and their meanings are explained as follows:

D: Designer related factors

DP: Design Process

TC: Time and Cost of design

CO: Coordination among design team

SC: Selection Criteria

DM: Design Management

CF: Client Related Factors

TP: Tendering Procedures

Ctg: Category

RII: Relative Importance Index

The causes of design deficiency were grouped into three main categories: causes related to designer subdivided into five subcategories, the others related to client and tendering procedures. These were analyzed based on the relative importance index of all causes that came under the category.

In order to cover the analysis of ranking design deficiency factors, it was decided to discuss each category separately, so that the relative importance index of the category for both (consultants and clients) based on severity and occurrence can be presented. However, the relative importance index of the individual design deficiency factors will be discussed in relation to the respondent group.

Table 4.16 shows summary of factors ranking according to all categories by all respondents. Furthermore, the causes of design deficiency were categorized into the most severe and occurrence ones, as shown in Table 4.17 and Table 4.18.

Table (4.16): RII and rank of factors affecting design quality by all respondents

			All Response			
			Severity		Occurrence	
	Factor	Ctg.	RANK	RII %	RANK	RII %
8	Lack of qualified consultant's staff	D/DP	**1**	96	**38**	44
26	Absence of an experienced overall design manager	D/DM	**2**	87	**34**	45
6	Lack of time available for checking and correlating all the information on all design documents	D/DP	**3**	86	**25**	53
15	Lack of experience on similar projects	D/DP	**4**	85	**38**	44
18	Designer's unfamiliarity with construction materials and techniques that will be used in the project	D/DP	**4**	85	**34**	45
31	Poor planning of workload	D/DM	**4**	85	**32**	49
7	Erroneous and Conflicting information from the client	D/DP	**7**	84	**24**	54
11	Insufficient design reviews with relevant parties	D/DP	**7**	84	**9**	61
16	Number of staff in each specialization (architect, structural… etc.)	D/DP	**7**	84	**34**	45
25	Absence of high cost experienced design team to projects	D/DM	**7**	84	**33**	48
22	Inadequate design coordination between design disciplines	D/CO	**11**	83	**26**	52
5	Insufficient and missing input information from the client	D/DP	**12**	82	**7**	62
10	Lack of time for design reviews	D/DP	**12**	82	**18**	58
34	Last minute changes by the client	CF	**12**	82	**5**	63
23	Selection of designers on the basis of lowest price selection strategy (Lowest bid approach)	D/SC	**15**	80	**1**	69
9	Leaving design issues to be sorted out in the construction process	D/DP	**16**	79	**27**	51
14	Change in project requirements by stakeholders at later stages	D/DP	**17**	78	**14**	57
19	Tight design schedule or Inaccurate time estimates	D/TC	**17**	78	**9**	61
21	Lack of data integration across design disciplines	D/CO	**17**	78	**14**	59

			All Response			
			Severity		Occurrence	
	Factor	Ctg.	RANK	RII %	RANK	RII %
24	Selection of designers on the basis of reputation instead efficiency	D/SC	**17**	78	**31**	50
32	Unstable client's requirements	CF	**17**	78	**5**	63
2	Copying and modifying from previous work to minimize time and cost	D/DP	**22**	73	**14**	59
20	Reduced design fees levels	D/TC	**22**	73	**3**	66
37	Unwillingness of clients to pay fees commensurate with the design of high-quality services	CF	**22**	73	**3**	66
29	Lack of time available for continuous and effective communication between parties	D/DM	**25**	71	**23**	55
30	Allocation of staff to more than one project in the same time	D/DM	**25**	71	**2**	68
33	Long waiting for client decision	CF	**25**	71	**7**	62
28	Lack of funds for stuff job training	D/DM	**28**	70	**13**	60
36	Defensive approach to variations and claims for additional costs or time	CF	**28**	70	**14**	59
12	Lack of owner reviewers for each project	D/DP	**30**	69	**18**	58
13	Increase of current workload of the designer	D/DP	**31**	68	**21**	56
38	Multiple "notices to tenderers" and question/answer steps and short time for amendment	TP	**31**	68	**9**	61
40	Tight tender times	TP	**31**	68	**14**	59
1	Inadequate/ineffective use of new technology	D/DP	**34**	67	**34**	45
35	Inadequate client's communication/relationship with design team members	CF	**34**	67	**27**	51
39	Reluctance by tenderers to ask questions that might reveal competitive edge	TP	**36**	62	**9**	61
17	Slow of payments' system for design services	D/DP	**37**	60	**21**	56
4	Increased statutory regulations, approvals and requirements	D/DP	**38**	59	**27**	51
3	Increase in the overall complexity of projects	D/DP	**39**	58	**27**	51
27	Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time	D/DM	**40**	57	**40**	42

As shown in Table 4.16 and with regard to the ranking of "Designer related factors" category; factors were distributed among different ranks. Based on severity, 14 of them were ranked in the fifteen most severe factors. While based on occurrence, the situations are different to some extent, design deficiency factors related to designer concentrated on the middle ranks, while only eight factors were ranked with the most fifteen frequent factors; the first four of them were ranked 1, 2, 3, and 7.

Table 4.17 shows that the most severe factors agreed by the clients and consultants and derived from Table 4.16 as the main causes of design deficiency were: Lack of time available for checking and correlating all the information on all design documents; Lack of qualified consultant's staff; Lack of experience on similar projects; Designer's unfamiliarity with construction materials and techniques that will be used in the project and absence of an experienced overall design manager.

With regard to the occurrence, Table 4.16 indicates that degree of existence is very low for all previous items. This gives positive indication about the consultancy services in Gaza Strip, with respect to the consultants' choice.

Table (4.17): The most severe factors agreed by the clients and consultants

			Severity					
			Clients		Consultants		All Response	
	Factor	Ctg.	RII %	RANK	RII %	RANK	RII %	RANK
6	Lack of time available for checking and correlating all the information on all design documents	D/DP	88.57	**3**	80	**8**	86	**3**
8	Lack of qualified consultant's staff	D/DP	95.71	**1**	96.67	**1**	96	**1**
15	Lack of experience on similar projects	D/DP	85.71	**9**	83.33	**4**	85	**4**
18	Designer's unfamiliarity with construction materials and techniques that will be used in the project	D/DP	90	**2**	73.33	**16**	85	**4**
26	Absence of an experienced overall design manager	D/DM	87.14	**7**	86.67	**3**	87	**2**

As illustrated in Table 4.17, there is an agreement between the clients and the consultants, that "Lack of qualified consultant's staff" factor being the most severe factor with relative importance index 95.71% for clients and 96.67% for consultants. This indicates that the respondents are fully aware of Lack of qualified staff consequences in design and contractual documents quality such as inconsistencies between the drawings and specifications. According to ASCE (2000), the project design team should include engineers with field experience. Many organizations have these engineers on staff. However, it may be necessary in some cases to retain engineers with the necessary expertise, or form a joint venture with appropriate body.

"Designer's unfamiliarity with construction materials and techniques that will be used in the project" was ranked by the clients in the second position with relative importance index 90.0% while it was ranked by consultants in the sixteenth position with relative importance 73.33%. The clients gave higher degree for the severity to this item than the consultants, because the consultants are fully informed of construction material in the market and also because of the lack of complexity of the projects in the Gaza Strip in comparison to other countries.

"Lack of time available for checking and correlating all the information on all design documents" was ranked by the clients in the third position with relative importance 88.57% while it was ranked by the consultants in the eighth position with relative importance index 80.0%. It indicates that most respondents are aware that undertaking of checking and correlating between design documents may well act as a prevention mechanism for reducing design deficiency, and it is vital for ensuring the design quality.

The relative importance index for item "Absence of an experienced overall design manager" equals 87.14% with rank equals "7" by the clients for severity of impact and 86.67% with rank equals "3" by the consultants. This shows that all respondents are aware to the fact that the design manager/coordinator will ensure alignment with project objectives; and ensure integration and coordination of the design effort with all parties through all stages of the project.

"Lack of experience on similar projects" was ranked by the clients in the ninth position with relative importance 85.71% while it was ranked by consultants in the fourth position with relative importance index 83.33%. The respondents confirmed that experience on similar projects is an important factor for design quality.

Table 4.18 illustrates the most frequent factors agreed by the clients and consultants and derived from Table 4.16 as the main causes of design deficiency were: Reduced design fees levels; Selection of designers on the basis of lowest price selection strategy (Lowest bid approach); Allocation of staff to more than one project in the same time; Unstable client's requirements; Last minute changes by the client and Unwillingness of clients to pay fees commensurate with the design of high-quality services.

Table (4.18): The most frequent factors agreed by the clients and consultants

			Occurrence					
			Clients		Consultants		All Response	
	Factor	Ctg.	RII %	RANK	RII %	RANK	RII %	RANK
20	Reduced design fees levels	D/TC	67.14	**3**	63.33	**8**	66	**3**
23	Selection of designers on the basis of lowest price selection strategy (Lowest bid approach)	D/SC	68.57	**1**	70	**2**	69	**1**
30	Allocation of staff to more than one project in the same time	D/DM	68.57	**1**	66.67	**6**	68	**2**
32	Unstable client's requirements	CF	57.14	**20**	76.67	**1**	63	**5**
34	Last minute changes by the client	CF	60	**13**	70	**2**	63	**5**
37	Unwillingness of clients to pay fees commensurate with the design of high-quality services	CF	65.71	**5**	66.67	**6**	66	**3**

From Table 4.18, it is observed that two factors were ranked in the first position by the clients with the same relative importance index of 68.57%. These factors are: "Selection of designers on the basis of lowest price selection strategy" and "Allocation of staff to more than one project in the same time". The results reflect that the selection criteria are not always appropriate and selection of consultants is often driven more by price than the required level of service and expertise necessary for a successful

outcome, and most of the clients believe that consultants allocate staff to more than project in the same time to save money.

"Reduced design fees levels" was ranked in the third position by the clients with relative importance index 67.14% for occurrence. The result agree with Gallo et al. (2002) who emphasized that design and contractual documents quality have worsened over time apparently in direct relationship with reductions in design fees.

In the ranks by the consultants, the situations are different to some extent. "Unstable client's requirements" was ranked in the first rank with relative importance index 76.67%. Two factors were ranked in the second position with the same relative importance index of 70.0%. These factors are: "Last minute changes by the client" and "Selection of designers on the basis of lowest price selection strategy". It's clear from Table 4.18 the difference in perception between the clients and consultants in ranking item "Unstable client's requirements" so while it was ranked in the first position by the consultants; it was ranked in the twentieth position by the clients. It's clear also the difference in perception between the clients and the consultants in ranking item "Last minute changes by the client". This result indicates to lack of clients' recognition and awareness of their responsibilities to unstable requirements and last minute changes on design documents.

4.4.1 Designer related factors

This major category includes causes 1-31. The "designer related factors" category was subdivided into five groups: design process, time and cost of design, coordination among design team, selection criteria and design management. The ranking is based on the perception of all respondents' regarding the listed factors.

Table 4.19 and Table 4.20 illustrate an agreement between clients and consultants, with the "Designer related factors" category being the most important category with average relative importance index 76.58% with the first rank for severity of impact, and 54.0% with the last rank for occurrence. The respondents gave the first rank for this category as most severe factors which indicate that most clients and consultants are aware that lack of efficient designer would lead to design deficiency and eventually

rework and non-conformance costs. While the occurrence of designer related factors in the projects was the last, which indicates to the lack of problems in the design staff.

Table (4.19): RII and rank of major categories by clients and consultants

	Factor	Respondents							
		Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
1	Designer Related Factors	78.30	**1**	55.21	**3**	72.58	**1**	51.18	**3**
2	Client Related Factors	75.48	**2**	59.29	**2**	68.89	**2**	63.89	**1**
3	Tendering Procedures	69.05	**3**	62.86	**1**	58.89	**3**	54.44	**2**

Table (4.20): RII and rank of major categories by all respondents

	Category	**Total**			
		Severity		**Occurrence**	
		RII %	RANK	RII %	RANK
1	Designer Related Factors	76.58	**1**	54.00	**3**
2	Client Related Factors	73.50	**2**	60.67	**1**
3	Tendering Procedures	66.00	**3**	60.33	**2**

4.4.1.1 Design process

Concerning the relative importance index of the categories, Table 4.21 shows that the category "Design process" was perceived more important for consultants than clients. But it was perceived in the most important by both of them. The scarcity of design deficiency causes in design process indicates to experience and efficiency of the design team.

Table (4.21): RII and rank of sub categories by clients and consultants

	Factor	Respondents							
		Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
1	Design process	78.41	2	53.10	7	72.41	3	52.04	5
2	Time and cost of design	77.14	**5**	64.29	**1**	71.67	**4**	61.67	**2**
3	Coordination among design team	82.86	**1**	62.14	**3**	75.00	**2**	40.00	**7**
4	Selection criteria	77.86	**3**	60.71	**4**	81.67	**1**	56.67	**3**
5	Design Management	77.14	**4**	54.49	**6**	70.00	**5**	47.62	**6**
6	Client Related Factors	75.48	**6**	59.29	**5**	68.89	**6**	63.89	**1**
7	Tendering Procedures	69.05	**7**	62.86	**2**	58.89	**7**	54.44	**4**

Table (4.22): RII and rank of sub categories by all respondents

	Category	Severity		Occurrence	
		RII %	RANK	RII %	RANK
1	Design process	76.61	**3**	52.78	**6**
2	Time and cost of design	75.50	**4**	63.50	**1**
3	Coordination among design team	80.50	**1**	55.50	**5**
4	Selection criteria	79.00	**2**	59.50	**4**
5	Design Management	75.00	**5**	52.43	**7**
6	Client Related Factors	73.50	**6**	60.67	**2**
7	Tendering Procedures	66.00	**7**	60.33	**3**

With regard to the rank of the individual causes related to "Design process" group, and referring to Table 4.16, nine factors were ranked by all respondents in the fifteen most severe factors for severity. Table 4.23 shows the relative importance index and rank by the clients and the consultants of the factors related to design process regarding severity and occurrence.

