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Factors That Hamper The Implementation Of Constructability In The Gaza Strip

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بسم الله الرحمن الرحيم

" قل إن صلاتي و نسكي

ومحياي ومماتي لله رب

العالمين "

صدق الله العظيم

Dedication

To my mother "may God have mercy on her soul" for her continuous prayers.

To my father "may God have mercy on his soul" whom I have never seen.

To my wife for her continuous encouragement.

To my children Shima', Saeb and Mohammed.

To my brothers and sisters for their unlimited support.

Acknowledgement

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Abstract

The subject of this research is about the barriers of constructability implementation in the Gaza strip. Therefore, this research aims at identifying the current implementation of constructability in the Gaza strip, clarifying the essential factors that hamper the implementation of constructability in the Gaza strip and clarifying solutions, whenever possible, that would help the participants to apply the constructability principles, in addition to develop guidelines for the practitioners of the construction industry.

The present investigation consists of literature review in subjects related to constructability to determine the hampering factors. Interviews with experts and from the researcher experience a questionnaire was designed incorporating all possible hampering factors in the Gaza strip. The questionnaire is divided into two parts:

The first part is related to the importance and affect of the barrier factors in construction industry in general. This part was completed by one of the main players of a project (Contractor, Consultant, Owner or their representatives).

The second part is related to the degree of existence of these barrier factors in the project under study. This part is completed by the researcher, from the project documents and through interviews with one or more of those who engaged in the project under study.

This research includes 28 case studies (projects), the result of data analysis of the respondents' answers and the case studies showed the followings:

1. All hampering factors were given a high rating by respondents in terms of the importance and affect of the barrier factors in construction industry.
2. About 54 % of the respondents have never heard of the constructability and its concepts before.
3. The political factors and project management factors have scored the highest rate amongst the nine main factors that hamper the implementation of constructability in the Gaza strip.
4. Nature of the project factors and knowledge & experience factors has scored the lowest rate amongst the nine main factors that hamper the implementation of constructability in the Gaza strip.

5. Recurrent closure of crossings and absence of preassembling before project's execution have scored the highest rate amongst the 56 sub-factors that hamper the implementation of constructability in the Gaza strip.
6. Project remoteness & lack of utilities and type of contract have scored the least rate amongst the 56 sub-factors that hamper the implementation of constructability in the Gaza strip.

Finally, the researcher has designed a framework that acts as a guideline for the construction industry's practioners to overcome barriers of constructability, in accordance with the appearance of the barrier factors in the project life cycle, in order to achieve the desired project objectives.

ملخص الدراســة

تتمثل دراسة هذا البحث في موضوع معوقات قابلية الإنشاء في قطاع غزة ، وعليه هدفت هذه الدراسة إلى تعريف التطبيق الحالي لقابلية الإنشاء بقطاع غزة و توضيح معوقات تطبيقها وإيجاد الحلول لهذه المعوقات ما أمكن بالإضافة إلى اعتبار الدراسة دليل إرشادي للعاملين بصناعة الإنشاءات لتطبيق مفاهيم قابلية الإنشاء.

من خلال الدراسات السابقة والمقابلات مع خبراء في صناعة الإنشاءات ومن خلال خبرة الباحث تم تصميم استبان يشمل كل المعوقات الممكنة لقابلية الإنشاء بقطاع غزة فصمم استبيان مكون من جزأين:

الجزء الأول: خاص بأهمية كل عامل من العوامل المعوقة في صناعة الإنشاءات ويقوم بتعبئة هذا الجزء، أحد العارفين بتفاصيل المشروع قيد الدراسة (المقاول أو الاستشاري أو المالك أو من يمثلهم).

الجزء الثاني: خاص بدرجة وجود العامل المعوق في الحالة الدراسية (المشروع) ويقوم بتعبئته الباحث من خلال وثائق المشروع المختلفة ومن خلال مقابلة طرف أو أكثر من العارفين بتفاصيل المشروع.

اشتمل هذا البحث على دراسة 28 حالة دراسية (مشروع)، وبتحليل نتائج إجابات المبحوثين والحالات المدروسة فقد تبين التالي:

1- كل العوامل المعوقة لقابلية الإنشاء الموجودة في الإستبيان أعطيت تقادير عالية من قبل المبحوثين كعوامل معوقة لقابلية الإنشاء في صناعة الإنشاءات بشكل عام.
2- حوالي 54% ممن شملتهم الدراسة لم يسمعوا بمصطلح قابلية الإنشاء ومفاهيمها.
3- العوامل السياسية لقطاع غزة و العوامل التي تعود لإدارة المشروع ظهرت كأعلى عوامل معوقة لقابلية الإنشاء من بين العوامل الرئيسية التسع الأخرى في الحالات المدروسة.
4- العوامل المتعلقة بطبيعة المشروع و العوامل التي تعود للمعرفة و الخبرة ظهرت كأدنى عوامل معوقة لقابلية الإنشاء من بين العوامل الرئيسية التسع الأخرى في الحالات المدروسة.
5- الإغلاق المستمر للمعابر وعدم تمثيل المشروع قبل تنفيذه ظهرا كأعلى عاملين معوقين لقابلية الإنشاء في قطاع غزة من بين العوامل الفرعية الستة و الخمسين في الحالات المدروسة.
6- بعد موقع المشروع وقلة الخدمات حوله ونوع العقد ظهرا كأدنى عاملين معوقين لقابلية الإنشاء في قطاع غزة من بين العوامل الفرعية الستة و الخمسين في الحالات المدروسة.

وأخيراً قام الباحث بتصميم دليل إرشادي للعاملين في حقل صناعة الإنشاءات لتفادي معوقات قابلية الإنشاء - حسب ظهورها في مراحل المشروع المختلفة - من أجل تحقيق أهداف المشروع المرجوة.

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List of Acronyms

TQM	Total Quality Management
A/E	Architecture Engineer
VE	Value Engineering
CII	Construction Industry Institute
CICE	Construction Industry Cost Effectiveness
3D	Three Dimensions
2D	Two Dimensions
SPSS	Statistical Package for Social Science
PCU	Palestinian Contractors Union
CM	Construction manager
SP	Success Percentage

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Chapter 1
Introduction

Constructability is defined as "The optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives" (Uhlik and Lores, 1998).

Constructability is a term of art which has come to encompass a detailed review of design drawings, specifications and construction processes by a highly experienced construction engineer before a project is put out for bids (Gransberg and Douglas, 2005).
Constructability is needed because the design and construction of the project have become very complex because of factors such as:
- A great selection of material can be used.
- Science and technology are moving so fast.
- Regulations, standards, codes are so diverse.
- Differences in professional training.

Because of these factors, it is impossible that one professional manages all the knowledge required to plan, design, and construct a project (Uhlik and Georgina, 1998).

Constructability should be an important objective in all phases of a construction project and designers play an important role in achieving superior constructability (Fischer and Tatum, 1997).

Constructability has several benefits such as: reduce cost, shorter schedule, improved quality, enhanced safety, better control of the risk, fewer change order, and fewer claims (Gransberg and Douglas, 2005).

Numbers of factors are prevent effective implementation of the constructability program, which almost present in projects of the Gaza strip so these factors should be treated as early as possible. Therefore efforts should focus on determining the presence and relative significance of constructability barriers.

1.1 Research Problem

The construction field in the Gaza strip is rapidly deteriorating as a result of many factors such as; political and economical unrest, poor management, lack of skilled employees, lack of experience and coordination amongst parties involved.

To prevent the loss and retreat of the construction sector in the Gaza strip, optimum methods should be carefully identified and implemented by all parties involved in order to achieve the construction projects objectives. Not only theses methods are found in the constructability concept, but also how to be implemented successfully. Therefore, each participant should know the barriers and how to overcome them.

1.2 Research Questions

1. Are the constructability principles considered as a new subject in the construction industry in the Gaza strip?
2. Do the participants apply any other techniques instead of the constructability concept?
3. Is there any difference between value engineering and constructability?
4. When the practioners can use constructability principles?
5. What are the barriers to implementing constructability?
6. How could the participants apply the constructability principles?

1.3 Importance of the present research

Knowing the factors that would hamper the implementation of constructability in the Gaza strip would have positive impacts on the construction projects by avoiding these factors and/or finding optimum solutions for them. This would assist to achieve the constructability benefits, i.e. reduce cost, shorter schedule, improved quality, enhanced safety, better control of the risk, fewer change orders, and fewer claims.

1.4 Thesis Objectives

1. Identifying the current practices of constructability in Gaza strip.
2. Clarifying the essential factors that hamper the implementation of constructability in the Gaza strip.
3. Clarifying solutions, whenever possible, that would help the participants to apply the constructability principles and also to develop guidelines for the practitioners of the construction industry.

1.5 Research Motivation

Since the researcher is currently working as a contractor in the Gaza strip, this topic is of special interest to him that would further improve his overall performance.