Table (4.23): RII and rank of the "Design process" factors

	Factor	Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
Design process (DP)									
1	Inadequate/ineffective use of new technology	62.86	**15**	48.57	**12**	76.67	**6**	36.67	**16**
2	Copying and modifying from previous work to minimize time and cost	75.71	**12**	64.29	**1**	66.67	**13**	46.67	**12**
3	Increase in the overall complexity of projects	60	**17**	48.57	**12**	53.33	**17**	56.67	**7**
4	Increased statutory regulations, approvals and requirements	60	**17**	45.71	**17**	56.67	**16**	63.33	**2**
5	Insufficient and missing input information from the client	84.29	**8**	58.57	**6**	76.67	**6**	70	**1**
6	Lack of time available for checking and correlating all the information on all design documents	88.57	**3**	50	**11**	80	**4**	60	**5**
7	Erroneous and Conflicting information from the client	88.57	**3**	51.43	**9**	73.33	**8**	60	**5**
8	Lack of qualified consultant's staff	95.71	**1**	48.57	**12**	96.67	**1**	33.33	**18**
9	Leaving design issues to be sorted out in the construction process	81.43	**10**	51.43	**9**	73.33	**8**	50	**11**
10	Lack of time for design reviews	85.71	**6**	60	**2**	73.33	**8**	53.33	**9**
11	Insufficient design reviews with relevant parties	88.57	**3**	60	**2**	73.33	**8**	63.33	**2**
12	Lack of owner reviewers for each project	71.43	**13**	60	**2**	63.33	**15**	53.33	**9**
13	Increase of current workload of the designer	68.57	**14**	60	**2**	66.67	**13**	46.67	**12**
14	Change in project requirements by stakeholders at later stages	77.14	**11**	54.29	**8**	80	**4**	63.33	**2**
15	Lack of experience on similar projects	85.71	**6**	42.86	**18**	83.33	**2**	46.67	**12**
16	Number of staff in each specialization (architect, structural… etc.)	84.29	**8**	48.57	**12**	83.33	**2**	36.67	**16**

	Factor	Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
17	Slow of payments' system for design services	62.86	**15**	55.71	**7**	53.33	**17**	56.67	**7**
18	Designer's unfamiliarity with construction materials and techniques that will be used in the project	90	**2**	47.14	**16**	73.33	**8**	40	**15**

"Lack of qualified consultant's staff" was ranked to the clients' perception as the most important cause of design deficiency with relative importance index 95.71% for the severity of impact and 48.57% with rank "12" for occurrence. It was considered as the most severe factor in the design quality according to the clients' perception. The result refers to the importance and impact of qualified staff on design and contractual documents quality from the viewpoint of the client. Occurrence result also indicates the presence of highly experienced design team. So consultant's staff is experienced and has extensive knowledge in all phases of the planning and design process.

Consultants have "completely agreed" in the opinion with the clients to consider this factor as the most severe factor which leads to design deficiency. Furthermore consultants gave this factor more importance as a cause of design deficiency. Consultants gave very high degree for the severity and very low degree for the occurrence, which means that consultants think that they have experienced and very qualified staff.

The second most important cause of design deficiency according to the clients' perception is "Designer's unfamiliarity with construction materials and techniques that are used in the project" with relative importance index 90.0% for the severity of impact and 47.14% with rank "16" for occurrence. According to Al-Hazmi (1987) and Adrian (1983), markets are comprised of many different types of materials, making the pre-selection difficult. Lack of current knowledge by designer about available materials and equipment can affect the design quality adversely (Cited in Arain and Assaf 2003).

The second most important cause of design deficiency according to consultants' perception is "Lack of experience on similar projects" with relative importance index 83.33% for severity and 46.67% with rank "12" for occurrence. The result indicates that the consultants realize the importance of an experience on similar projects. Therefore, previous experience on similar projects shall contribute to reduce design deficiency.

"Number of staff in each specialization" was ranked in the second position also with relative importance index 83.33% for severity and 36.67% with rank "16". The result shows the importance of staff's number in design office agrees with Abolnour (1994). Abolnour pointed out that increasing office staff contribute to reduce design deficiency because it establishes sort of peer review inside the office and it injects teamwork and cooperation inside the office which increases the degree of creativity in the office designs. This item frequency was very low in the occurrence which refers to the fact that all design offices were included adequate number of teamwork.

"Lack of time available for checking and correlating all the information on all design documents"; "Erroneous and conflicting information from the client" and "Insufficient design reviews with relevant parties" were the third most severe causes of design deficiency with relative importance index 88.57% for the severity of impact. The clients gave an advanced rank for these items as severe factors that cause design deficiencies, which indicates that most clients are aware that these items would lead to design deficiency and eventually variations, contract disputes and cost overruns. And undertaking of sufficient design reviews and checking with relevant parties may well act as a prevention mechanism for reducing errors due to inappropriate construction methods, while, the relative importance indices for occurrence for this items ranged from 50.0% to 60%. The clients gave high degree for the severity and low degree for the importance.

The relative importance index for item "Change in project requirements by stakeholders at later stages" equals 80.0% with rank equals "4" for the severity and 63.33% with rank "2" for occurrence. The consultants gave high degree for severity and medium for the occurrence. Consultants have believed more to the fact that stakeholders may not change in project requirements at later stages to decrease the design deficiency and as a result, to save a lot of time and money spend in rework and correction.

According to clients' perception, the relative importance index for item "Increased statutory regulations, approvals and requirements" equals 60.0% with last rank for severity and 45.71% with last rank also for occurrence. Also item "Increase in the overall complexity of projects" was in the last rank with relative importance index 60.0% and 48.57% with rank "12" for occurrence, which indicates that the clients are certain from the consultant's experience and the consultant ability to deal with any project despite its complexity and increased statutory regulations.

The item "Slow of payments' system for design services" is ranked as the last cause of design deficiency by the consultants with relative importance index 53.33% for severity and 56.67% with rank "7" for occurrence. The consultants gave higher degree for occurrence than severity. This means that the consultants face this problem in their project frequently because the Gaza Strip projects are funded by outside donor and therefore it has a complex payment system.

Mann-Whitney Test for the differences between means (Factors related to design process)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the severity of impact and occurrence due to respondent's type regarding "Design process" sub category.

The researcher used Mann-Whitney Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the respondents in the severity and occurrence of design deficiency causes due to respondent's type. The results illustrated in Table 4.24 show that the Z-values for severity and occurrence are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the severity and occurrence due to respondent's type regarding "Design process".

Table (4.24): Mann-Whitney Test due to respondent's type regarding "Design process"

Ctg.	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
			Severity of impact				
Design process	Consultant	6	7.333	23	1.572	0.116	not sig.
	Client	14	11.857				
			Occurrence				
	Consultant	6	9.667	37	0.413	0.680	not sig.
	Client	14	10.857				

4.4.1.2 Time and cost of design

Table 4.25 shows the relative importance index and rank by the clients and the consultants of the factors related to time and cost regarding severity and occurrence.

Table (4.25): RII and rank of the factors related to "Time and cost of design"

		Clients				**Consultants**			
		Severity		**Occurrence**		**Severity**		**Occurrence**	
	Factor	**RII %**	**RANK**	**RII %**	**RANK**	**RII %**	**RANK**	**RII %**	**RANK**
Time and cost of design (TC)									
19	Tight design schedule or Inaccurate time estimates	81.43	**1**	61.43	**2**	70	**2**	60	**2**
20	Reduced design fees levels	72.86	**2**	67.14	**1**	73.33	**1**	63.33	**1**

As shown in Table 4.25, the clients gave "Tight design schedule or inaccurate time estimates" higher score than "Reduced design fees levels" as an important factor that affects the design quality. At the same time, the two factors were found medium (almost similar) in the occurrence. Tilley et al. (2002) in his study considered inadequate design fees and inadequate design time allowances as the most important factors which lead to design deficiency.

There is different perception between the clients and the consultants in ranking these factors regarding severity only. "Reduced design fees levels" was ranked the first regarding severity by consultants, with relative importance index 73.33%, and was ranked the first also regarding occurrence with relative importance index 63.33%. This result shows the importance of design fees to the consultants rather than time allowance. The result illustrates clearly from consultants' point of view that most clients select a consultant on the low bid, whether or not appropriate services can be provided for that cost.

"Tight design schedule or inaccurate time estimates" was ranked in the second position by the consultants with relative importance index 70.0% for severity and 60.0% with the second rank also for occurrence. The results shows that consultants need appropriate time frames from the clients to develop concept design, review and then carry out detailed design to reduce design deficiency.

Mann-Whitney Test for the differences between means (Factors related to time and cost of design)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the severity of impact and occurrence due to respondent's type regarding "Time and cost of design" sub category.

The results illustrated in Table 4.26 shows that the Z-values for severity and occurrence are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the severity and occurrence due to respondent's type regarding "Time and cost of design".

Table (4.26): Mann-Whitney Test due to respondent's type regarding "Time and cost of design"

Ctg.	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
Client	**Severity of impact**						
	Consultant	6	9.000	33	0.775	0.438	not sig.
	Client	14	11.143				
	Occurrence						
	Consultant	6	9.667	37	0.419	0.675	not sig.
		14	10.857				

4.4.1.3 Coordination

Referring to Table 4.22, The "Coordination" subcategory was ranked in the first position by all respondents with relative importance index 80.50% for severity and 64.29% with rank "5" for occurrence. This result refers to the existence of permanent cooperation between design team members.

With regard to the rank of the individual causes related to "Coordination" group, Table 4.27 shows the relative importance index and rank by clients and consultants of these causes regarding severity and occurrence.

Table (4.27): RII and rank of the factors related to "Coordination"

	Factor	Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
Coordination (CO)									
21	Lack of data integration across design disciplines	78.57	**2**	67.14	**1**	76.67	**1**	40	**1**
22	Inadequate design coordination between design disciplines	87.14	**1**	57.14	**2**	73.33	**2**	40	**1**

Table 4.27 shows that, "Inadequate design coordination between design disciplines" was ranked in the first position by the clients as a critical factors affecting design quality with relative importance index 87.14% for severity and 57.14% with rank "2" for occurrence. While it ranked in the second position by the consultants. These results illustrate the importance of coordination between designs member, therefore coordination should start at the initial design stage where many important decisions take place at this stage. And it indicates also that design coordination function not adequately recognized by the clients

"Lack of data integration across design disciplines" was ranked the second by clients with relative importance index equals 78.57% for severity of impact and 67.14% with the first rank for occurrence. This result reflects the adverse relationship between the clients and the consultants and the client's dissatisfaction form consultant's work

As shown in Table 4.27, the results show that consultants are not fully aware of the importance of data integration across design disciplines and coordination in increasing the degree of creativity and experience exchange between office employees to improve the design quality. The results also show that there is a good integration across design disciplines in consultants' offices and adequate coordination.

Mann-Whitney Test for the differences between means (Factors related to coordination)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the severity of impact and occurrence due to respondent's type regarding "Coordination" sub category.

The results illustrated in Table 4.28 shows that the Z-values for severity are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the severity due to respondent's type regarding "Coordination". While the Z-values for occurrence are significant which means the null hypothesis is accepted. As such, there is significant difference at $\alpha \leq 0.05$ among the respondents in the occurrence due to respondent's type regarding "Coordination"

Table (4.28): Mann-Whitney Test due to respondent's type regarding "Coordination"

Ctg.	Severity of impact						
	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
Coordination	Consultant	6	7.833	26	1.391	0.164	not sig.
	Client	14	11.643				
	Occurrence						
	Consultant	6	5.750	13.5	2.410	**0.016**	sig. at 0.05
	Client	14	12.536				

4.4.1.4 Selection strategy and bidding philosophy

Concerning the relative importance index of the categories, the "Selection strategy and bidding philosophy" group in the second rank with relative importance index 79.0% for severity with total agreements by the clients and the consultants as Table 4.22 indicates, and the fourth rank with relative importance index 59.50%. Therefore, design and contractual documents suffer deficiency because of "Selection strategy and bidding philosophy" factors and that can be ascribed to the adversarial relationships between clients and consultants. Table 4.29 shows the relative importance index and rank by clients and consultants of the factors related to selection strategy regarding severity and occurrence.

Table (4.29): RII and rank of the factors related to "Selection strategy"

		Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
	Factor	**RII %**	**RANK**	**RII %**	**RANK**	**RII %**	**RANK**	**RII %**	**RANK**
Selection strategy and bidding philosophy (SC)									
23	Selection of designers on the basis of lowest price selection strategy (Lowest bid approach)	75.71	**2**	68.57	**1**	90	**1**	70	**1**
24	Selection of designers on the basis of reputation instead efficiency	80	**1**	52.86	**2**	73.33	**2**	43.33	**2**

The results show that the respondents gave higher degree for severity than occurrence. This means that although many clients award the design contract to the lowest prices, they believe that it is important to consider the consultants with higher prices who provide better services. Furthermore consultants gave item "Selection of designers on the basis of lowest price selection strategy" higher relative importance index 90.0% than clients 75.71%. This indicates the inappropriate selection of designer by clients. Therefore all service providers will be selected on the basis of value and competency - and will not be selected on the basis of lowest price alone. In addition procedures for selection of consultants will be based on assessment of value for the service offered.