There are also another three reasons motivated the research within this field:

1- Constructability is considered as a new concept in our area.
2- For accurate assessment of the factors that hamper the implementation of constructability in the Gaza strip.
3- To develop guidelines for the construction industry practioners.

1.6 Assumptions and Limitation

This research is based upon the assumption that the Constructability concepts used in the Gaza Strip are weak and need an indepth study.

This research is restricted by the following items:

1. Only identifying and clarifying the factors that hamper the implementation of constructability in the Gaza strip with some solutions.
2. The population is limited to contracting companies of first grade registered by the Palestinian Contractors Union (PCU) in any main construction type (only buildings class (A), only roads class (A), and only water and sewage or any combination between them) in Gaza strip.

1.7 Research Design

The first phase of the research thesis proposal included identifying and defining the problems and establishment of the objective of the study and development research plan.

The second phase of the research included a summary of the comprehensive literature review. A comprehensive literature review describing the factors that hamper the implementation of the constructability principles was carried out before data collection and analysis.

The third phase of the research included a questionnaire that is divided into two parts; the first part measures the importance and affect of the barrier factors in construction industry that is applied by one or more of the project participants. The second part measures the degree of existence in the projects under study (cases) that is applied by the researcher using the project documents and interviews.

The research focuses on modification of the questionnaire design by distributing the questionnaire to a pilot study to make sure that the questionnaire is understandable by respondents in a way that achieve the target of the study.

For data gathering, the research is based on 28 case studies by investigating the documents of projects under study. The data collected was complemented with personal interviews. The case studies (projects) have been executed within the last five years in order to get real and useful results.

The forth phase of the research was data analysis and discussion. Statistical Package for the Social Sciences (SPSS) was used to perform the required analysis. Finally conclusion of research and recommendations were then drafted.

Chapter 2
Literature Review

2.1 Definition of Constructability

Gibson et al. (1996) defined the constructability as "The optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve the overall project objective".

2.2 Constructability needed

Uhlik and Lores (1998) pointed that, the design and construction of projects have become very complex because of factors such as these:

1- A great selection of materials can be used in design and building construction.
2- Science and technology are moving so fast that it is difficult, even for professionals in particular areas of specialization, to stay up to date.
3- Regulations, standards, and codes are so diverse and stringent that they limit the design and construction in different ways.
4- There seems to be a demand for the fragmentation of knowledge and for specialization in order to demonstrate expertise.
5- The differences in professional training.

Because of the above mentioned factors, it is impossible that one professional (as was done in the past) to manage all the knowledge required to plan, design, and construct a project. There is no longer a "master builder professional" who does it all. Instead, participation of owners, consultants, suppliers, designers, and builders are required in exchanging knowledge during the preconstruction stage to develop the best design solution.

2.3 Benefits of constructability

Gibson et al. (1996) suggested that, the benefits that should accrue from the application of constructability during preproject planning include reduced cost, shorter schedules, improved quality, enhanced safety, better control of risk, fewer change orders and fewer claims.

Gransberg and Douglas (2005) pointed that, the implementation of formal constructability reviews as early as possible in a project's life cycle is of benefit to the designers and as well as the constructors and owners in the reduction of lost design effort due to required changes identified during construction and the better coordination of cross-disciplinary issues. Constructability is a powerful tool that works to the benefit of all parties in the capital construction project delivery process.
They said either, "Constructability can mean better projects, lower costs, better productivity, earlier project completions, and earlier start-ups."

Significant savings in both cost and time can accrue from the implementation of established constructability reviews as early as the conceptual planning of especially large and complex projects (Arditi et al. 2002).

2.4 Total quality management (TQM), value engineering (VE) and constructability

The objective of total quality management (TQM), value engineering (VE) and Constructability is to deliver a quality product in a manner that will provide the client with the most value per investment dollars. All three are management methods designed to jointly achieve the overall project objective (Chasey and Schexnayder, 2000).

Tables 2.1 and 2.2 emerge the comparisons between TQM with Constructability and VE with Constructability.

Table 2.1 TQM and Constructability Comparison (Chasey and Schexnayder, 2000).

No	Characteristics	TQM	Constructability
1	Performance Driver	Customer.	A/E's Customer-Constructor.
2	Principle	Do it right the first time.	Problem Avoidance. Optimize Construction Process.
3	Growth	Continuous Improvement.	Document Lessons Learned.

Table 2.2 VE and Constructability Comparison (Chasey and Schexnayder, 2000).

No	Criteria	VE	Constructability
1	Focus	Overall reduction of life cycle cost.	Optimize construction process in terms of construction cost, schedule, safety and quality.
2	Implementation	A brainstorming session where life cycle cost alternatives is considered for systems components while maintaining design function.	An integral part of project management and scheduling allowing construction knowledge and experience to be integrated into project planning and design.
3	Timing	Performed during design phase.	On-going from conceptual planning through construction and start-up.

2.5 Principles and concepts of constructability

Boyce (1991) focused on the concepts of designing for constructability which called the Ten Commandments of the KISS (first letter of every word in the commandment bellow) Philosophy of engineering and design. They are as follows:

1. Keep it straight and simple.
2. Keep its specification simple.
3. Keep it shop standard.
4. Keep its standards simple.
5. Keep its standards size.
6. Keep it same size.
7. Keep it square and squatty.
8. Keep it support simple.
9. Keep it site suitable.
10. Keep its schedule sacred.

Uhlik and Lores (1998) discussed the constructability concepts and showed that the most common activities performed by the general contractors during the conceptual phase were elaboration of schedules, estimates, and budget; selection of the major construction methods and materials; and suggestion of structural systems.

The writers concluded that the implementation of constructability concepts in two main points which are:

1. A relationship was found between the implementation of constructability concepts by general contractors with the type of work performed, and arrangement of contract used.
2. General contractors often implement the constructability concepts established by the Construction Industry Institute (CII) for the construction stage.

Nima et al. (2002) reported that out of the 23 constructability concepts adopted by their paper; only 7 were applied.

Any constructability concept should not be implemented at the expense of other concepts. Alternatively, the 23 concepts should be applied as a comprehensive formal program under the umbrella of constructability.

It is to be noted also that the 23 concepts should not be implemented unconsciously or individually.

Fox et al. (2002) mentioned that constructability rules have been available for a number of years. The following guidelines for the more successful application of constructability rules have been proposed:

1- Focus rules on each design stage in sequence;

2- Support rules with self-explanatory strategies and production databases;

3- Develop routine and foolproof application methods for rules;

4- Target rules on best available productivity/quality improvement opportunities.

Jergeas and Put (2001) detailed the constructability principles and divided them according to the project phases as follows:

1. Conceptual Planning Phase

- A formal constructability program is made an integral part of the project execution plans.
- Early project planning actively involves construction knowledge and experience.
- Construction personnel are involved in developing the project contracting strategy.

- Project schedules are sensitive to construction requirements.
- Basic design approaches consider major construction methods such as modularization or preassembly.
- Site layouts promote efficient construction.
- Project team participants responsible for constructability are identified early in the project.
- Advanced information technologies such as 3D computer modeling or field notebook computers are applied.

2. Design and Procurement Phases

- Design and procurement schedules are construction sensitive.
- Designs are configured to enable efficient construction considering issues like simplicity, flexibility, sequencing of installation, and labor skill and availability.
- Design elements are standardized including maximum use of manufacturers' standards and standardized components.
- Construction efficiency is considered in specification development including prior review of specifications by construction personnel.
- Modular/preassembly designs are prepared to facilitate fabrication, transportation and installation.
- Designs promote construction accessibility of personnel, materials, and equipment.
- Designs facilitate construction under adverse weather.
- Design and construction sequencing facilitates system turnover and start-up.

3. Field Operations Phase

- Innovative construction methods are used such as innovative sequencing of field tasks. Or use of temporary construction systems, or innovative use of construction equipment.

2.6 Constructability program

Chasey and Schexnayder (2000) discussed constructability program to reduce investment risk in the construction. To help eliminate construction problems, a constructability program must be implemented. A constructability program is the application of a disciplined, systematic optimization of the construction related aspects of a project during the planning, design, procurement, construction, test, and start-up phases by knowledgeable, experienced construction personnel who are part of the project team. The program's purpose is to enhance the project's goals.

Uhlik and Lores (1998) reported that, there are three actions toward constructability program which are:

1- A great proportion of general contractors do not have formal constructability programs, nor do they take actions toward the implementation of programs.

2- The majority of general contractors that participated in the survey agreed that the management of their organization supports constructability.

3- Companies with larger volumes of work tend to have formal constructability programs.

2.7 The implementation of constructability

Young (1996) clarified that while many leading design firms have begun formal or informal constructability implementation programs, many firms remain unconvinced.
The constructability review process must be viewed as a discipline to be observed during the design process, with regular meeting.
While each project will be different, some constructability review components as applied to the standard design process could be as follows:

1- Predesign

Comparative systems analyses, bay size and other structural element analysis, staging/phasing review, review overall schedule, and contract strategy.

2- Schematic design

Finishes options, outline specifications review for coordination, work packaging determination, scope/schedule/cost review, and construction risks identification/mediation plan.

3- Design development

Component interfaces review, equipment schedule, construction detailing review, scope/schedule/cost review, and system routing.

4- Construction documents

Review of documents for coordination.

Eldin (1999) focused on the reasons for constructability implementation. Although the reasons for constructability implementation were specific to each case study, it appeared that the owners' request for constructability implementation was a major common driver.

The writer believes that strong communication routines must be established early and maintained throughout the process.

The examination of the 'success factors' for the five case studies in Eldin (1999) suggested that these factors were related to Employee, Management, or Process issues. The following were the common success factors for the implementation of constructability:

1- Possession of technical skills among the individuals of the project teams.
2- Possession of interpersonal skills of individuals.
3- Management's demonstration of visible support for achievers.
4- Creation of an environment in which employees develop sense of ownership of their tasks.
5- Creation of long-term relationships between owners, designers, and contractors.
6- Establishment of strong communication routines among project participants.
7- Involvement of end-users in early project decisions.
8- Enforcing safety practices.

The major findings of Arditi et al. (2002) are summarized as follows:

1- Most design professionals are aware of constructability as a quality indicator of their finished product.
2- Slightly more than half of the designers indicated that they have a documented formal corporate policy to conduct constructability reviews in their organization.
3- There is evidence that designers are abandoning the traditional, physical small-scale models in favor of computer generated 3D models.

4- Peer reviews and feedback systems are the most prevalent tools used to achieve high levels of constructability.
5- Most designers conduct constructability reviews in both the preliminary and developed design stages.
6- Design professionals believe that project complexity is an essential factor that affects the way a constructability review is conducted in the design stage.
7- Design practices and philosophy usually determine the approach followed in analyzing the constructability of a design.

According to Chasey and Schexnayder (2000) constructability may be implemented in varying degrees of formality. Informal constructability approaches are usually indistinguishable from other construction management activities and include design reviews and construction coordinators.

The most effective approach to constructability is owner, architect/engineer, and constructor integration from project inception. This approach creates an atmosphere in which team participants can form the essential bonds of trust, mutual confidence, and good rapport necessary for a successful project.

Fisher et al. (2000) identified, defined, and evaluated existing analytical review tools that could facilitate the application of constructability. According to the survey, a total of 52 tools were compiled, which included both paper-based (people, processes, and forms) and computer-based (CAD, databases, multimedia) tools.

2.8 Enhancing constructability

Gibson et al. (1996) outlined a case study using a contractor symposium to enhance constructability during early detailed design on a project in Texas.

They considered the following key recommendations:

1- Implement project partnering for construction.
2- Develop contract documents in such a way to minimize uncontrollable risks for the contractor.
3- Test and expose site conditions to the best extent possible prior to bid, particularly dewatering and pile driving.

4- Provide specific contractual guidance on quality control and acceptance criteria for placement of finish materials.
5- Mooring facilities to the island should be provided under a separate contract and should be in place before construction.
6- The status and disposition of all permits should be specifically addressed in the contract documents.
7- The contract should be drafted to maximize government payments in relation to contractor progress, specifically for mobilization, storm recovery, unit pricing basis, and so forth.

Constructability symposiums appear to benefit both owners and participating contractors. Owners benefit by developing contractor interest in the project, by gaining input on such things as the proposed design, risk management, or contracting strategy, and by improving their relationship with the contractors by demonstrating willingness to listen to what the contractors have to say. Contractors benefit by getting a lead on potential new work, by helping to produce what should be more constructable design, which is to their benefit if they get the job, and by networking with other contractors.

According to Eldin (1999) some common significant lessons learned were identified in the five case studies presented. These common lessons learned were employee related, management related, and process related. The following were the common significant lessons learned:

1- Select team members to include all the skills required for the project.
2- Obtain top management's visible, strong support for the constructability efforts.
3- Cultivate the sense of employees' ownership of their tasks.
4- Persuade decision-makers of the benefits of long term relationships with other participants.
5- Convince management of accepting the calculated risk taken by employees.
6- Involve the end-users in the early project decisions.
7- Establish strong communication routines among project participants.
8- Invite ideas from all participants.

2.9 The participant roles in constructability process

Arditi et al. (2002) indicated that the designers consider developing good relationships with contractors and clients and avoiding litigation to be the best rewards of a highly constructable design.
Value engineering (VE) can be a complementary process to constructability, but cannot replace it. Most of designers indicated that VE could not be an alternative to constructability.

Nima et al. (1999) mentioned that the obligations of the engineer's personnel to enhance project constructability, these obligations summarized as the following:

1. The designers

1- Encouraging the owner to implement a constructability program.
2- They should be restricted to the start-up and construction sequence when establishing procurement and the master project schedule.
3- They should analyze the major construction methods in-depth as early as possible.
4- Taking the project site layout into consideration.
5- Exploiting the capabilities and benefits of advanced information technology.
6- Standardizing the design elements as much as possible and simplify the designs.
7- Tailoring of technical specifications to achieve efficient construction.
8- Increasing the use of the module/ preassembly designs.
9- Preparing designs that promote accessibility of manpower, material and equipment.
10- Preparing designs that facilitate construction under adverse weather conditions.

2. The surveyors

1- Collaborating with the designers to establish a master project schedule and designs.
2- Using advanced surveying equipment.
3- The surveyors should establish clear bench marks to achieve efficient construction.

3. The engineer's estimators

Contributing in configuring the designs to enable efficient constructability, through advising the designers to prepare designs within the limits of the budget allotted.

4. The resident engineer

1- Contributing in establishing the early project planning.
2- Giving his suggestions about the best contracting strategy.
3- Advising the designers to make the master project schedule and the design and procurement schedules to be start-up and construction-sensitive.
4- Identifying the best contractors and subcontractors.
5- Documenting issues of the constructability concepts used through the project.

Harbuck (1991) spoke about the cost engineer and he pointed that, the role of the cost engineer in providing construction cost estimates for capital projects is well established. The role of the cost engineer in constructability for capital projects has not been established. The cost engineers must be at the forefront of promoting constructability as an asset to a total project management concept while at the same time demonstrating the level of expertise and efficiency that can be achieved through the integration of these two project roles**.**

2.10 Barriers of constructability

Faulty working drawings and incomplete specifications are the major constraints working against constructability of design; on the other hand, owner resistance and budget limitations are perceived by designers as having a trivial effect on constructability (Arditi et al. 2002).

Eldin (1999) mentioned some common significant constructability implementation barriers were identified in all five case studies of Eldin (1999), these common barriers were employee related, management related, and process related.
Table 2.3 shows the general description of constructability implementation barriers issues.

Table 2.3 General description of constructability implementation barriers issues (Eldin, 1999).

Employee related issues	Management related issues	Process related issues
1. Lack of skilled employees	1. Lack of top management support	1. Lack of continuity (interruption)
	2. Lack of implementa-tion and budget training	2. Lack of training
	3. Lack of willingness to accept risk of empowering employees	3. Lack of process understanding
		4. Regulatory requirements

Uhlik and Lores (1998) mentioned that, the most significant barriers selected were the following:

1- Design without construction input is the traditional way of contracting;
2- Designers' lack of construction experience and construction technologies knowledge;
3- The concept is unknown by the owner.

These confirm the results of some previous research, which found that the fragmentation of the construction process, complacency with status quo, and the lack of construction knowledge of the designers were the most important barriers to constructability. The least selected barriers were the following:

1- There are no proven benefits of constructability;
2- Reluctance of field personnel to offer preconstruction advice;
3- And the concept is unknown by contractors.

In briefly way, the writers concluded the barriers of constructability as follows:

1- General Contractors have the same opinion on the topic of barriers to constructability, regardless of type of work, volume of work, or arrangement of contract used.
2- The most common barriers to constructability, identified by general contractors, were that design without construction input is the traditional form of contracting, and designers lack construction experience and knowledge of construction technologies.
3- It was found that barriers to constructability were changing because contractors were getting used to such a concept and because forms of contracting, such as design-build and construction management, have been implemented since the 1970s. These contractual forms are based on the integration of construction into design.
4- Recurring barriers were the limitation of lump-sum competitive contracting and the adversarial attitude between designers and contractors.
5- A new barrier to constructability was found to be designers' reluctance to include contractors in constructability review for fear of marring their reputation.

Chasey and Schexnayder (2000) pointed that, the construction industry cost effectiveness (CICE) project research identified seven barriers that reduce the effectiveness of construction integration.