Therefore the client must establish and adopt consultancy selection tools based on value for money and they could consider prequalification of consultants with proven record of performance and base selection on previous performance assessments, thereby reinforcing the selection of the better performers.

Mann-Whitney Test for the differences between means (Factors related to selection strategy and bidding philosophy)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the severity of impact and occurrence due to respondent's type regarding "Selection strategy and bidding philosophy" sub category.

The results illustrated in Table 4.30 shows that the Z-values for severity and occurrence are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the severity and occurrence due to respondent's type regarding "Selection strategy and bidding philosophy".

Table (4.30): Mann-Whitney Test due to respondent's type regarding "Selection strategy and bidding philosophy"

Ctg.	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
	Severity of impact						
Selection strategy and bidding philosophy	Consultant	6	11.167	38	0.340	0.734	not sig.
	Client	14	10.214				
	Occurrence						
	Consultant	6	9.917	38.5	0.294	0.769	not sig.
	Client	14	10.750				

4.4.1.5 Design management

As shown in Table 4.21 and Table 4.22, among the seven categories, design management was ranked fifth by all respondents with relative importance index 75.0% for severity and the last one for occurrence. In addition it was ranked fourth and fifth by the clients and the consultant respectively regarding severity and ranked sixth regarding occurrence by both of them, which mean that clients and consultants respondents' do not perceive that design management leads to high level of design deficiency and there is a poor understanding of design management.

Table 4.31 shows the relative importance index and rank by the clients and the consultants of the factors related to design management regarding severity and occurrence.

Table (4.31): RII and rank of the factors related to "Design management"

	Factor	Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
Design management (DM)									
25	Absence of high cost experienced design team to projects	84.29	**3**	50	**6**	83.33	**2**	43.33	**5**
26	Absence of an experienced	87.14	**2**	51.43	**5**	86.67	**1**	30	**7**

		Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
	Factor	RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
	overall design manager								
27	Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time	61.43	7	38.57	7	46.67	7	50	4
28	Lack of funds for stuff job training	75.71	4	64.29	2	56.67	6	50	3
29	Lack of time available for continuous and effective communication between parties	74.29	5	54.29	4	63.33	5	56.67	2
30	Allocation of staff to more than one project in the same time	68.57	6	68.57	1	76.67	3	66.67	1
31	Poor planning of workload	88.57	1	54.29	3	76.67	4	36.67	6

The relative importance index for item "Poor planning of workload" equals 88.57% with rank "1" for severity and 54.29% with rank "3" for occurrence. Poor planning by design manager in design process is one of the most important factors that cause design deficiency. The clients ranked this item the third most frequent factor, hence they think that there is a poor planning of workload from the consultants, while consultants think that there is often an adequate planning of workload. Consultants must identify through workload planning the relationships among the various activities promoting the completion of the project, and notes the responsibilities and assignments with regards to each activity.

The relative importance index for items "Absence of an experienced overall design manager" equals 87.14% with rank "2" for severity and 51.43% with rank "5" for occurrence. This result shows the importance of experienced design manager, also indicates that there is a lack of qualified design manager in design process. Overall design manager must carries out the design processes in an organized way to eliminate the design deficiency and other problems.

While the clients ranked the item "Absence of an experienced overall design manager" in the second position, the consultants ranked it in the first position. High agreement was achieved between the clients and the consultants as they assigned the same rank "7" to item "Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time". As shown in Table 4.31 the results indicate the similarity in the opinions between the clients and the consultants.

"Absence of high cost experienced design team to projects" was ranked third by clients with relative importance index 84.29% and 50.0% with rank equals "6" for occurrence. This result indicates that the clients are fully aware of the impact of high cost experienced design team on design quality. The experience and knowledge of a design team have a significant effect on design quality and consequently on cost. For occurrence this item appeared almost low, perhaps because of the strength of respondents' experience.

Table 4.31 shows that client' respondents ranked "Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time" as the least factor that cause design deficiency in this subcategory with relative importance index 61.43% and 50.0% with rank "4" for occurrence. This result shows that in addition of unimportance of this factor from the clients' point of view they think that it is infrequent in projects.

The extraordinary point is that, the factor "Lack of funds for stuff job training" was allocated fourth with relative importance index 75.71% by the clients and the consultants ranked it sixth with relative importance index 56.67% regarding severity. The result shows that stuff job training is more important from the clients' point of view and highly existed in projects which mean most of the consultants ignore stuff training because it takes time and it is costly.

Mann-Whitney Test for the differences between means (Factors related to design management)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the severity of impact and occurrence due to respondent's type regarding "Design management" sub category.

The results illustrated in Table 4.32 shows that the Z-values for severity and occurrence are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the severity and occurrence due to respondent's type regarding "Design management".

Table (4.32): Mann-Whitney Test due to respondent's type regarding "Design management"

Ctg.	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
	Severity of impact						
Design Management	Consultant	6	6.833	20	1.842	0.065	not sig.
	Client	14	12.071				
	Occurrence						
	Consultant	6	8.083	27.5	1.204	0.229	not sig.
	Client	14	11.536				

4.4.2 Client related factors

This category includes causes 32-37. According to Table 4.19 and Table 4.20, among the three main categories, the relative importance index for "Client Related Factors" category equals 73.5% with rank "2" for the severity of impact and 60.67% with rank "1" for occurrence. The result shows total agreement of the clients and consultants on the ranking of this category. It means that the causes of clients' deficiency are the most frequent.

Table 4.33 shows the relative importance index and rank by the clients and the consultants of the factors related to design management regarding severity and occurrence.

Table (4.33): RII and rank of the factors related to "Client"

	Factor	Clients				Consultants			
		Severity		Occurrence		Severity		Occurrence	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
Client Related Factors (CF)									
32	Unstable client's requirements	77.14	**2**	57.14	**5**	80	**2**	76.67	**1**
33	Long waiting for client decision	74.29	**4**	58.57	**4**	63.33	**4**	70	**2**
34	Last minute changes by the client	81.43	**1**	60	**3**	83.33	**1**	70	**3**
35	Inadequate client's communication /relationship with design team members	71.43	**6**	52.86	**6**	56.67	**6**	46.67	**6**
36	Defensive approach to variations and claims for additional costs or time	72.86	**5**	61.43	**2**	63.33	**5**	53.33	**5**
37	Unwillingness of clients to pay fees commensurate with the design of high-quality services	75.71	**3**	65.71	**1**	66.67	**3**	66.67	**4**

As shown in Table 4.33, according to the relative importance index of factors, total agreement of the clients and consultants on the ranking of these factors. Such agreement leads to total belief in this rank and an acceptance of it as an undoubted fact.

Clients and consultants assigned the most severe factor in this category among the six factors to the "Last minute changes by two groups" with relative importance index 81.43% for severity of impact and in the third rank with relative importance index 60% for occurrence. The result indicates to the severity of last minute changes by clients on quality of design and refers to frequently occurrence of this problem in projects. This is due to unrealistic client expectations, particularly of time and cost due to poor client appreciation of cost drivers and project risks.

"Unstable client's requirements" was ranked in the second rank by the clients and the consultants with relative importance index 77.14% and 80% respectively for

severity. Therefore; clear client objectives for the project being articulated to allow all consultants to respond to the true project goals.

On the other hand, there is no agreement in ranking regarding occurrence, while it was ranked in the first rank by the consultants; it was ranked in the fifth rank by the clients, this refers to adversarial relationships between the consultants and the clients.

As shown in Table 4.33, "Inadequate client's communication /relationship with design team members" was ranked in the last position by clients and consultants with relative importance index 71.43% and 56.67% respectively for severity. This means that clients and consultants are not fully aware of the importance of clients' communication with design team and the positive influence of client involvement in projects. Inadequate communication between the client and design team members can result in documentation errors and omissions occurring. Therefore by empowering clients in the design process, change orders (specifically design-related) during the construction phase can be minimized.

Mann-Whitney Test for the differences between means (Factors related to client)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the severity of impact and occurrence due to respondent's type regarding "Client" category.

The results illustrated in Table 4.34 shows that the Z-values for severity and occurrence are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the severity and occurrence due to respondent's type regarding "Client".

Table (4.34): Mann-Whitney Test due to respondent's type regarding "Client"

Ctg.	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
			Severity of impact				
Client	Consultant	6	7.833	26	1.340	0.180	not sig.
	Client	14	11.643				
			Occurrence				
	Consultant	6	11.417	36.5	0.456	0.648	not sig.
	Client	14	10.107				

4.4.3 Tendering procedures related factors

Table 4.35 shows the relative importance index and rank by the clients and the consultants of the factors related to tendering procedure regarding severity and occurrence.

Table (4.35): RII and rank of the factors related to "Tendering procedures"

	Factor	Clients				Consultants			
		Severity		**Occurrence**		**Severity**		**Occurrence**	
		RII %	**RANK**	**RII %**	**RANK**	**RII %**	**RANK**	**RII %**	**RANK**
Tendering Procedures (TP)									
38	Multiple "notices to tenderers" and question/answer steps and short time for amendment	68.57	**2**	62.86	**2**	66.67	**1**	56.67	**1**
39	Reluctance by tenderers to ask questions that might reveal competitive edge	67.14	**3**	64.29	**1**	50	**3**	53.33	**2**
40	Tight tender times	71.43	**1**	61.43	**3**	60	**2**	53.33	**2**

"Tight tender times" was ranked in the first rank by the clients with relative importance index 71.43% for severity of impact and in the last rank with relative importance index 61.43% for occurrence as Table 4.35 indicates; on the other hand the consultants placed it in the second rank for both severity and occurrence. Therefore, projects suffer lack of time available for design process from consultants' point of view.

In general, a complete agreement between clients and consultants was achieved; they assigned the last rank to this category with relative importance index 66.0% for the severity of impact as shown in Table 4.20. While it ranked in the second position with relative importance index 60.33% for occurrence.

Mann-Whitney Test for the differences between means (Factors related to tendering procedures)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the severity of impact and occurrence due to respondent's type regarding "Tendering procedures" sub category.

The results illustrated in Table 4.36 shows that the Z-values for severity and occurrence are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the severity and occurrence due to respondent's type regarding "Tendering procedures".

Table (4.36): Mann-Whitney Test due to respondent's type regarding "Tendering procedures"

Ctg.							
	Severity of impact						
	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
Tendering procedures	Consultant	6	7.500	24	1.503	0.133	not sig.
	Client	14	11.786				
	Occurrence						
	Consultant	6	8.167	28	1.182	0.237	not sig.
	Client	14	11.500				

4.5 Remedial Methods

Eleven remedial methods to reduce design deficiency were identified and provided in the questionnaire form. Determining the importance degree and relative use of each method was sought as it leads to the main objectives of this survey. The following parts present and discuss the data collected regarding the importance and relative use of the remedial methods. The eleven remedial methods are shown in Table 4.37.

Table (4.37): RII and rank of the "Remedial Methods"

	Remedial Method	Importance				Relative Use				All Respondents			
		Clients		Consultants		Clients		Consultants		Importance		Relative Use	
		RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK	RII %	RANK
1	Working cooperatively together, sharing the same vision and objectives for the project.	98.57	**1**	86.67	**2**	75.71	**1**	73.33	**1**	95.00	**1**	75.00	**1**
2	Communication between all parties in decision making processes, from project inception to completion	91.43	**3**	83.33	**4**	71.43	**3**	73.33	**1**	89.00	**3**	72.00	**3**
3	Select all service providers on the basis of value and competency not on the basis of lowest price alone	98.57	**1**	86.67	**2**	67.14	**6**	56.67	**10**	95.00	**1**	64.00	**8**
4	Identifying and analysis of all risks and uncertainty inherent in the project and its circumstances	81.43	**7**	66.67	**9**	67.14	**6**	60.00	**7**	77.00	**8**	65.00	**6**
5	Continuing client involvement in the design management	81.43	**7**	66.67	**9**	74.29	**2**	70.00	**3**	77.00	**8**	73.00	**2**
6	Continuing involvement of contractor with experience in the design process	62.86	**11**	56.67	**11**	44.29	**11**	40.00	**11**	61.00	**11**	43.00	**11**
7	Spend sufficient time and money in project planning and design	88.57	**5**	90.00	**1**	71.43	**3**	70.00	**3**	89.00	**3**	71.00	**4**
8	Training design and documentation personnel available across all disciplines to gain experience and competition	82.86	**6**	83.33	**4**	55.71	**9**	60.00	**7**	83.00	**6**	57.00	**9**
9	Continuing professional development for ensuring that staff maintain up-to-date qualifications and competency standards	90.00	**4**	83.33	**4**	55.71	**9**	60.00	**7**	88.00	**5**	57.00	**9**
10	Understand and encourage the role of technology in the delivery of projects by all stakeholders	81.43	**7**	80.00	**7**	65.71	**8**	63.33	**5**	81.00	**7**	65.00	**6**
11	Framing the contracting arrangement around goodwill and fair dealing in an open communication environment.	80.00	**10**	70.00	**8**	70.00	**5**	63.33	**5**	77.00	**8**	68.00	**5**

Table 4.37 illustrates high agreement between the clients and the consultants regarding the eleven remedial methods being very important except "Continuing involvement of contractor with experience in the design process" it was ranked by all respondents in the last position with relative importance index 61.0% for importance and also in the last position with relative importance index 43.0% for relative use. This reflects that the clients and the consultants don't believe in contractor's involvement in design process and this return to the culture and adversarial attitudes towards contractor. However this result refers to lack of interaction between client, designer and contractor and dealing with the contractor is none of consultants' and clients' concern.

"Working cooperatively together, sharing the same vision and objectives for the project" and "Select all service providers on the basis of value and competency not on the basis of lowest price alone" were ranked first. This indicates that the respondents are fully aware of the importance of working together and designers' values. On the other hand, the relative importance index for relative use of "Select all service providers on the basis of value and competency not on the basis of lowest price alone" was in the eighth rank which means that selection of consultants is often driven more by price than the required level of service and expertise necessary for a successful outcome.

Mann-Whitney Test for the differences between means (Remedial methods)

There is a significant difference at $\alpha \leq 0.05$ among the clients and the consultants in the importance and relative use to respondent's type regarding "Remedial methods".

The results illustrated in Table 4.38 shows that the Z-values for importance and relative use are not significant which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the respondents in the importance and relative use due to respondent's type regarding "Remedial methods".

Table (4.38): Mann-Whitney Test due to respondent's type regarding "Remedial methods"

Ctg.	Type	N	Mean Rank	Mann Whitney U	Z	Asymp. Sig. (2tailed)	
			Importance				
Remedial methods	Consultant	6	10.250	40.5	0.125	0.901	not sig.
	Client	14	10.607				
			Relative use				
	Consultant	6	8.313	30.5	1.358	0.175	not sig.
	Client	14	11.958				

CHAPTER 5: CASE STUDIES RESULTS AND DISCUSSION

Ten case studies were considered for this research work. They were public buildings from Gaza Strip. The intention for the case studies is to provide real examples to demonstrate the negative parts of the design deficiency especially on cost and time. In additions they were used to identify the design deficiency types and their sources. Detailed methodology for the case studies is given in Chapter 3.

5.1 Case Study One (Administrative building)

This project consists of a main building with basement and three floors and other external works. The design was carried out by the client's own design office (Buildings Department). The supervision was carried out by a consulting engineering firm and the consultancy agreement was to cover the full supervision of all project's parts mentioned above. Table 5.1 highlights the types of design deficiency and their main sources.

Table (5.1): Case study one – types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source	Cost ($)
1	Addition of new basement	Client	87,660.0
2	Modification of facade's external finish	Client	28,720.0
3	Addition of new floor	Client	121,800.0
4	Changes in reinforcement steel design (contract's conflict)	Designer	2,400.0
	Total cost of change order due to design deficiency		**240,580.0$**
	% of Original Cost		**25%**

***Note**: Original project cost 960,138.63$*

It is clear from this case study that the major design deficiencies were related to the client and they were additions of new works and modifications. Also there were many contract conflicts and discrepancies between drawings and bill of quantities.

5.2 Case Study Two (Hospital 1)

This project has the following main elements:

- Main building with basement, ground floor, first floor and roof;
- Services building and generator room;
- Main and secondary boundary walls with entrance gates; and
- landscaping works

The full design and supervision was carried out by consulting engineering firm. Table 5.2 highlights the types of design deficiency and their main sources.

Table (5.2): Case study two - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source
1	Missing of court covering	Designer
2	Modifications of retaining walls works	Designer
3	Missing of submersible pumps	Designer
	Cost of change order due to design deficiency	**47,500.0$**
	% of Original Cost	**2.1%**

***Note**: Original project cost 2,290,000.0$*

5.3 Case Study Three (Hospital 2)

The structural construction stage of this project started on December 2005 and completed on January 2007. This project consists of main building with basement, ground floor and second floor with total area 2900m2. The full design and supervision was carried out by consulting engineering firm.

In this case study the position was different because there wasn't any change order because of design deficiency during the construction phase, but after implementing the building it was found that the water tanks had a major design deficiency which led to repairing this defect. However, Defective building design not only contributes to the final cost of the product but also to the cost of maintenance, which can be substantial. Table 5.3 highlights the types of design deficiency and their main sources.

Table (5.3): Case study three - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source
1	Water tanks design deficiency	Designer
	Cost of change order due to design deficiency	**15,000.0$**
	% of Original Cost	**2.0%**

***Note**: Original project cost 739,802.00$*

5.4 Case Study Four (School No. 1)

This project has the following main elements:

- Main building with ground floor, first floor and second floor with total area 3507m2;
- 2 Toilet units;
- Canteen unit with steel shed; and
- Boundary walls and landscaping works.

The full design and supervision was carried out by consulting engineering firm. Table 5.4 highlights the types of design deficiency and their main sources.

Table (5.4): Case study four - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source	Cost ($)
1	Difference of site levels between drawings and the site	Designer	4,500.0
2	Addition of new area in the site plan	Client	15,000.0
3	New additions (steel doors, glazed fireclay hand wash basin and water storage plastic tank)	Client	3,165.0
4	Modification in tiles specifications	Client	1,200.0
5	Contradictions between drawings and bill of quantities (Doors details, pipes diameter)	Designer	1,635.0
	Cost of change order due to design deficiency		**25,500.0$**
	% of Original Cost		**4.1%**

***Note**: Original project cost 627,643.17$*

5.5 Case Study Five (School No. 2)

This project consists of a main building with ground floor, first floor and second floor with total area 3100m2, toilet units; canteen unit with steel shed; and boundary walls and landscaping works. The full design and supervision was carried out by consulting engineering firm. Table 5.5 highlights the types of design deficiency and their main sources.

Table (5.5): Case study five - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source	Cost ($)
1	Modification in water tanks specifications	Designer	850.0
2	Addition of new science laboratory	Client	7,500.0
3	Addition of new doors	Client	250.0
4	Addition of new aluminum windows	Client	3,400.0
5	Contradictions between drawings and bill of quantities	Designer	860.0
	Cost of change order due to design deficiency		**12,860.0$**
	% of Original Cost		**2.2%**

***Note**: Original project cost 592,086.72$*

5.6 Case Study Six (School No. 3)

This project consists of a main building with ground floor, first floor and second floor with total area 3390m2, toilet units; canteen unit with steel shed; and boundary walls and landscaping works. The full design and supervision was carried out by consulting engineering firm. Table 5.6 highlights the types of design deficiency and their main sources.

Table (5.6): Case study six - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source	Cost ($)
1	Change in building level	Designer	700.0
2	Addition of new works	Client	1,800.0
	Cost of change order due to design deficiency		**2500.0$**
	% of Original Cost		**0.4%**

***Note**: Original project cost 585,633.80$*

5.7 Case Study Seven (School No. 4)

This project consists of a main building with ground floor, first floor and second floor with total area 3620m2, toilet units; canteen unit with steel shed; and boundary walls and landscaping works. The full design and supervision was carried out by consulting engineering firms. Table 5.7 highlights the types of design deficiency and their main sources.

Table (5.7): Case study six - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source	Cost ($)
1	Modification in windows specifications	Client	1,800.0
2	Addition of new doors	Client	250.0
3	Addition of new aprons	Designer	350.0
4	Modification in tiles specifications	Client	950.0
	Cost of change order due to design deficiency		**3350.0$**
	% of Original Cost		**0.5%**

***Note**: Original project cost 653,371.0$*

5.8 Case Study Eight (School No. 5)

This project consists of 2 main buildings with ground floor, first floor and second floor for each building with total area 3250 m2, 2 toilet units; 2 canteen unit with steel shed; and boundary walls and landscaping works. The full design and supervision was carried out by consulting engineering firm. Table 5.8 highlights the types of design deficiency and their main sources.

Table (5.8): Case study eight - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source	Cost ($)
1	Modification in windows specifications	Client	2,600.0
2	Increase in blackboards area	Designer	250.0
3	Missing in drawings and quantities	Designer	190,0
4	Modification in tiles specifications	Client	800.0
	Cost of change order due to design deficiency		**3840.0$**
	% of Original Cost		**0.6%**

***Note**: Original project cost 639,545.0$*

5.9 Case Study Nine (School No. 6)

This project consists of 2 main buildings with ground floor, first floor and second floor for each building with total area 3350 m2, 2 toilet units; canteen unit with steel shed; and boundary walls and landscaping works. The full design was carried out by the client and supervision of this project was carried out by consulting engineering firms. In this case study there is no design deficiency except addition of new work (new stadium) to solve the difference in levels between design and natural. Also there were some contradictions between drawings and bill of quantities. Nevertheless, no change orders because the new works were loaded on other items.

5.10 Case Study Ten (Administrative building)

This project consists of a main building with basements and six floors and other external works. The design was carried out by the consulting engineering firm. The supervision was carried out by client's own design office. Table 5.9 highlights the types of design deficiency and their main sources.

Table (5.9): Case study ten - types, sources and cost of design deficiency

No.	Design Deficiency Types	Main source	Cost ($)
1	Uncompleted details	Client	5,500.0
2	Raising building's level	Client	7,500.0
3	A decrease in calculation of some quantities (Tiles, Plastering)	Designer	18,000.0
4	Modification in Natural stone specifications	Client	31,000.0
	Cost of change order due to design deficiency		**62,000.0$**
	% of Original Cost		**4.3%**

***Note**: Original project cost 1,442,000.0$*

5.11 Types of Design Deficiency

The types of design deficiency as identified from the ten case studies and were shown in Tables 5.1 to Table 5.9 can be categorized as one of the following three types:

- Discrepancies between contracts documents (e.g. drawings, specification, bill of quantities etc.).

- Non adherence to the appropriate design guidelines.
- Missing or new additions.

These types of design deficiency are in-line with the types that have been identified by (Lutz et al. 1990).

One of the possible reasons for limiting the types of design deficiency to the ones mentioned above is that, only major design changes or new works that have reasonable cost effect have been considered as valid change order claims. There were possibly many other types and causes of design deficiency of minor impacts, in which some of them may fall under the types that have been identified in the literature review part. As mentioned in case studies, many design changes have been covered by loading new works on other existing items. As a result, the majority of the changes are clients' oriented changes due to poor project briefs by client based on unrealistic expectations.

5.12 Sources of Design Deficiency

Similar to the results of the questionnaire, the case studies revealed that clients are the most common source of design deficiency beside the designer. This can be contributed to the fact that the client's briefs and details of the projects were not completed at the time of design tender stage. Due to this, many new ideas from the clients came up at later stage and at the construction stage, which in turn leads to increase the number of clients' oriented changes.

5.13 Causes of Design Deficiency

As it can be seen from Table 5.10, the most ten occurred causes of design deficiency which appeared in most of the case studies were designers and clients' oriented causes. In general, the case studies results were close to a large extent to the result of the questionnaire. The factors' occurrence percentages in case studies are shown in Figure 4.5.

Table (5.10): Case studies – Causes of design deficiency

	Factors *(Causes of design deficiency)*	**Occurrence**									
		Case Study (1)	Case Study (2)	Case Study (3)	Case Study (4)	Case Study (5)	Case Study (6)	Case Study (7)	Case Study (8)	Case Study (9)	Case Study (10)
Designer Related Factors											
Design process											
1.	Inadequate/ineffective use of new technology										
2.	Copying and modifying from previous work to minimize time and cost	✓			✓	✓	✓	✓	✓	✓	
3.	Increase in the overall complexity of projects										
4.	Increased statutory regulations, approvals and requirements		✓	✓							
5.	Insufficient and missing input information from the client		✓	✓	✓	✓	✓	✓	✓	✓	
6.	Lack of time available for checking and correlating all the information on all design documents	✓			✓	✓			✓	✓	
7.	Erroneous and Conflicting information from the client	✓	✓	✓			✓	✓	✓		
8.	Lack of qualified consultant's staff										
9.	Leaving design issues to be sorted out in the construction process	✓			✓	✓	✓	✓	✓	✓	✓
10.	Insufficient design reviews with relevant parties										
11.	Lack of time for design reviews	✓								✓	
12.	Lack of owner reviewers for each project										
13.	Increase of current workload of the designer	✓								✓	
14.	Change in project requirements by stakeholders at later stages	✓	✓	✓				✓			
15.	Lack of experience on similar projects										
16.	Number of staff in each specialization (architect, structural… etc.)	✓								✓	
17.	Slow of payments' system for design services										
18.	Designer's unfamiliarity with construction materials and techniques that will be used in the project										
Time and cost of design											
19.	Tight design schedule or Inaccurate time estimates	✓									
20.	Reduced design fees levels					✓	✓	✓			
Coordination (poor coordination)											
21.	Lack of data integration across design disciplines	✓				✓			✓	✓	
22.	Inadequate design coordination between design disciplines	✓								✓	
Selection strategy and bidding philosophy											
23.	Selection of designers on the basis of lowest price										