1- Resistance by owners: Constructability programs add highly visible extra costs to projects but the benefits are less tangible.
2- Tradition: Construction persons are unaccustomed to being involved during project planning and working in architect/engineering offices.
3- Resistance by architect/engineers: Construction experts are sometimes perceived as meddling and troublesome during design.
4- Shortages of qualified personnel: It may be difficult to obtain qualified construction personnel.
5- Training: Neither industry nor schools are training people in the integration of construction with architect/engineering.
6- Incentives: The incentives for contractors to expand integration are minimal.

7- Priority: Integration has a low priority on many projects because owners are unaware of the potential savings.

Jergeas and Put (2001) concerned on the barriers to implementing constructability principles and they told that, the barriers listed under each of the seven constructability principles groupings were taken from the comments provided by the respondents in their completed surveys. Under each grouping, the comments that were more frequently cited are listed first. Also the number of times each comment was cited is shown in parentheses.

1. Up-from involvement of construction personnel:

1- Not having the construction resources available to the design team when it is needed.
2- Reluctance on the part of owners to spend money early in the project.
3- Designers request construction input too late.
4- Timing of construction contractor selection has often reduced actual benefits achieved.
5- Client does not always want to pay for the time spent on this task.
6- Dividing lines between designers and construction personnel are sometimes too rigid.
7- May be limited by the choice of tendering the project.
8- Limitations of lump sum competitive contracting. This type of contracting tends to create adversarial conditions between the constructors and the designers.
9- Falls short in regard to earlier involvement of trade supervision. While project construction management staffs are being involved from day one, first and second level supervisors are rarely consulted even on a daily scheduling basis.

2. Use of construction sensitive schedules:

1- Schedule requirements are often out of the control of project personnel.
2- Too many variables at the construction stage to foresee during design.
3- Difficulty resides in maintaining engineering deliverables to meet construction need.
4- Traditional construction/engineering rift where engineering does not accept that project is construction driven. Fear on such jobs that construction will "sacrifice" engineering to get the job done faster than engineering is capable of supporting.

3. Modularization and preassembly:

1- Modularization is very specific to only certain projects.
2- Does not lend itself to very large equipment.
3- Need to make sure that a specialist in transportation is consulted up front to identify size/route and other restrictions.
4- Need to ensure that the end user knows what he is getting as an end product. Otherwise rework at site will result.
5- Problem with this is if engineering or fabrication quality is poor. Field repairs to poorly design or fabricated items quickly erode any benefits achieved.
6- More development is still required to create the "out of-the-box thinking:' we need to move beyond what we are accustomed to and think innovatively.
7- Must be a front-end activity and not a detailed design afterthought to be successful.
8- Must be designed into the project at the front end.

4. Standardization:

1- It is often difficult to get meaningful vendor input.
2- Client engineers and operations do not typically buy into it in practice; each operating area has different wants.
3- Designers often customize too much.
4- Major clients like use their own standards.
5- Manufacture’s standards are not normally accepted in place of client specifications and standards. We do not seem to be able to standardize from one project to the next even though the projects may be very similar.
6- Different construction companies have different standards.

5. Designs facilitate construction efficiency:

1- Design engineers lack practical on-site construction experience and their communication skills with other groups are lacking.
2- Communication between construction and engineering needs development.
3- Construction personnel do not know how to deal with formative designs.
4- Some sites are extremely congested.
5- Restrictions imposed by operations on sites with operating facilities.
6- Short-sightedness by developers reducing consultant fees resulting in minimal design detailing and poor quality control and specification documents.

7- Designers reluctant to change their design to accommodate the field.
8- Designers/engineers do not understand the goals and concepts of constructability.
9- It is difficult to find people who have knowledge in both the engineering and construction fields.
10- Designs are usually done to facilitate operations first and then constructions if formal constructability review has taken place.

6. Use of innovative construction methods:

1- Lack of imagination and resourcefulness among constriction contractors.
2- Very little advancement in construction methods over the past two decades.
3- Need to be built into design process.
4- Developers and design build contractors exploit innovation to be competitive and increase profit margins.
5- If designs have been frozen, innovation may be precluded.
6- Contractors are reluctant to come up with suggested innovation.
7- Tendency to fall back to proven methods.
8- Generally, the writers do not believe that there is anything truly "innovative."

7. Advanced computer technology:

1- As with modularization, only certain projects would benefit from this technology.
2- In piping design, the many changes in software systems and revisions have cost dearly. Staff never gets the time to become expert in a system before they move on to a new one.
3- CAD systems need to become more users friendly.
4- Good but costly. Better than plastic models but not as easy to see all at once.
5- Limited to very large projects due to cost of current technology.
6- They have not sold the construction community on the benefits and they are not sufficiently disciplined to avoid "garbage in" problems.
7- There is a need to invest time and dollars in our construction people to get the optimum benefits in order to create "thinkers" and not just "doers".
8- Although computer systems are getting better. Actual practical use and applications are not there yet. Perhaps in the next 5 years.
9- Field construction personnel still reluctant to embrace 3D as tool to replace 2D drawings that they insist they must have to be able to build.

According to O'Connor and Miller (1995), Constructability barrier evaluation involves three phases: identification, mitigation, and review.

The writers discuss the assessment of potential barrier breakers and they reported that, the identification of prevalent barriers to constructability was an earlier part of the overall research effort and has been thoroughly discussed in an earlier publication. Efforts focused on the seven most common barriers encountered, identified as significant by 19% or more of all study participants:

1- Complacency with status quo.
2- Reluctance to invest additional money and effort in early project stages.
3- Limitations of lump-sum competitive contracting.
4- Lack of construction experience in the design organization.
5- Designer's perception that "we do it."
6- Lack of mutual respect between designers and constructors.
7- Construction input is requested too late to be of value.

O'Connor and Miller suggested that, assessment of potential barrier breakers consisted of two phases:

1- Identification of the potential barrier breakers; and
2- Industry assessment of these barrier breakers.

The literature review in this research focused on some cornerstones related to constructability subject such as:

Constructability definition,

Constructability needed,

Benefits of constructability,

The different between constructability, TQM and VE,

Principles and concepts of constructability,

Constructability program,

The implementation of constructability,

Enhancing constructability,

The participant roles in constructability process, and

It discussed in details the barriers of constructability that act as basis to determine the checklist of factors that hamper the implementation of constructability.

Chapter 3
Research Methodology

In order to realize the study objectives which are: identifying the current implementation of constructability in the Gaza strip, clarifying the essential factors that hamper the implementation of constructability in the Gaza strip and clarifying solutions, whenever possible, that would help the participants to apply the constructability principles and also to develop guidelines for the practitioners of the construction industry. The methodology adopted in this research can be summarized in the following points:

1- Literature review.

2- Defining the factors that hamper the implementation of constructability.

3- Developing a research model.

4- Pilot Study.

5- Instrument validity.

6- Research sample.

7- Sample size.

8- Method of choosing the sample.

9- Instrument reliability.

10- Method of collecting data.

11- Method of data analysis.

The research methodology flowchart, which leads to achieve the research objectives, is shown in Figure 3.1.