	Factors *(Causes of design deficiency)*	**Occurrence**									
		Case Study (1)	Case Study (2)	Case Study (3)	Case Study (4)	Case Study (5)	Case Study (6)	Case Study (7)	Case Study (8)	Case Study (9)	Case Study (10)
	selection strategy (Lowest bid approach)										
24.	Selection of designers on the basis of reputation instead efficiency		✓	✓	✓	✓	✓	✓	✓		
Design management											
25.	Absence of high cost experienced design team to projects	✓					✓			✓	✓
26.	Absence of an experienced overall design manager										
27.	Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time										
28.	Lack of funds for stuff job training										
29.	Lack of time available for continuous and effective communication between parties	✓								✓	
30.	Allocation of staff to more than one project in the same time	✓								✓	
31.	Poor planning of workload	✓								✓	
Client Related Factors											
32.	Unstable client's requirements	✓	✓		✓		✓	✓	✓		✓
33.	Long waiting for client decision		✓	✓			✓	✓	✓		✓
34.	Last minute changes by the client	✓	✓	✓				✓	✓	✓	✓
35.	Inadequate client's communication/relationship with design team members		✓		✓		✓	✓			
36.	Defensive approach to variations and claims for additional costs or time										
37.	Unwillingness of clients to pay fees commensurate with the design of high-quality services										
Tendering Procedures											
38.	Multiple "notices to tenderers" and question/answer steps and short time for amendment										
39.	Reluctance by tenderers to ask questions that might reveal competitive edge										
40.	Tight tender times										

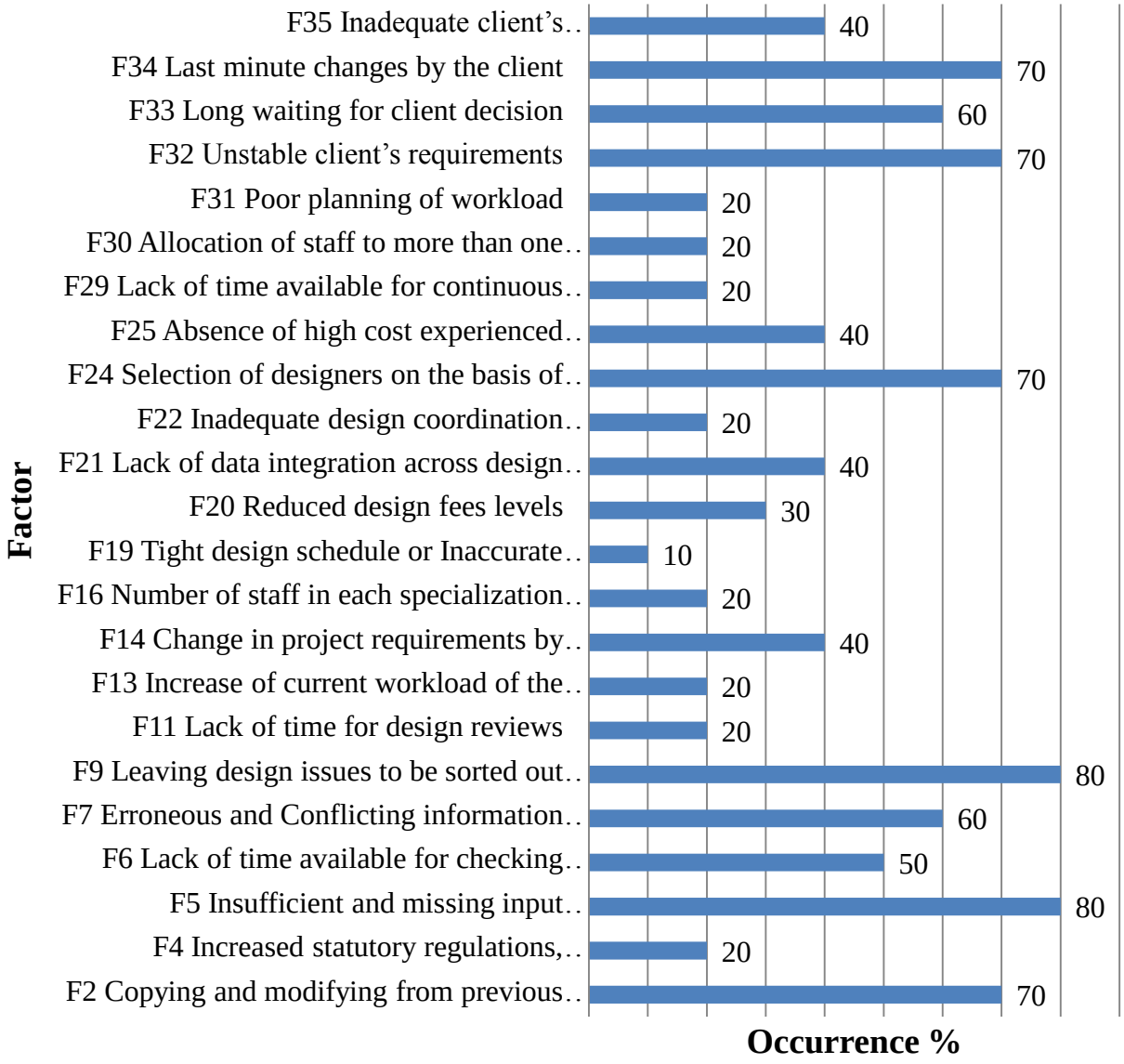

Figure (5.1): Factors' occurrence percentage in case studies

5.14 Impact of Design Deficiency on Cost

Table 5.11 summarizes the impact of design deficiency on cost for the case studies. The case studies have indicated that poor design quality can contribute up to 5% of project costs. This value was supported by questionnaire survey which has indicated that cost of design deficiency was less than 10% of project cost. Also, it has been found from the case studies that most of the change orders (near 80%) were directly design deficiency related.

Table (5.11): Case studies – Impact on cost

Case	Original project cost	Actual project cost	Cost of design deficiency	% of Original Cost
	($)	($)	($)	
1	960,138.63	1,200,736.06	240,580.0	**25%**
2	2,290,000.0	2,468,850.0	47,500.0	**2.10%**
3	739,802.00	745,381.73	15,000.0	**2.0 %**
4	627,643.17	647,614.62	25,500.0	**4.1%**
5	592,086.72	486,687.89	12,860.0	**2.2%**
6	585,633.80	560,504.12	2500.00	**0.4%**
7	653,371.00	619,531.77	3348.00	**0.5%**
8	639,545.00	539,981.84	3836	**0.60%**
9	656,053.94	609,321.32	0.0	**0.0**
10	1,442,000.0	1,500,000.0	62,000.0	**4.30%**

Table 5.12 shows that the minimum design deficiency cost is 0.0% and the maximum design deficiency cost is 25.06% of the project cost.

Table (5.12): Summary statistics of design deficiency cost

Case study	% of Project Cost
Minimum value	**0.0**
Maximum value	**25.06**
Average value	**4.13**
Median value	**2.07**
Note: Number of case studies = 10	

However, it can be seen from Table 5.11 and Table 5.12 the average cost overrun was not substantial in the case studies because of lack of projects' complexity in the Gaza Strip in comparison to other countries and the similarity of projects in structure and materials. Hence the designer's experience in similar projects might be substantially contributed to reducing design deficiency.

5.15 Impact of Design Deficiency on Schedule

The impact on schedule and the amount of the design deficiency delays for the case studies is given in Table 5.13. Although design deficiency no doubt cause delay on the progress of construction works, the total delay on construction cannot be totally contributed to design deficiency and design changes. Other factors such as contracts' or clients' oriented reasons and Israeli closures may have negative effects as well in the construction programs. Hence the percentage of delay on construction shown in Table 5.13 might be partially contributed to design deficiency.

Table (5.13): Case studies – Impact on schedule

Case	Scheduled Construction Duration	Time Delay	% of Scheduled	Time Delay due to Design Deficiency
	(Days)	(Days)	(%)	(%)
1	300	154	51.3	31.6
2	500	240	48.0	6.0
3	150	270	180.0	-
4	300	-	-	-
5	300	20	6.7	3.3
6	300	-	-	-
7	300	47	15.7	-
8	300	31	10.3	-
9	300	39	13.0	13.0
10	360	570	158.3	9.7
		Average Delay (% of Scheduled)		**6.36%**

As shown in Table 4.13 the average delay time in the project because of design deficiency was approximately 6.36% of scheduled time.

It can be noted from the questionnaire survey and case studies that the major design deficiency and design changes cause delay on the planned completion time and also increase the cost of the projects. In this regard, while consultants, contractors and clients spend great effort to ensure the completion of the work within the allocated time, cost and good quality, design deficiency no doubt deviate these essential goals. Furthermore design

deficiencies built bad atmosphere and increased the chances for change orders and disputes. Therefore, a common interest between clients and consultants must be found to build good relation with each other and to work in harmony to achieve a successful project.

CHAPTER 6: FRAMEWORK FOR MANAGING DESIGN DEFICIENCY

This chapter discusses the development of the framework to assist in identifying solutions for the various causes of design deficiency. The framework is designed to include all the design phases which are: client's project briefing phase, bidding and selection phase and design phase from concept design to detailed design. Each phase contains the most occurred causes that couldn't be encountered during the phases and the possible solutions and actions that clients and consultants should consider.

6.1 Improving Consultancy Design and Contractual Documents

The following is a preliminary list of recommended solutions and actions for improving the design and contractual documents based on the results of the case studies and questionnaire survey.

6.1.1 Client briefing phase and project establishment

Regarding to the questionnaire survey and the case studies, it is observed that the most frequent causes of design deficiency are related to client and this return to the inadequate client briefing. Therefore project briefing must be comprehensive and accurate and must permit all parties to properly assess the work required. Table 5.1 shows the recommended solutions to the design deficiency causes related to the client project briefing and the possible actions.

Table (6.1): Recommended solutions in the project briefing phase and possible actions

Root cause: Poor project briefs based on unrealistic expectations

Recommended Solutions	Actions
Spend sufficient time and money in project planning ▪ Establishment of well defined client brief comprising key drivers and parameters such as: budgets, functions, quality. ▪ Identifying and analysis of all risks and uncertainty inherent in the project and its circumstances.	▪ Review and establish industry based guidelines for effective briefs, including checklists. ▪ Engage Government agencies, significant private sector clients and industry associations as stakeholders in the process. ▪ Consider engagement of professional assistance at this time.
Increase client awareness of effective project's briefs benefits	▪ Present seminars, forums and training sessions on the benefits of developing briefs, and the skills required to develop them, with topics such as: 1. The use of independent consultants in the preparation of the brief where the client lacks the skill or experience. 2. Conducting general awareness program on effective project briefs and consultants' services briefs. 3. Clear client objectives and key drivers for the project being articulated to allow all service providers to respond to the true project goals. 4. Importance of identifying site restraints and existing infrastructure and services.

Root cause: Poor project briefs based on unrealistic expectations	
Recommended Solutions	Actions
	▪ Encourage professional service providers to include finalization and sign-off of brief as part of quality plan.
Successful brief preparation requires specialist expertise and experience, including, technical services, budgeting and programming.	▪ Engage specializing external consultants. ▪ Increase consultants' skills in principles of brief preparation to assist the client when undertaking pre-design and development of the project brief.

6.1.2 Bidding and selection phase

Table 6.2 shows the recommended solutions to the design deficiency causes related to selection strategy and bidding philosophy and the possible actions.

Table (6.2): Recommended solutions in the selection phase and possible actions

Root cause: Selection of consultants on a lowest bid basis	
Recommended Solutions	Actions
Selection criteria Promote consultancy selection tools that recognize qualifications of the proponents.	▪ Promote consultant selection criteria that take into account: 1. current workload 2. available resources 3. past commission performance 4. experience on similar projects 5. ability to meet the design /documentation program 6. the ability to work in cooperation with the client, the other consultants and the project team

Root cause: Selection of consultants on a lowest bid basis	
Recommended Solutions	Actions
Selection on value for money Each client organization should establish and adopt consultancy selection tools based on value for money.	▪ Present seminars to clients that insufficient fees and premature commitment of work will increase the probability of inadequate design.
Ethical selection of consultants	▪ Ensure and encourage selection assessment practices to be ethical and transparent.
Fee guidelines Adopt recommended guidelines on how to calculate fees, formulated in consultation with all relevant stakeholders, and to switch the emphasis in the selection of a professional consultant from price to value, capability and experience.	▪ Produce a guideline on the calculation of fees based on cost and time records and measured overheads.

6.1.3 Design phase

Hereinafter the most frequent causes of design deficiency during the design phase and the recommended solutions for them.

6.1.3.1 Clients and contractor's involvement in coordination of project design

Clients must accept the benefits of staying involved in the management of the project from start to finish, and monitoring the design process through the appointment of a client design manager/coordinator. Table 6.3 shows the suggested solutions and actions aimed at addressing these issues.

Table (6.3): Recommended solutions of lack of client's and contractor's involvement in design phase

Root cause: Lack of a qualified, client-appointed design manager/coordinator to formulate and oversee project integrity and continuity

Recommended Solutions	Actions
Continuing client involvement in the design management Ensure communication between all parties in decision making processes, from project inception to completion	▪ Working cooperatively together, sharing the same vision and objectives for the project.
Client design manager coordinator Manage and communicate skills, and increase the status and benefits of good design management.	▪ Promote the benefits of effective design management to achieve coordination across all parties involved in the construction effort.
Involvement of contractor in the design development phase Inviting creative and practical ideas from the contractor as he is supposed to have recent market knowledge about materials and the latest techniques of construction.	▪ Promote the benefits of contractor's involvement in design process to riddance from existing adversarial culture and attitudes towards contractor.