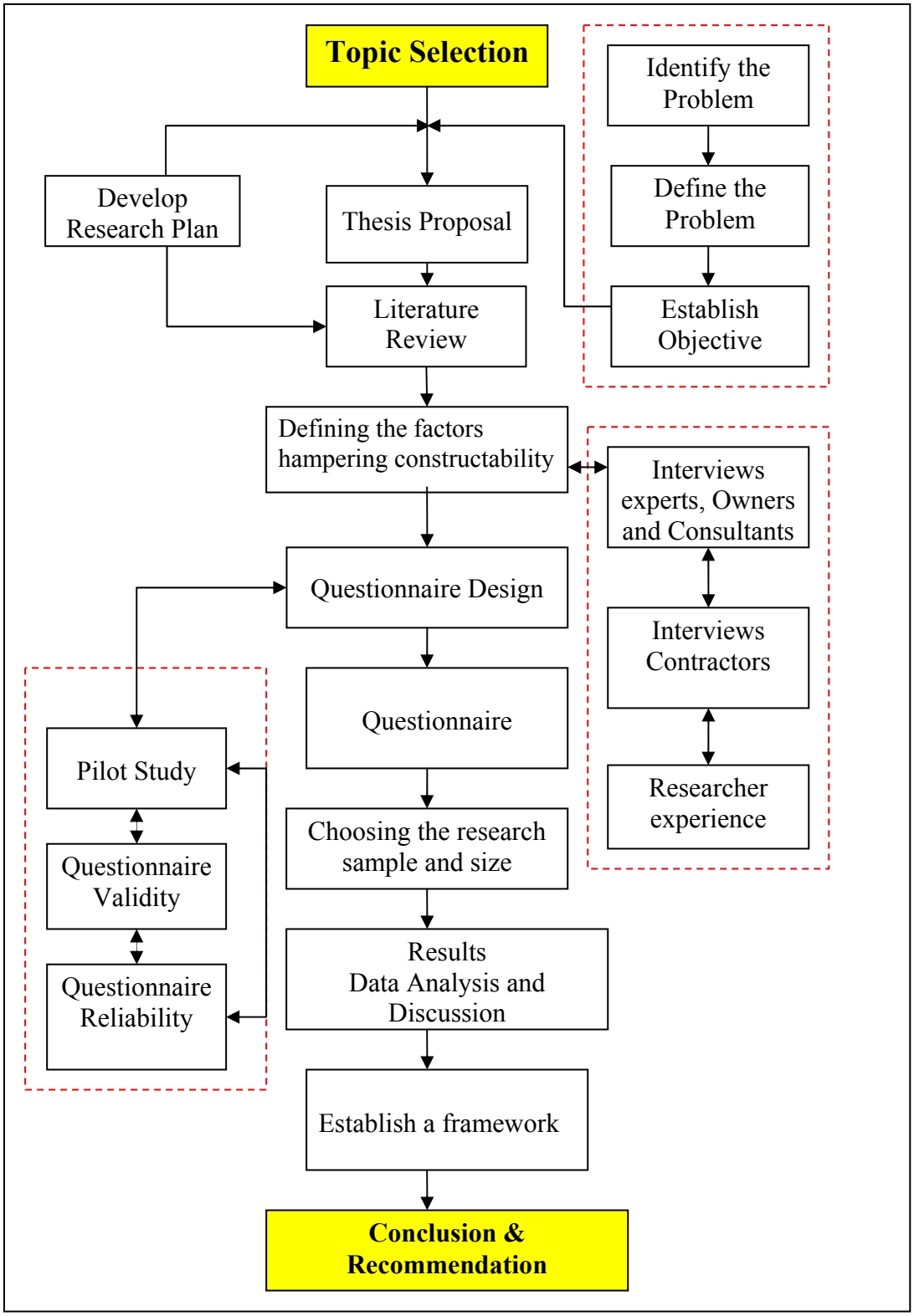


Figure 3.1 Research Methodology Flowchart

3.1 Literature review

A comprehensive literature search was conducted to determine and explain some cornerstones that relate to constructability issues which are: definition of constructability, constructability needed, benefits of constructability, principles and concepts of constructability, constructability program, the implementation of constructability, enhancing constructability, the participant roles in constructability process, and barriers of constructability.

3.2 Defining the factors that hamper the implementation of constructability

A literature review was conducted to identify the factors that hamper the implementation of constructability. By combining this literature review, as discussed in chapter 2, supported with some interviews with the participants as well as the researcher experience as an engineer and a contractor, the main factors that hamper the implementation of constructability were identified. They are categorized into nine main factors covering the main phases in the project life cycle, and each factor is divided into sub-factors as shown in Table 3.1.

Table 3.1 Factors that hamper the implementation of constructability

	Main factors	Sub-factors	Author
1	**Related to project management**	Owner is not supporting and committed throughout the project	Eldin, 1999
		Construction phases are not analyzed by the consultant	Young, 1996
		Design stages are not reviewed by the consultant	Young, 1996
		The contractor is not involved in the preparation and the design of the project	Chasey and Schexnayder, 2000
		Ambiguity or contradiction of project documents	Experts interview
		Overlapping of the contractor's team roles	Researcher experience
		Some parties of the project are not serious in resolving disputes	Experts interview
		The project is not implemented in accordance with the planned implementation schedule	Nima et al., 1999
		None of the parties applying lessons learned from previous projects	Researcher experience
		The contractor has no objective in the project or it is limited to making profit	Experts interview
		The contractor is not interested in quality during project execution	Researcher experience
		Safety and health measures are not followed	Eldin, 1999
		Lack or absence of the contractors' project management support	Researcher experience
		Lack or absence of workers' training	Eldin, 1999
		Finishing subcontractors are not involved from the beginning of project execution	Researcher experience
		Latest technology is not used in the project	Experts interview
		Project management is not willing to accept any risk related to workers	Eldin, 1999
		Absence of motivation for project's employees	Researcher experience
		Lack or absence of project risk control from the contractor	Experts interview
		Insufficient number of employees required in project activities.	Researcher experience
2	**Related to employees**	Lack of employees' experience in the project	Researcher experience
		Lack of employees' skills in the project	Eldin, 1999

	Main factors	Sub-factors	Author
3	**Related to relations and communications**	Bad relations between one party or more in the project	Arditi et al., 2002
		Miscommunication between one party or more in the project	Eldin, 1999
		Existence of claims between project's parties	Researcher experience
		Existence of disputes between one party or more in the project	Uhlik and Lores, 1998
		Absence of mutual confidence between the project parties	Experts interview
		Bad relation among the project's employees	Experts interview
4	**Related to knowledge and experience**	Lack of experience and practice of the owner or his/her representative	Uhlik and Lores, 1998
		Ignorance of latest technology	Jergeas and Put, 2001
		Lack of experience and practice of the contractor or his/her representative	Researcher experience
		Lack of experience and efficiency of the project's executing team	Eldin, 1999
5	**Related to project executing process**	Lack of knowledge of the used codes and specifications in the project	Experts interview
		Absence of preassembling before project's execution	Nima et al., 1999
		Absence or lack of project execution process	Researcher experience
		Absence of evaluation and documentation of the project	Nima et al., 1999
		Bad procurement method	Researcher experience
		Intensive and bad timing of change orders	Experts interview
		Absence or not following execution plan of the project	Researcher experience
		Priorities are not applied in the project	Experts interview
		Rework of some activities of the project	Researcher experience
		Interruption of project activities	Eldin, 1999
6	**Related to nature of project**	Project's difficulties and complexities	Arditi et al., 2002
		Project remoteness and lack of utilities	Researcher experience

	Main factors	Sub-factors	Author
7	Related to financial issues	Limited project budget	Experts interview
		No review of project cost before execution	Researcher experience
		Wrong cost estimates of project	Researcher experience
		Inadequate system of interim and final payments	Experts interview
		Existence of damages in the project	Experts interview
8	Related to political issues	Recurrent closure of crossings	Researcher experience
		Existence of political interruption and disputes	Researcher experience
9	Related to other miscellaneous issues	Type of contract	Uhlik and Lores, 1998
		Lack of equipment for project use	Experts interview
		Existence of environmental issues and bad weather	Researcher experience
		Weak project's productivity	Experts interview
		Extensive regulations, legislations and licenses required	Eldin, 1999

3.3 Development of the Research Model (Questionnaire Design and Content)

According to the review of literature and after interviewing experts who deal with the subject at different levels, all information that of help in achieving the study objectives were collected, reviewed and formalized to be suitable for the study survey. After many stages of brainstorming, consulting, amending, and reviewing executed by the researcher with the supervisor, a questionnaire was developed with closed and open-ended questions.

The questionnaire was designed in the Arabic language (Appendix 2), as most members of the target population were unfamiliar with the English language and to be more understandable. An English version is attached in (Appendix 1). Unnecessary personal data, complex and duplicated questions were avoided. The questionnaire was provided with a covering letter which explained the purpose of the study, the way of responding, the aim of the research and the security of the information in order to encourage high response.

The questionnaire design was composed of three sections to accomplish the aim of the research, as follows:

1. The first section contained institution profile.
2. The second section contained data on the project under study
3. The third section is about questions on factors that hamper constructability in terms of importance and affect in the construction industry (to be completed by one of the respondents) and the degree of existence in the project under study (to be completed by the researcher). It included nine main subsections as follows:

    - The first subsection is related to project management.
    - The second subsection is related to employees.
    - The third subsection is related to relations and communications.
    - The fourth subsection is related to knowledge and experience.
    - The fifth subsection is related to project executing process.
    - The sixth subsection is related to nature of project.
    - The seventh subsection is related to financial issues.
    - The eighth subsection is related to political issues.
    - The ninth subsection is related to other miscellaneous issues.

In this research, ordinal scale was used. Ordinal scale is a ranking or a rating data that normally uses integers in ascending or descending order. The numbers assigned to the agreement or degree of influence (1, 2, 3, 4, 5) do not indicate that the interval between scales are equal, nor do they indicate absolute quantities. They are merely numerical labels. Based on Likert scale we have the following:

Ratings related to the importance and affect of factors that hamper the implementation of constructability in construction industry were completed by the respondents as follows:

1	Item	Not important	Low important	Medium important	Important	Very important
	Scale	1	2	3	4	5

Ratings related to the degree of existence of factors that hamper the implementations of constructability in the projects under study were completed by the researcher as follows:

2	Item	Does not exist at all	Low existence	Medium existence	Exist	Intensively exist
	Scale	1	2	3	4	5

3.4 Pilot Study

It is customary practice that the survey instrument should be piloted to measure its validity and reliability and test the collected data. The pilot study was conducted by distributing the prepared questionnaire to panels of experts having experience in the same field of the research to have their remarks on the questionnaire.