6.1.3.2 Consultant's staff

Table 6.4 shows the recommended solutions to the design deficiency causes related to skill shortages and the possible actions.

Table (6.4): Recommended solutions of consultant's staff in design phase

Root cause:

- *Skill shortages "Lack of qualified consultant's staff"*
- *Lack of time available for checking and correlating all the information on design documents*

Recommended Solutions	Actions
Qualified staff Continuing professional development for ensuring that staff maintains up-to-date qualifications and competency standards.	▪ Promote to client bodies the necessity for engagement of adequately qualified professionals and technical staff and the need to regularly assess performance.
Skilled personnel Training might be through continuing education, seminars, or on-the-job training.	▪ Encourage consulting firms to increase the number of traineeships. ▪ A policy and budget for staff training should be established.
Developing skill levels of consultant's staff	▪ Create training programs to encourage a co-operative approach to integrating the project phases and to problem solving. ▪ Ensure training of new staff provides adequate graduate competency in regard to CAD packages and other technology; and produces competent design professionals capable of correctly using technology.

Root cause:

- *Skill shortages "Lack of qualified consultant's staff"*
- *Lack of time available for checking and correlating all the information on design documents*

Recommended Solutions	Actions
Communication among the design team members to achieve quality in the design phase.	▪ Promoting high levels of collaboration and communication within the project team ▪ Establish and agree a design review process

6.1.3.3 Use of technology (CAD)

To avoid design errors, it is important to understand and encourage the role of technology in the delivery of projects by all stakeholders. Table 6.5 shows the recommended solutions to avoid the design deficiency causes related to ineffective use of technology and the possible actions.

Table (6.5): Recommended solutions of inadequate use of technology in design phase

Root cause: Inadequate/ineffective use of technology (CAD)

Recommended Solutions	Actions
Adopt the rapidly changing technology	▪ Encourage use of compatible software programs that are capable of integrating with each other, and capable of integrating across the different disciplines allowing fast and effective communication.
Enhance software for the best design practice	▪ Guide the development of software to meet best design practice that, for example: 1. uses technology as a design tool not a design process 2. allows integration of data across disciplines

Root cause: Inadequate/ineffective use of technology (CAD)	
Recommended Solutions	Actions
	3. enables electronic modeling to: - visualize the project for public consultation - allow a full appreciation by the constructor 4. produce a reliable bill of quantities

6.2 Evaluation of Design Deficiency Management Framework

To validate the developed framework, face-to-face interviews were conducted with three experts in the related subject, and the researcher set out and explained to them the design deficiency management framework. Then the experts were asked to rate the following issues on a scale of 0-100%, the average results of the respondents are given below.

Table (6.6): Framework evaluation (Issues' rating results)

	Issue	Rating out of 100
1.	Decreasing the probability of inadequate design	92
2.	Permitting all parties to properly assess the work required	95
3.	Sufficiency of the framework activities	93
4.	Clearness of the framework activities	94
5.	Practicality of the framework activities	92
6.	Overall degree of satisfaction with the framework	95

As shown above the results show that the recommended solutions and actions that form the design deficiency management framework will enable to minimize the design deficiency problems and eliminate extra costs incurred. The results also show that the solutions and actions of the framework are sufficient, clear and particle. The responses obtained from the experts confirm the validity of the design deficiency management framework.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

The quality of the design and contractual documents has a major influence on the overall performance and efficiency of construction projects. Declining standard of design quality has contributed significantly to a similar decline in construction efficiency. The aim of this research was to assist all stakeholders to plan effectively before starting a project, beginning with the design phases by creating awareness and paying enough attention to minimize the problems and eliminate extra costs incurred to make corrective actions to complete the defective design. According to the review of literature and after interviewing experts who deal with the design and contractual documents process at different levels, seven major factors and 40 sub-factors that affect design and contractual documents quality were determined.

A collective approach of investigating the issues under this research work led to the establishment of several objectives that helped to achieve the aim of this study. These objectives were to:

7.1 Identify the Most Severe and Occurred Factors

The weighting process in terms of severity and affect on design quality showed that the designer related factors are the most severe factors on design quality. While the least weighted main factors are tendering procedure factors. In addition, the weighting process in terms of occurrence in projects showed that the client related factors are the most occurred factors in projects. While the least weighted main factors are designer related factors.

With regard to the ranking of the individual factors it has been found that the most five severe factors agreed by the clients and consultants as the main causes of design deficiency were:

1. Lack of time available for checking and correlating all the information on all design documents;
2. Lack of qualified consultant's staff;
3. Lack of experience on similar projects;

4. Designer's unfamiliarity with construction materials and techniques that will be used in the project and
5. Absence of an experienced overall design manager.

These factors were related to designer – design process and design management. On the other hand it has been found that the most occurred factors-causes of design deficiency were:

1. Reduced design fees levels;
2. Selection of designers on the basis of lowest price selection strategy;
3. Allocation of staff to more than one project in the same time;
4. Unstable client's requirements;
5. Last minute changes by the client and
6. Unwillingness of clients to pay fees commensurate with the design of high-quality services.

Similarly, the results of the case studies have revealed the most occurred causes of the design deficiency. There are:

1. Copying and modifying from previous work to minimize time and cost;
2. Insufficient and missing input information from the client;
3. Leaving design issues to be sorted out in the construction process;
4. Selection of designers on the basis of reputation instead efficiency;
5. Unstable client's requirements;
6. Long waiting for client decision;
7. Last minute changes by the client;
8. Erroneous and Conflicting information from the client.

While, regarding the sources of design deficiency, it has been found that client is the most common source of design deficiency beside the designer.

7.2 Investigate the Impacts of Design Deficiencies on Project Cost and Time

The extent of the impacts of design deficiency have also been investigated firstly through the questionnaire and then verified through the case studies.

7.2.1 Impact on project cost

It has been found that the average cost overrun because of design deficiencies in the project/s was less than 10% of the project cost. This result has been confirmed through the case studies, case studies have indicated that poor design quality can contribute up to 5% of project costs, and the average cost overrun was 4.13%.

7.2.2 Impact on project time

The questionnaire's results indicate that the average delay time was less than 10% of project's time for 81.08% of respondents. These results were confirmed by case studies which found that the average delay time in the project because of design deficiency was approximately 6.36% of scheduled project's time.

7.3 Calculate the Percentage Agreement on Ranking Factors

A test for correlation agreement on the ranking of the factors between project participants "consultants and clients" was also calculated using Mann-Whitney Test. It was found that the overall parties have moderate agreement on the ranking of severity and occurrence factors.

7.4 Investigate the Conflict between the Documents

Case studies revealed that most of projects contained discrepancies between contract documents such as conflicts between drawings and bill of quantities.

7.5 Establish Framework for Managing Design Deficiency

It has been concluded that design process comprises three phases which are client's briefs phase, bidding and selection phase and design phase. Each phase contains a set of

possible solutions and actions that clients and consultants should consider. These solutions and actions are shown in framework in chapter five.

7.6 Recommendations

Recommendations are suggested below based on the findings of the research results and the literature review done.

1. Creating an awareness of the value of design quality is considered as an important step in decreasing design deficiency.
2. Clients are encouraged to establish better articulation of requirements to receive better consultant response.
3. For the design process to work effectively, a collaborative working environment needs to be in place by promoting high levels of collaboration and communication within the project team.
4. It is recommended to impose higher degree of peer review of contract documents from third party in order to minimize the possibility of having design deficiency.
5. In selection of consultant, clients should recognize that insufficient fees and premature commitment of work will increase the probability of inadequate design and significant contractual claims.
6. Increasing the awareness of the benefits of contractor's involvement at the design conception and development phases, therefore the contractor should provide inputs during these phases to help achieve better designs and to provide an opportunity to overcome the causes of design deficiencies (discrepancies between drawings and specifications).

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ANNEX (A): Questionnaire; English version.

Faculty of Engineering
Civil Engineering Department
Master Program in Construction Management
Islamic University, Gaza

Questionnaire for

Factors Affecting the Quality of Design and Contractual Documents in Gaza Strip

In Partial Fulfillment of Degree of M.Sc. Construction Management Study

Researcher
Shady Kh. Abdalaziz
120043796

Supervised By
Prof. Rifat Rustom

2009

Questionnaire for

Factors Affecting the Quality of Design and Contractual Documents in Gaza Strip

Dear: Projects' owners, Consultants, Contractors Greetings

Subject: Survey

I am presently preparing a thesis on factors affecting the quality of design and contractual documents as part of my Master's Degree course in Construction Management.
An important element of the thesis is to carry out a field survey to:

1. To identify main factors that may influence design and contractual documents quality in Gaza Strip construction industry.
2. To investigate the nature and extent of the impacts of design and documentation deficiencies on project cost and time.
3. To investigate the conflict between the documents (specifications, drawings, bill of quantities).
4. To establish a framework for managing design deficiency.

Enclosed please find a questionnaire, and based on your experience as a professional in this field, I kindly request you to spare part of your valuable time to fill it in. Please note that your name and your company or department name will remain confidential as far as the results are concerned.

The collected data will be statistically analyzed, and a conclusion will be finalized. If you wish, I shall be happy to provide you with the results of the study once finished.

Your assistance and cooperation will be highly appreciated
Thank you,
Shady Abdul-Aziz

SECTION ONE – *Questions related to the respondent's experience*

1.1 Respondent's Type

☐ Contractor ☐ Consultant ☐ Client/ Client representative

☐ Other please specify ……

1.2 Class of classification *(contractors)*

☐ First class (A) ☐ First class (B) ☐ Second class

1.3 The position of the respondent

☐ Manager ☐ Vice manager ☐ Project manager ☐ Engineer

1.4 Sector type of work

☐ Public ☐ Private ☐ Both

1.5 Number of employees

☐ Less than 25 ☐ 25-100 ☐ More than 100

1.6 Experience in dealing with construction projects

☐ <5 years ☐ 5-10 years ☐ 10-15 years ☐ >15 years

SECTION TWO – *Questions related to the performance of project/s you have been involved in.*

2.1 How many building projects have you participated in? (Last five years)

☐ <5 ☐ 6-10 ☐ >10

2.2 The proportion of projects which contained minor design deficiency (Did not cause the suspension of the work)

☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 % ☐ 71 to 100%

2.3 The proportion of projects which contained major design deficiency (cause temporary suspension of the work)

☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 % ☐ 71 to 100%

2.4 The proportion of projects that exceeded the contract cost because of design deficiencies? (Last five years)

☐ No ☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 %

☐ 71 to 100%

2.5 The proportion of that decreased the contract cost because of design deficiencies? (Last five years)

☐ No ☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 %

☐ 71 to 100%

2.6 What is the average cost overrun because of design deficiencies of the project/s? (Last five years)

☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 % ☐ 71 to 100%

2.7 What is the average cost decreasing because of design deficiencies of the project/s? (Last five years)

☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 % ☐ 71 to 100%

2.8 How many projects were delayed because of design deficiencies? (Last five years)

☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 % ☐ 71 to 100%

2.9 What is the average delay time of the delayed projects because of design deficiencies?

☐ Less than 10% ☐ 10 to 40 % ☐ 41 to 70 % ☐ 71 to 100%

☐ Over 100 % please specify ……

2.10 Who's responsible of design deficiency?

☐ Consultant ☐ Client ☐ Both

SECTION THREE – *Factors influencing design and contractual documents quality - Causes of design deficiency*

3.1 Please determine the severity weight and occurrence of the following factors which influencing design and contractual documents quality. The range of weighting in the research survey scaled from 1 to 5, as shown below:

S/N	Factors Affecting the Quality of Design and Contractual Documents	Severity					Occurrence in the projects (Owner & Consultant) only				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
		No effect	Low severe	Fairly severe	Severe	Very severe	Never	Rarely	Occasionally	Frequently	Constantly
	Designer Related Factors										
	Design process										
1.	Inadequate/ineffective use of new technology	1	2	3	4	5	1	2	3	4	5
2.	Copying and modifying from previous work to minimize time and cost	1	2	3	4	5	1	2	3	4	5
3.	Increase in the overall complexity of projects	1	2	3	4	5	1	2	3	4	5
4.	Increased statutory regulations, approvals and requirements	1	2	3	4	5	1	2	3	4	5
5.	Insufficient and missing input information from the client	1	2	3	4	5	1	2	3	4	5
6.	Lack of time available for checking and correlating all the information on all design documents	1	2	3	4	5	1	2	3	4	5
7.	Erroneous and Conflicting information from the client	1	2	3	4	5	1	2	3	4	5
8.	Lack of qualified consultant's staff	1	2	3	4	5	1	2	3	4	5
9.	Leaving design issues to be sorted out in the construction process	1	2	3	4	5	1	2	3	4	5
10.	Lack of time for design reviews	1	2	3	4	5	1	2	3	4	5
11.	Insufficient design reviews with relevant parties	1	2	3	4	5	1	2	3	4	5
12.	Lack of owner reviewers for each project	1	2	3	4	5	1	2	3	4	5
13.	Increase of current workload of the designer	1	2	3	4	5	1	2	3	4	5
14.	Change in project requirements by stakeholders at later	1	2	3	4	5	1	2	3	4	5

S/N	Factors Affecting the Quality of Design and Contractual Documents	Severity					Occurrence in the projects (Owner & Consultant) only				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
		No effect	Low severe	Fairly severe	Severe	Very severe	Never	Rarely	Occasionally	Frequently	Constantly
	stages										
15.	Lack of experience on similar projects	1	2	3	4	5	1	2	3	4	5
16.	Number of staff in each specialization (architect, structural… etc.)	1	2	3	4	5	1	2	3	4	5
17.	Slow of payments' system for design services	1	2	3	4	5	1	2	3	4	5
18.	Designer's unfamiliarity with construction materials and techniques that will be used in the project	1	2	3	4	5	1	2	3	4	5
Time and cost of design											
19.	Tight design schedule or Inaccurate time estimates	1	2	3	4	5	1	2	3	4	5
20.	Reduced design fees levels	1	2	3	4	5	1	2	3	4	5
Coordination among design team											
21.	Lack of data integration across design disciplines	1	2	3	4	5	1	2	3	4	5
22.	Inadequate design coordination between design disciplines	1	2	3	4	5	1	2	3	4	5
Selection critria and bidding philosophy											
23.	Selection of designers on the basis of lowest price selection strategy (Lowest bid approach)	1	2	3	4	5	1	2	3	4	5
24.	Selection of designers on the basis of reputation instead efficiency	1	2	3	4	5	1	2	3	4	5
Design Management											
25.	Absence of high cost experienced design team to projects	1	2	3	4	5	1	2	3	4	5
26.	Absence of an experienced overall design manager	1	2	3	4	5	1	2	3	4	5
27.	Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time	1	2	3	4	5	1	2	3	4	5
28.	Lack of funds for stuff job training	1	2	3	4	5	1	2	3	4	5
29.	Lack of time available for continuous and effective communication between parties	1	2	3	4	5	1	2	3	4	5
30.	Allocation of staff to more than one project in the same time	1	2	3	4	5	1	2	3	4	5
31.	Poor planning of workload	1	2	3	4	5	1	2	3	4	5
Client Related Factors											
32.	Unstable client's requirements	1	2	3	4	5	1	2	3	4	5
33.	Long waiting for client decision	1	2	3	4	5	1	2	3	4	5

S/N	Factors Affecting the Quality of Design and Contractual Documents	Severity					Occurrence in the projects (Owner & Consultant) only				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
		No effect	Low severe	Fairly severe	Severe	Very severe	Never	Rarely	Occasionally	Frequently	Constantly
34.	Last minute changes by the client	1	2	3	4	5	1	2	3	4	5
35.	Inadequate client's communication/relationship with design team members	1	2	3	4	5	1	2	3	4	5
36.	Defensive approach to variations and claims for additional costs or time	1	2	3	4	5	1	2	3	4	5
37.	Unwillingness of clients to pay fees commensurate with the design of high-quality services	1	2	3	4	5	1	2	3	4	5
	Tendering Procedures										
38.	Multiple "notices to tenderers" and question/answer steps and short time for amendment	1	2	3	4	5	1	2	3	4	5
39.	Reluctance by tenderers to ask questions that might reveal competitive edge	1	2	3	4	5	1	2	3	4	5
40.	Tight tender times	1	2	3	4	5	1	2	3	4	5

SECTION FOUR - *Remedial Methods*

4.1 In the table shown below, please determine the relative use and the importance of each preventive method

S/N	Remedial Methods	Importance					Relative Use				
		Not important	Low important	Medium important	Important	Very important	Never	Rarely	Sometimes	Often	Always
1.	Working cooperatively together, sharing the same vision and objectives for the project.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2.	Communication between all parties in decision making processes, from project inception to completion	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3.	Select all service providers on the basis of value and competency not on the basis of lowest price alone	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4.	Identifying and analysis of all risks and uncertainty inherent in the project and its circumstances	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5.	Continuing client involvement in the design management	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
6.	Continuing involvement of contractor with experience in the design process	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7.	Spend sufficient time and money in project planning and design	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
8.	Training design and documentation personnel available across all disciplines to gain experience and competition	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
9.	Continuing professional development for ensuring that staff maintain up-to-date qualifications and competency standards	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10.	Understand and encourage the role of technology in the delivery of projects by all stakeholders	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11.	Framing the contracting arrangement around goodwill and fair dealing in an open communication environment.	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

COMMENTS:

Thank you very much; your response is highly appreciated.

ANNEX (B): Questionnaire; Arabic version.

الجامعة الإسلامية - غزة
عمادة الدراسات العليا
كلية الهندسة - قسم الهندسة المدنية
برنامج الماجستير
إدارة التشييد

استبانة بخصوص

العوامل التي تؤثر على جودة التصميم و وثائق العطاء في قطاع غزة

وذلك كجزء من البحث التكميلي لنيل درجة الماجستير في إدارة المشروعات الهندسية

الباحث

شادي خليل عبد العزيز

المشرف

الأستاذ الدكتور: رفعت رستم

أستاذ إدارة المشروعات الهندسية

2009

استبانة بخصوص

العوامل التي تؤثر على جودة التصميم و وثائق العطاء في قطاع غزة

الأخوة الكرام / مالكو المشاريع – الإستشاريون – المقاولون ،،،
السلام عليكم و رحمة الله وبركاته

يقوم الباحث في الوقت الحاضر بتحضير دراسة حول العوامل التي تؤثر على جودة وثائق التصميم كبحث تكميلي لنيل شهادة الماجستير في إدارة المشاريع الهندسية في الجامعة الإسلامية بغزة، حيث يستعرض الباحث مشكلة النقص أو القصور الملحوظ في جودة وثائق التصميم و تأثيرها على مدة تنفيذ و تكلفة المشروع.
الهدف من هذه الاستبانة هو عمل مسح ميداني لـــ :

1. تحديد العوامل الأساسية التي تؤثر على جودة التصميم و وثائق العطاء
2. التحقق من طبيعة و مدى تأثير قصور التصميم على وقت و تكلفة المشروع
3. التحقق من التعارضات بين وثائق المشروع المختلفة (المواصفات، جداول الكميات، المخططات)
4. تأسيس اطار عام للحد من مشاكل جودة التصميم

يرجى ان تكون الاجابات مبنية على الخبرة في هذا المجال بدلا من الاستناد لمعلومات مشروع محدد و لكم جزيل الشكر و الامتنان لمساهمتكم بجزء من وقتكم للإجابة على هذه الاستبانة، هذا مع العلم بأن المعلومات التي ستتم تعبئتها في الاستبانة المرفقة ستحظى بالسرية التامة و سوف تستخدم للأغراض البحثية.
سوف يتم احاطة من يرغب من المشاركين في هذه الاستبانة بالنتائج المستخلصة بعد أن يتم تحليل البيانات المجمعة

مقدرين مساعدتكم و تعاونكم معنا الذي هو إثراء لهذا العمل

شكراً لكم،
شادي عبد العزيز

القسم الأول: معلومات عن الخبرة العملية

1.1 نوع المؤسسة

☐ مقاول ☐ شركة استشارية ☐ المالك / ممثل المالك

☐ أخرى / فضلا حدد

1.2 درجة التصنيف (شركات المقاولات)

☐ درجة أولى (أ) ☐ درجة أولى (ب) ☐ درجة ثانية

1.3 المركز الاداري لمن يقوم بتعبئة الاستبيان

☐ مدير ☐ نائب مدير ☐ مدير مشروع ☐ مهندس

1.4 القطاع الذي تعمل به المؤسسة

☐ القطاع العام ☐ القطاع الخاص ☐ كليهما

1.5 عدد الموظفين بالمؤسسة

☐ أقل من 25 ☐ من 25-100 ☐ أكثر من 25

1.6 عدد سنوات خبرة المؤسسة في مجال الإنشاءات

☐ أقل من 5 ☐ 5-10 سنوات ☐ 11-15 سنة ☐ أكثر من 15 سنة

القسم الثاني: معلومات عن أداء المشاريع التي اشتركت فيها

2.1 عدد المشارع التي شاركت بها (خلال الخمس سنوات الأخيرة)

☐ أقل من 5 ☐ 6-10 ☐ أكثر من 10

2.2 نسبة المشاريع التي اشتملت على أخطاء تصميمية بسيطة (لم تتسبب في وقف العمل)

☐ أقل من 10% ☐ 10-40% ☐ 41-70% ☐ 71-100%

2.3 نسبة المشاريع التي اشتملت على أخطاء تصميمية رئيسية أو كبيرة (تسببت في وقف العمل مؤقتاً)

☐ أقل من 10% ☐ 10-40% ☐ 41-70% ☐ 71-100%

2.4 نسبة المشاريع التي تجاوزت قيمة العقد الأصلي بسبب القصور في التصميم (خلال الخمس سنوات الأخيرة)

☐ لا يوجد ☐ أقل من 10% ☐ 10-40% ☐ 41-70%

☐ 71-100%

2.5 نسبة المشاريع التي قلت قيمة العقد الأصلي فيها بسبب القصور في التصميم (خلال الخمس سنوات الأخيرة)

☐ لا يوجد ☐ أقل من 10% ☐ 10-40% ☐ 41-70% ☐ 71-100%

2.6 معدل تجاوز التكلفة الأصلية بسبب القصور في التصميم (خلال الخمس سنوات الأخيرة)

☐ أقل من 10% ☐ 10-40% ☐ 41-70% ☐ 71-100%

2.7 معدل نقص التكلفة الأصلية بسبب القصور في التصميم (خلال الخمس سنوات الأخيرة)

☐ أقل من 10% ☐ 10-40% ☐ 41-70% ☐ 71-100%

2.8 نسبة المشاريع التي تجاوزت مدة العقد بسبب القصور في التصميم (خلال الخمس سنوات الأخيرة)

☐ أقل من 10% ☐ 10-40% ☐ 41-70% ☐ 71-100%

2.9 معدل التأخر الزمني في مدة تنفيذ المشروع بسبب القصور في التصميم

☐ أقل من 10% ☐ 10-40% ☐ 41-70% ☐ 71-100%

☐ أكثر من 100% (فضلا حدد)

2.10 في رأيك من كان المسئول عن قصور التصميم (يمكنك اختيار أكثر من إجابة)

☐ الاستشاري ☐ المالك ☐ كليهما

القسم الثالث: الأسباب التي تؤثر على جودة التصميم و وثائق العطاء

3.1 حدد شدة التاثير السلبي و درجة الوجود للأسباب التالية و التي تؤثر على جودة وثائق التصميم و المدرجة في الجدول ,مع العلم بان شدة التاثير السلبي و درجة الوجود للاسباب قسمت الى خمس مستويات من 1 الى5 كما هو مبين في الجدول :

العوامل التي تؤثر على جودة التصميم و وثائق العطاء	شدة التأثير السلبي					درجة الوجود في المشاريع التي تم تنفيذها من قبل (المالك و الاستشاري) فقط				
	1	2	3	4	5	1	2	3	4	5
	غير مؤثر	مؤثر بدرجة قليلة	مؤثر لدرجة ما	مؤثر	مؤثر بدرجة كبيرة	غير موجود مطلقاً	نادراً	أحياناً	غالباً	دائماً
عوامل متعلقة بالمصمم (Designer Related Factors)										
عملية التصميم (Design process)										
1. قلة أو عدم استخدام التقنيات الحديثة في التصميم	1	2	3	4	5	1	2	3	4	5
2. النسخ و التعديل من مشروعات سابقة مشابهة لتقليل الوقت و التكلفة	1	2	3	4	5	1	2	3	4	5
3. صعوبة و تعقيدات المشروع	1	2	3	4	5	1	2	3	4	5
4. التعليمات القانونية والتشريعية المتزايدة و المتطلبات و الموافقات	1	2	3	4	5	1	2	3	4	5
5. عدم توفر المعلومات اللازمة للتصميم من قبل المالك	1	2	3	4	5	1	2	3	4	5
6. عدم توفر الوقت اللازم للزيارات الموقعية و جمع البيانات اللازمة للتصميم	1	2	3	4	5	1	2	3	4	5
7. وجود أخطاء و تضارب في المعلومات المقدمة من قبل المالك	1	2	3	4	5	1	2	3	4	5
8. قلة خبرة وكفاءة طاقم التصميم	1	2	3	4	5	1	2	3	4	5
9. ترك بعض التفاصيل التصميمية دون توضيح لحين الوصول لمرحلة الإنشاء	1	2	3	4	5	1	2	3	4	5
10. عدم توفر الوقت اللازم لمراجعة التصميم	1	2	3	4	5	1	2	3	4	5
11. المراجعة الغير الكافية للتصميم من قبل الأطراف ذات العلاقة	1	2	3	4	5	1	2	3	4	5