Two panels were contacted to assess the questionnaire validity. The first panel, which consisted of ten experts (owners, consultants and contractors), was asked to verify the validity of the questionnaire topics and its relevance to the research objective. The second panel, which consisted of two 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.

Expert comments and suggestions were collected and evaluated carefully. All the suggested comments and modifications were discussed with the supervisor before taking them into consideration. At the end of this process, some minor changes, modifications and additions were introduced to the questions and the final questionnaire was constructed.

3.5 Instrument Validity

Validity refers to the degree to which an instrument measures what it is supposed to be measuring. Validity has a number of different aspects and assessment approaches. The researcher assessed the content validity of the questionnaire by four ways which are as follows:

3.5.1 Instrument validity by arbitrators

It is customary practice that the survey instrument should be piloted to measure its validity and reliability and test the collected data. The pilot study was conducted by distributing the prepared questionnaire to panels of experts having experience in the same field of the research to have their remarks on the questionnaire.

The questionnaire was distributed to a group of arbitrators of 10 persons (owners, designers, and contractors) who have wide experience in subject of the research.

The expert comments and suggestions were collected and evaluated carefully. All the suggested comments and modifications were discussed with the supervisor before taking them into consideration. At the end of this process, some minor changes, modifications and additions were introduced to the questions and the final questionnaire was constructed.

The researcher modified, deleted, and added the necessary parts of the questionnaire (see Appendix 1) based on the group's suggestions and comments. The parts of the questionnaire were accepted if 9-10 of the arbitrators agreed with, modified if 6-8 of arbitrators agreed with and rejected if less than 6 of arbitrators agreed with. Finally, the experts in field have diagnosed the validation of the factors' list and methodology where they have determined that they are suitable to achieve the research's objectives.

3.5.2 Instrument validity by Pilot study

After the preliminary testing, a pilot study was conducted to evaluate the questionnaire. The researcher distributed the questionnaire to a sample of 28 persons. Generally speaking, it appeared that the respondents had no difficulty in understanding the items or the instructions to complete the questionnaire. The researcher tested the internal consistency of the questionnaires by calculating the correlation coefficients between each item and the related items field.

3.5.3 Spearman Correlation Coefficients between the items

This test clarifies the correlation coefficients between the items (sub-factors hampering constructability) and the average of the related section. The coefficients denoted significance at 0.05 levels, which means a content validity of the questionnaire for what is being measured. For detailed information on the test in each section of the research questionnaire, see Appendix 3.

3.5.4 Structure Validity of the Questionnaire

Structure validity is 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 liker scale.

As shown in Table 3.2, the significance values are less than 0.05 or 0.01, so the correlation coefficients of all the fields are significant at $\alpha = 0.01$ or $\alpha = 0.05$. It can be said that the fields are valid to measure what it was set for to achieve the main aim of the study.

Table 3.2 Structure Validity of the Questionnaire

No.	Main Factors	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
1	Factors related to project management	0.786	0.000	0.536	0.003
2	Factors related to employees	0.598	0.001	0.460	0.014
3	Factors related to relations and communications	0.720	0.000	0.777	0.000
4	Factors related to knowledge and experience	0.547	0.003	0.593	0.001
5	Factors related to project executing process	0.810	0.000	0.648	0.000
6	Factors related to nature of project	0.773	0.000	0.725	0.000
7	Factors related to financial issues	0.781	0.000	0.814	0.000
8	Factors related to political issues	0.426	0.024	0.547	0.003
9	Factors related to other miscellaneous issues	0.698	0.000	0.766	0.000

3.6 Research sample

The population of this study is limited to projects executed by contracting companies of first grade that are registered by the Palestinian Contractors Union (PCU) in any major construction type of the following classifications:

- ✓ Buildings class (A) only,
- ✓ Roads class (A) only,
- ✓ Water and Sewage only,
- ✓ Or any combination between two or more of them in the Gaza strip.

The above-stated population (projects executed by contracting companies of first grade) was selected because of the following reasons:

1- First grade companies execute large projects; which makes the survey applicable.

2- The responses of executed companies are of great value due to broad experience and knowledge of their teams.

3- These projects are the closest population encountering factors that hamper the implementation of constructability.

4- The executed companies' teams had deep understanding of construction issues enables them to provide accurate responses for the survey questions.

3.7 Sample size

The term "sample" means a specimen or part of a whole population which is drawn to show what the rest is like (Naoum, 1998). The advantage of using a sample is that it is more practical and less costly than collecting data from all of the population.

The risk is that the selected sample might not adequately reflect the behaviors, traits symptoms, or beliefs of the population (Polit and Hungler, 1999).

The sampling is defined as "the process of selecting representative units of a population for the study in research investigation". The objective of the sampling is to provide a practical means of enabling the data collection and processing the components of the research to be carried out while ensuring that the samples provide a good representation of the population. A sample is a small proportion of a population selected for observation and analysis. The samples were selected randomly from the population.

To choose the sample size from the population (projects executed by construction companies, first grade class A), which equal 30 companies; the formula shown below was used for unlimited population (Creative Research System, 2007):

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

Where SS = Sample size

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

P = Degree of variance between the elements of population (0.5)

C = Confidence interval (0.05).

$$SS = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2} = 384.16 = 385$$

Correction for finite population, use the formula below:

$$\text{New SS} = \frac{SS}{1 + \frac{SS-1}{POP}}$$

$$\text{New SS} = \frac{385}{1 + \frac{385-1}{30}} = 27.90 \text{ companies} = \textbf{28 projects} \text{ (one project for every company)}$$

3.8 Method of Choosing the Sample

The contracting companies which have the required criteria are 30 companies from the 3 main types of construction (buildings projects, roads projects and water and sewage projects).

The number of case studies (projects) needed in this study is 28 from various companies; (one project for every company) therefore, the cases in every construction type according to its representative percentage of the original classification of contracting companies are as shown in Table 3.3.

Table 3.3 Case studies samples distribution

Class	No. of contracting company	% from the whole population	No. of projects needed
Buildings only	13	43.3 %	12
Water and sewage only	10	33.3 %	9
Buildings + Water and sewage	3	10 %	3
Buildings + Roads + Water and sewage	4	13.3 %	4
Total	**30**	**100%**	**28**

Note: The sample (case studies) should have been executed within the last (5) years to give real and useful results.

3.9 Instrument Reliability

The reliability of an instrument is the degree of consistency which measures the attribute. The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability. Reliability can be equated with the stability, consistency, or dependability of a measuring tool.

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 two tests can be applied to the scouting sample in order to measure the consistency of the questionnaire. The first test is the Half Split Method and the second is Cronbach's Coefficient Alpha.

3.9.1 Split-Half Coefficient method

This method depends on finding Spearman correlation coefficient between the means of odd questions and even questions of each field of the questionnaire. Then, correcting the Spearman 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 = $\frac{2r}{1+r}$ where r is the Spearman correlation coefficient.

The normal range of corrected correlation coefficient $\frac{2r}{1+r}$ is between 0.0 and + 1.0.

As shown in Table 3.4 all the corrected correlation coefficients values are between 0.0 and +1.0 and the significant (α) is less than 0.05 so all the corrected correlation coefficients are significant at α = 0.05. It can be said that according to the Half Split method, the main group factors are reliable.

Table 3.4 Split-Half Coefficient method

Main Factors	The importance and affect in construction industry			Degree of existence in the projects under study		
	Spearman coefficient	Spearman-Brown Coefficient	p- value	Spearman coefficient	Spearman-Brown Coefficient	p- value
Factors related to project management	0.6103	0.7580	0.000	0.6606	0.7956	0.000
Factors related to employees	0.7649	0.8668	0.000	0.8373	0.9114	0.000
Factors related to relations and communications	0.6830	0.8116	0.000	0.5901	0.7422	0.000
Factors related to knowledge and experience	0.6415	0.7816	0.000	0.7885	0.8817	0.000
Factors related to project executing process	0.7557	0.8609	0.000	0.754	0.8597	0.000
Factors related to nature of project	0.6412	0.7814	0.000	0.8439	0.9153	0.000
Factors related to financial issues	0.8258	0.9046	0.000	0.7557	0.8609	0.000
Factors related to political issues	0.6987	0.8226	0.000	0.6851	0.8131	0.000
Factors related to other miscellaneous issues	0.8186	0.9003	0.000	0.691	0.8173	0.000
Total	**0.7947**	**0.8856**	**0.000**	**0.7587**	**0.8628**	**0.000**

3.9.2 Cronbach's Alpha method

This method is used to measure the reliability of the questionnaire between each field and the mean of the whole fields of the questionnaire. The normal range of Cronbach's coefficient alpha value is between 0.0 and + 1.0, and the higher values reflect a higher degree of internal consistency. As shown in Table 3.5, the Cronbach's coefficient alpha was calculated for the factors that hamper the implementation of constructability in the Gaza Strip. The results were in the range from 0.7432 and 0.9514. This range is considered high; the result ensures the reliability of the questionnaire.

Table 3.5 Cronbach's Alpha method

Main Factors	The importance and affect in construction industry	Degree of existence in the project under study
	Cronbach's Alpha	Cronbach's Alpha
Factors related to project management	0.7432	0.8681
Factors related to employees	0.8667	0.9115
Factors related to relations and communications	0.8125	0.7534
Factors related to knowledge and experience	0.8854	0.8451
Factors related to project executing process	0.8452	0.8914
Factors related to nature of project	0.8345	0.9245
Factors related to financial issues	0.9124	0.892
Factors related to political issues	0.8455	0.8451
Factors related to other miscellaneous issues	0.9514	0.8542
Total	**0.8654**	**0.9012**

3.10 Normal distribution of the data

3.10.1 One-Sample Kolmogorov-Smirnov Test

Kolmogorov-Smirnov test will be used to identify if the data follow normal distribution or not. This test is considered necessary in case testing hypotheses as most parametric tests stipulate data to be normally distributed.

The results as shown in Table 3.6, clarifies that the significant level calculated are less than 0.05 (sig. < 0.05), this in turn denotes that the data does not follow normal distribution, and so the nonparametric tests can be used.

Table 3.6 One-Sample Kolmogorov-Smirnov Test

Main Factors	The importance and affect in construction industry		Degree of existence in the projects under study	
	Kolmogorov-Smirnov	P-value	Kolmogorov-Smirnov	P-value
Factors related to project management	2.459	0.000	2.281	0.000
Factors related to employees	1.364	0.048	1.732	0.005
Factors related to relations and communications	1.912	0.001	1.828	0.002
Factors related to knowledge and experience	2.208	0.000	1.642	0.009
Factors related to project executing process	1.643	0.009	1.681	0.007
Factors related to nature of project	1.457	0.029	1.432	0.033
Factors related to financial issues	2.076	0.000	1.561	0.015
Factors related to political issues	1.432	0.033	2.488	0.000
Factors related to other miscellaneous issues	1.828	0.002	1.880	0.002
Total	**2.173**	**0.000**	**2.514**	**0.000**

3.11 Method of collecting data

3.11.1 Case studies method

The case study is an extremely flexible and the most popular method of conducting research. It is considered an important approach for presenting information, describing the problem at hand, and prescribing solutions or treatments (Kirszner and Mandell, 1992 cited in Nima et al., 2002).

The purpose of the case study method is to obtain information from one or a few situations that are similar to the researcher's problem situation and the primary advantage of the case study is that an entire organization or entity can be investigated in depth and with meticulous attention to detail (Zikmund, 2000 cited in Nima et al. 2002).

Based on the above, the researcher used the case study method.

The case study method was applied on the selected projects through:

1- Reviewing the project's document (bid documents, daily, weekly, monthly and final reports, payments, claims, correspondences, etc) to answer the list of questions in Table 3.1.

2- Interviewing with some participants of projects (owners, consultants, contractors or their representatives) to complete and verify the answers.

3.11.2 Other methods

Project documents analysis for constructability barriers in the Gaza strip or any data needed were obtained by reviewing the practioners, personal interviews, correspondence, faxes and telephone calls.

3.12 Method of Data analysis

Data analysis was focused on identifying issues that may characterize constructability implementation barriers in planning, design, procurement and field operations phases. For each case study, data was organized under nine main factors in the main phase of project life cycle, and each factor is divided into sub-factors.

To achieve the research objectives, the Statistical Package for the Social Science (SPSS) was used for Manipulating and analyzing the collected data. The following statistical analysis tools were used**:**

1. Frequencies and percentile.
2. Spearman correlation coefficients for measuring validity of the items.
3. Split-Half Coefficient method for measuring reliability.
4. Spearman – Brown Coefficient.
5. Alpha - Cronbach Test for measuring reliability of the items.
6. One- Sample Kolmogorov - Smirnov test for normality of the distribution of data.
7. Kruskal Wallis Test.
8. Relative Importance Index.
9. Correlations coefficient between the groups by using some statistical analysis.

Finally, judgments of experts were considered as to support data analysis and results.

Chapter 4

Results

Data Analysis and Discussion

Analysis of data will be done through two statistical analysis methods. The first method which is called "The descriptive statistics method" provides a general overview of results. It gives an idea of what is happening. The other method which is called "The inferential statistics method" provides different statistical tests to be applied for the factors that hamper the implementation of constructability in the Gaza strip.

4.1 The descriptive statistics method

This method was applied on the survey data collection in section 1 and section 2 of the questionnaire. Frequency distribution and the percentage of different items are presented.

4.1.1 Section 1: Institution profile

1. Institution Type

Figure 4.1 shows that the data was obtained as follows:

50.0% of the research data obtained by owners, 10.7% obtained by consultants, and 39.3% obtained by the contractors.

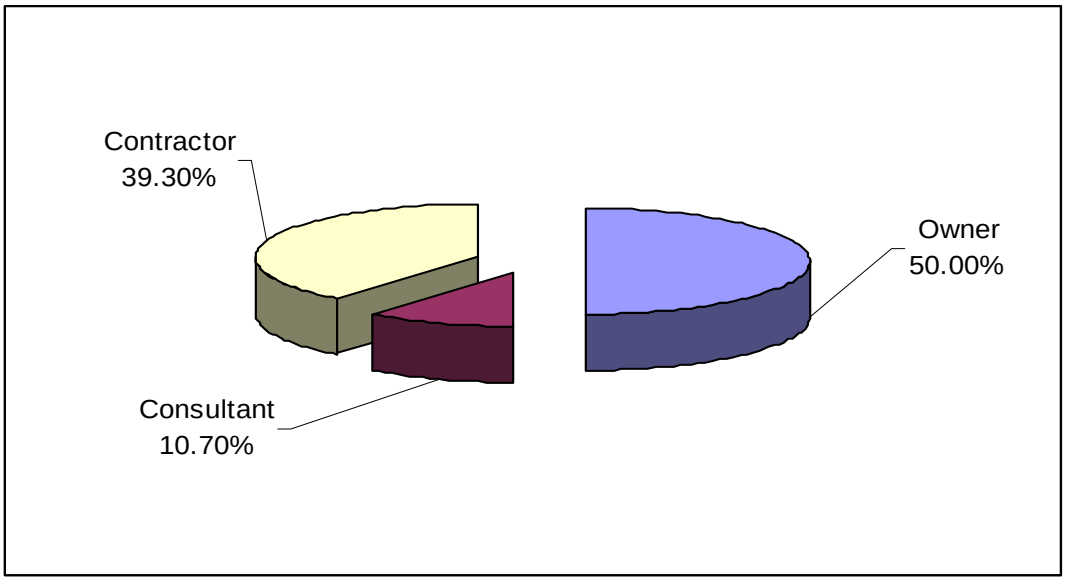


Figure 4.1 Institution type

2. Age of Institution

As shown in Table 4.1, it is noticed that (35.7 %) of the sample is less than 15 years, (28.6 %) is from 15 to 20 years and (35.7 %) is more than 20 years.

Table 4.1 Age of Institution

Age of Institution	Frequency	Percentage %
Less than 15 years	10	35.7
From 15 to 20 years	8	28.6
More than 20 years	10	35.7
Total	**28**	**100.0**

3. Implementing company

Four classes of contracting companies are surveyed as shown in Table 4.2. It is noticed that (42.9%) from the sampled the implementing companies are Buildings classification Only, (32.1%) are Water and Sewage classification only, (14.3%) are Buildings and Water and Sewage classification only, and (10.7%) are Buildings, Roads and water and sewage classification.