العوامل التي تؤثر على جودة التصميم و وثائق العطاء	شدة التأثير السلبي					درجة الوجود في المشاريع التي تم تنفيذها من قبل (المالك و الاستشاري) فقط				
	1	2	3	4	5	1	2	3	4	5
	غير مؤثر	مؤثر بدرجة قليلة	مؤثر لدرجة ما	مؤثر	مؤثر بدرجة كبيرة	غير موجود مطلقاً	نادراً	أحياناً	غالباً	دائماً
12. عدم توفر العدد الكافي للمراجعين من قبل المالك	1	2	3	4	5	1	2	3	4	5
13. زيادة أعباء المصمم خلال فترة التصميم	1	2	3	4	5	1	2	3	4	5
14. التغيير في متطلبات المشروع من قبل الأطراف ذات العلاقة في المراحل الأخيرة للتصميم	1	2	3	4	5	1	2	3	4	5
15. قلة خبرة المصمم في مشاريع مشابهة	1	2	3	4	5	1	2	3	4	5
16. عدم توفر العدد الكافي من المستخدمين في كل تخصص (معماري، إنشائي ... الخ)	1	2	3	4	5	1	2	3	4	5
17. سوء أو بطء نظام الدفعات مقابل الخدمات التصميمية	1	2	3	4	5	1	2	3	4	5
18. عدم معرفة المصمم الكافية بمواد البناء المتوفرة و تقنيات البناء المستخدمة في المشروع	1	2	3	4	5	1	2	3	4	5
الجدول الزمني و التكلفة (Time and cost of design)										
19. التقدير الخاطئ أو ضيق الوقت الزمني لتصميم و ربط معلومات المشروع	1	2	3	4	5	1	2	3	4	5
20. المستويات المنخفضة لأجور التصميم	1	2	3	4	5	1	2	3	4	5
التعاون بين فريق التصميم (Coordination among design team)										
21. قلة أو عدم تكامل البيانات بين مجالات التصميم المختلفة	1	2	3	4	5	1	2	3	4	5
22. التعاون الغير كافي بين مجالات التصميم المختلفة	1	2	3	4	5	1	2	3	4	5
معايير اختيار المصمم (Selection criteria and bidding philosophy)										
23. إختيار الاستشاري أو المصمم بناءا على استراتيجية السعر الأقل	1	2	3	4	5	1	2	3	4	5
24. إختيار الاستشاري أو المصمم بناءا على السمعة و ليس الكفاءة و جودة التصميم	1	2	3	4	5	1	2	3	4	5

العوامل التي تؤثر على جودة التصميم و وثائق العطاء	شدة التأثير السلبي					درجة الوجود في المشاريع التي تم تنفيذها من قبل (المالك و الاستشاري) فقط				
	1	2	3	4	5	1	2	3	4	5
	غير مؤثر	مؤثر بدرجة قليلة	مؤثر لدرجة ما	مؤثر	مؤثر بدرجة كبيرة	غير موجود مطلقاً	نادراً	أحياناً	غالباً	دائماً
ادارة التصميم (Design Management)										
25. عدم تعيين فريق تصميم من قبل الاستشاري بخبرة و أسعار مناسبة	1	2	3	4	5	1	2	3	4	5
26. عدم وجود مدير عام لفريق التصميم	1	2	3	4	5	1	2	3	4	5
27. زيادة أفراد طاقم التصميم بدلاً من زيادة ساعات العمل للتغلب على مشكلة الوقت المحدود	1	2	3	4	5	1	2	3	4	5
28. عدم عمل دورات تدريبية بشكل دوري لتطوير طاقم التصميم	1	2	3	4	5	1	2	3	4	5
29. قلة الوقت المتوفر للإتصال المستمر و الفعال بين أطراف المشروع	1	2	3	4	5	1	2	3	4	5
30. اشغال طاقم التصميم في أكثر من مشروع في نفس الوقت	1	2	3	4	5	1	2	3	4	5
31. التخطيط السيئ للأعمال	1	2	3	4	5	1	2	3	4	5
عوامل متعلقة بالمالك (Client Related Factors)										
32. المتطلبات و التغييرات المتكرة من قبل المالك	1	2	3	4	5	1	2	3	4	5
33. الإنتظار الطويل لقرارات المالك من قبل الاستشاري	1	2	3	4	5	1	2	3	4	5
34. التغييرات التي يطلبها المالك في اللحظة الأخيرة أو قبيل الإنتهاء من التصميم	1	2	3	4	5	1	2	3	4	5
35. عدم وجود اتصال بين المالك و أعضاء فريق التصميم بشكل مباشر	1	2	3	4	5	1	2	3	4	5
36. نظرة المالك العدائية للأوامر التغييرية و المطالبات بزيادة التكلفة و الوقت	1	2	3	4	5	1	2	3	4	5
37. اصرار المالك على عدم دفع أجور متناسبة مع خدمات تصميمية عالية الجودة	1	2	3	4	5	1	2	3	4	5

العوامل التي تؤثر على جودة التصميم و وثائق العطاء	شدة التأثير السلبي					درجة الوجود في المشاريع التي تم تنفيذها من قبل (المالك و الاستشاري) فقط				
	1	2	3	4	5	1	2	3	4	5
	غير مؤثر	مؤثر بدرجة قليلة	مؤثر لدرجة ما	مؤثر	مؤثر بدرجة كبيرة	غير موجود مطلقاً	نادراً	أحياناً	غالباً	دائماً
عوامل متعلقة بإجراءات العطاء (Tendering Procedures)										
38. زيادة عدد الملاحظات للمتقدمين للعطاء و عدم توفر الوقت الكافي للتعديلات	1	2	3	4	5	1	2	3	4	5
39. تردد المتقدمين للعطاء لسؤال الأسئلة التي قد تكشف التفوق التنافسي	1	2	3	4	5	1	2	3	4	5
40. ضيق الوقت المعطى لتقدير العطاء	1	2	3	4	5	1	2	3	4	5

القسم الرابع: الإجراءات العلاجية

4.1 الجدول الموضح أدناه يحتوي بعض الطرق العلاجية للتقليل من الأخطاء التصميمية في وثائق التصميم، الرجاء تحديد أهمية و نسبة استخدام هذه الطرق تبعاً للرموز الموضحة

	الإجراءات العلاجية	الأهمية					نسبة الإستخدام				
		غير مهم	مهم بدرجة قليلة	مهم لدرجة ما	مهم	مهم جدا	مطلقاً	نادراً	أحياناً	غالبا	دائماً
.1	العمل سويةً و التعاون الجيد من جميع أطراف المشروع في تحديد رؤية و أهداف المشروع	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.2	الاتصال بين جميع الأطراف و التنسيق الدائم أثناء عمليات اتخاذ القرارات من بداية المشروع لنهايته	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.3	اختيار الاستشاري على أساس القيمة و الكفاءة و ليس على أساس أقل الأسعار فقط	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.4	تحديد و تحليل كل ظروف وأخطار المشروع بشكل جيد	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.5	اشراك و إطلاع المالك في عملية التصميم بشكل دائم و مستمر	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.6	اشراك و إطلاع مقاول ذو خبرة في عملية التصميم	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.7	توفير الوقت و المال الكافي للتخطيط و تصميم المشروع	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.8	توفير الدورات الخاصة لموظفي المؤسسة من جميع التخصصات لإكتساب الخبرة	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.9	التحفيز المستمر في المؤسسة لضمان بقاء الموظفين بأعلى درجات الكفاءة و المؤهلات	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.10	الفهم الجيد من قبل المساهمين للدور الفعال لاستخدام التقنيات الحديثة في المشاريع	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
.11	وضع الترتيبات التعاقدية في ظل نوايا حسنة و اتصالات جيدة	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

ملاحظات:

شكرا جزيلا ,نقدر لك تعاونك

ANNEX (C): Questionnaire Validity

Table (1): Person Correlation Coefficients between the items and their related section

S/N	Factors Affecting the Quality of Design and Contractual Documents	Severity		Occurrence in the projects	
		Person correlation coefficient	p- Value	Person correlation coefficient	p- Value
	Designer Related Factors				
	Design process				
1.	Inadequate/ineffective use of new technology	0.512	0.021	0.546	0.013
2.	Copying and modifying from previous work to minimize time and cost	0.587	0.007	0.547	0.013
3.	Increase in the overall complexity of projects	0.627	0.003	0.828	0.000
4.	Increased statutory regulations, approvals and requirements	0.577	0.008	0.705	0.001
5.	Insufficient and missing input information from the client	0.445	0.050	0.672	0.001
6.	Lack of time available for checking and correlating all the information on all design documents	0.493	0.027	0.735	0.000
7.	Erroneous and Conflicting information from the client	0.468	0.037	0.632	0.003
8.	Lack of qualified consultant's staff	0.720	0.000	0.490	0.028
9.	Leaving design issues to be sorted out in the construction process	0.551	0.012	0.782	0.000
10.	Lack of time for design reviews	0.579	0.007	0.702	0.001
11.	Insufficient design reviews with relevant parties	0.588	0.006	0.776	0.000
12.	Lack of owner reviewers for each project	0.556	0.011	0.621	0.003
13.	Increase of current workload of the designer	0.621	0.003	0.578	0.008
14.	Change in project requirements by stakeholders at later stages	0.592	0.006	0.673	0.001
15.	Lack of experience on similar projects	0.756	0.000	0.539	0.014
16.	Number of staff in each specialization (architect, structural… etc.)	0.623	0.003	0.708	0.000
17.	Slow of payments' system for design services	0.447	0.048	0.657	0.002
18.	Designer's unfamiliarity with construction materials and techniques that will be used in the project	0.554	0.011	0.492	0.027
	Time and cost of design				
19.	Tight design schedule or Inaccurate time estimates	0.688	0.001	0.899	0.000
20.	Reduced design fees levels	0.780	0.000	0.922	0.000
	Coordination among design team				

S/N	Factors Affecting the Quality of Design and Contractual Documents	Severity		Occurrence in the projects	
		Person correlation coefficient	p- Value	Person correlation coefficient	p- Value
21.	Lack of data integration across design disciplines	0.841	0.000	0.929	0.000
22.	Inadequate design coordination between design disciplines	0.626	0.003	0.929	0.000
Selection criteria and bidding philosophy					
23.	Selection of designers on the basis of lowest price selection strategy (Lowest bid approach)	0.776	0.000	0.758	0.000
24.	Selection of designers on the basis of reputation instead efficiency	0.774	0.000	0.849	0.000
Design Management					
25.	Absence of high cost experienced design team to projects	0.586	0.007	0.762	0.000
26.	Absence of an experienced overall design manager	0.492	0.027	0.722	0.000
27.	Increase design staff members, rather than increasing the number of hours of work to overcome the problem of limited time	0.705	0.001	0.445	0.049
28.	Lack of funds for stuff job training	0.768	0.000	0.687	0.001
29.	Lack of time available for continuous and effective communication between parties	0.630	0.003	0.639	0.002
30.	Allocation of staff to more than one project in the same time	0.580	0.007	0.586	0.007
31.	Poor planning of workload	0.668	0.001	0.553	0.011
Client Related Factors					
32.	Unstable client's requirements	0.733	0.000	0.828	0.000
33.	Long waiting for client decision	0.578	0.008	0.844	0.000
34.	Last minute changes by the client	0.770	0.000	0.885	0.000
35.	Inadequate client's communication/relationship with design team members	0.742	0.000	0.886	0.000
36.	Defensive approach to variations and claims for additional costs or time	0.692	0.001	0.771	0.000
37.	Unwillingness of clients to pay fees commensurate with the design of high-quality services	0.760	0.000	0.800	0.000
Tendering Procedures					
38.	Multiple "notices to tenderers" and question/answer steps and short time for amendment	0.749	0.000	0.706	0.000

S/N	Factors Affecting the Quality of Design and Contractual Documents	Severity		Occurrence in the projects	
		Person correlation coefficient	p- Value	Person correlation coefficient	p- Value
39.	Reluctance by tenderers to ask questions that might reveal competitive edge	0.912	0.000	0.706	0.000
40.	Tight tender times	0.642	0.002	0.653	0.002

Table (2): Person Correlation Coefficients between the items and their related section (For remedial methods)

S/N	Remedial Methods	Severity		Occurrence in the projects	
		Person correlation coefficient	p- Value	Person correlation coefficient	p- Value
1	Working cooperatively together, sharing the same vision and objectives for the project.	0.502	0.024	0.778	0.000
2	Communication between all parties in decision making processes, from project inception to completion	0.776	0.000	0.839	0.000
3	Select all service providers on the basis of value and competency not on the basis of lowest price alone	0.582	0.007	0.578	0.008
4	Identifying and analysis of all risks and uncertainty inherent in the project and its circumstances	0.690	0.001	0.769	0.000
5	Continuing client involvement in the design management	0.642	0.002	0.645	0.002
6	Continuing involvement of contractor with experience in the design process	0.721	0.000	0.728	0.000
7	Spend sufficient time and money in project planning and design	0.577	0.008	0.604	0.005
8	Training design and documentation personnel available across all disciplines to gain experience and competition	0.755	0.000	0.862	0.000
9	Continuing professional development for ensuring that staff maintain up-to-date qualifications and competency standards	0.890	0.000	0.862	0.000
10	Understand and encourage the role of technology in the delivery of projects by all stakeholders	0.703	0.001	0.876	0.000
11	Framing the contracting arrangement around goodwill and fair dealing in an open communication environment.	0.722	0.000	0.827	0.000

Table (3): Structure Validity of the Questionnaire

	Main Factors		Severity		Occurrence in the projects	
			Person correlation coefficient	p- Value	Person correlation coefficient	p- Value
1	**Designer Related Factors**	Design process	0.884	0.000	0.941	0.000
2		Time and cost of design	0.673	0.001	0.884	0.000
3		Coordination among design team	0.744	0.000	0.763	0.000
4		Selection criteria and bidding philosophy	0.559	0.010	0.452	0.044
5		Design Management	0.757	0.000	0.823	0.000
6	**Client Related Factors**		0.756	0.000	0.930	0.000
7	**Tendering Procedures**		0.785	0.000	0.458	0.042
			Importance		**Relative Use**	
8	**Remedial Methods**		0.601	0.005	0.547	0.013