Table 4.2 Implementing companies' classification (First Class)

Implementing company (First Class)	Frequency	Percentage %
Buildings only	12	42.9
Water and Sewage only	9	32.1
Buildings and Water and Sewage only	4	14.3
Buildings, Roads and Water and Sewage	3	10.7
Total	**28**	**100.0**

4. Average number of employees in the institution

As shown in Figure 4.2, (25.0%) have less than 25 employees, (28.6%) have between 25-100 employees and (46.4%) have more than 100 employees**.**

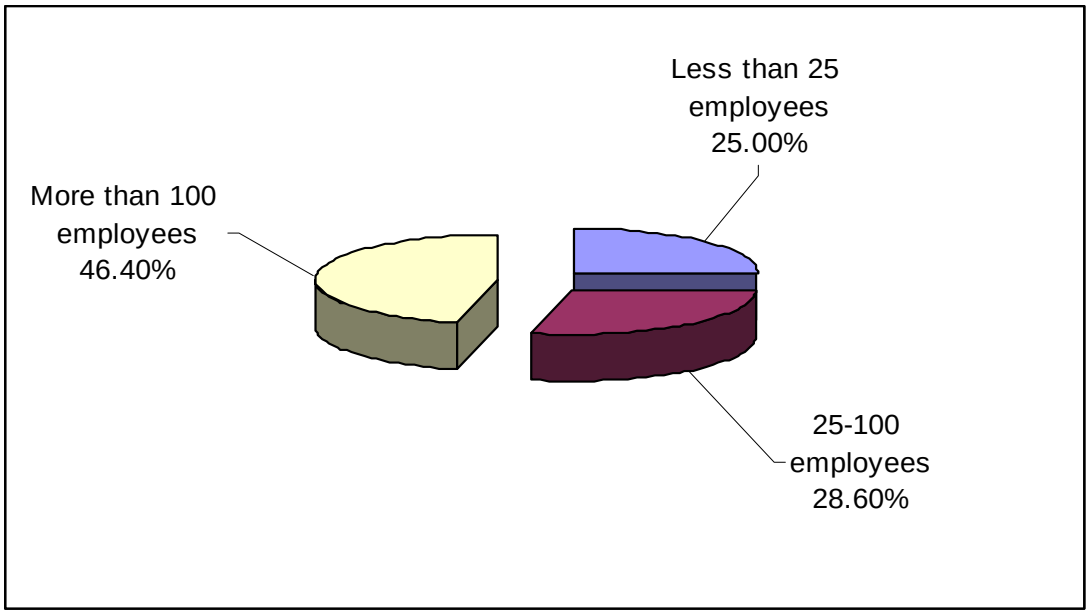


Figure 4.2 Average number of employees in the institution

5. Number of projects executed in the last five years

Table 4.3 shows that (10.7%) executed less than 10 projects, (50.0%) executed between 10-20 projects, (10.7%) executed between 21-30 projects and (28.6%) executed more than 30 projects.

Table 4.3 Number of projects executed in the last five years

Number of projects executed in the last five years	**Frequency**	**Percentage %**
Less than 10	3	10.7
10 to 20	14	50.0
21 to 30	3	10.7
More than 30	8	28.6
Total	**28**	**100.0**

6. Value of projects implemented in the last five years

As shown in Table 4.4, (0 %) are less than 2 Millions USD, (46.4 %) are between 2 to 5 Millions USD, (14.3 %) are between 5 to 8 Millions USD and (39.3 %) are more than 8 Millions USD. The above-stated percentages and great values of the research sample confirm that the population had deep experience and broad knowledge also they enable to provide accurate responses for the survey questions.

Table 4.4 Value of projects implemented in the last five years

Value of projects implemented in the last five years	**Frequency**	**Percentage %**
Less than 2 Millions USD	0	0.0
2 to 5 Millions USD	13	46.4
5 to 8 Millions USD	4	14.3
More than 8 Millions USD	11	39.3
Total	**28**	**100.0**

7. Have you ever heard of the concept of Constructability?

As shown in Figure 4.3, most of the respondents (53.6%) have not heard of the concept of constructability and (46.4%) heard about it.

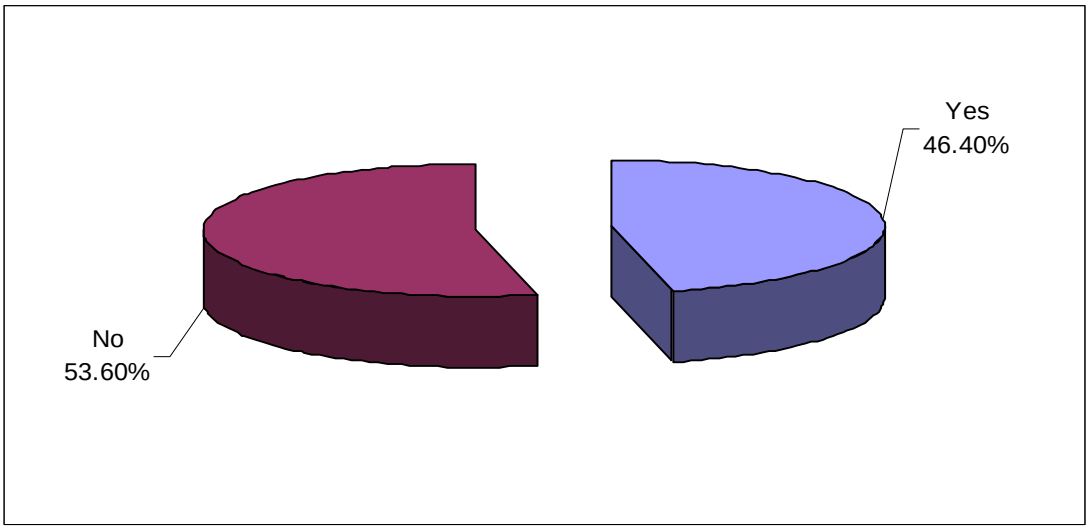


Figure 4.3 Percentage of companies know about the concept of Constructability

4.1.2 Section 2: Data regarding the projects under study

1. Nature of work for the case studies.

Table 4.5 shows that (50.00%) of the cases (studied projects) were in Buildings, (35.70%) were in Water and Sewage and (14.30%) were in Roads.

Table 4.5 Nature of work for the case studies

Class	Frequency	Percentage %
Buildings	14	50.00
Water and sewage	10	35.70
Roads	4	14.30
Total	**28**	**100**

2. Planned and actual durations of the studied projects

Table 4.6 shows that (32.1%) of the case studies had planned duration less than 7 months, (46.45%) had planned duration from7 to 10 months, (21.45%) had planned duration more than 10 months. It is shown that (21.4 %) had actual duration less than 7 months, (35.7%) had actual duration from7 to 10 months and (42.9%) had actual duration more than 10 months.

It is noted that most of the case studies had delays and some of this delay could be explained by the constructability barriers with absence of breaker action efforts from the parties.

Table 4.6 Planned and actual durations of the studied projects

	Planned Duration		Actual Duration	
	Frequency	**Percentage %**	**Frequency**	**Percentage %**
Less than 7 months	9	32.10	6	21.4
7-10 months	13	46.45	10	35.7
More than 10 months	6	21.45	12	42.9
Total	**28**	**100.0**	**28**	**100.0**

3. Budgeted amount for the project and actual implementation cost

Table 4.7 shows that (21.4%) of the case studies had budgeted amount less than $500,000, (39.3%) had budgeted amount from $500,000 to $1,000,000, (39.3%) had budgeted amount more than $1,000,000, (28.6%) of the cases had actual amount less than $500,000, (28.6%) had actual amount from $500,000 to $1,000,000 and (42.9%) had actual amount more than $1000000.

From the above mentioned percentages, it is noted that some of the case studies had a difference between the budgeted amount and the actual implementation cost, which signify that there were wrong estimates of some projects, or no revision of project cost before execution and intensive and bad timing of change orders, which might indicate lack of constructability concepts.

Table 4.7 Budgeted and actual project cost

	Budgeted cost		Actual cost	
	Frequency	**Percentage %**	**Frequency**	**Percentage %**
Less than $500 000	6	21.4	8	28.6
$500 000 - $1000 000	11	39.3	8	28.6
More than $1000 000	11	39.3	12	42.9
Total	**28**	**100.0**	**28**	**100.0**

4. Durations and profits of the case studies

From Table 4.8, it is noticed that the mean actual duration of the projects is 11.91 months, which is higher than the planned duration (8.93 months). This might indicate the presence of some constructability barriers during the implementation of the cases. It is also noticed that there is a variance between the percentage of profit when pricing and the percentage of profit after implementation, which might indicate lack of constructability implementation.

Table 4.8 Durations and profits of the case studies

Variable	Mean	Standard deviation	Minimum	Maximum
Planned duration of the Project	8.93 months	4.791	4 months	30 months
Actual duration of Project	11.91 months	6.013	4 months	30 months
Percentage of profit when pricing %	10.00	3.410	2	15
Percentage of profit after implementation%	5.79	4.281	-5	12

5. Delay Penalties (according to the contract)

Table 4.9 shows that (28.6%) from the case studies had delay penalties (according to the contract) of less than $150 per day, (39.3%) had delay penalties from $150 to $500 and (32.1%) had delay penalties of more than $500.

Table 4.9 Delay Penalties (according to the contract)

Delay Penalties ($/day)	Frequency	Percentage %
Less than $150	8	28.6
$150 - $500	11	39.3
More than $500	9	32.1
Total	**28**	**100.0**

6. Actual delay Penalties/ day

According to Table 4.6 and 4.8, it was noticed that some cases (projects) were delayed and Table 4.9 shows that every contract had a delay penalty, but in fact none of the contractors had paid any penalty due to the project delay. This might lead to contractors' negligence, lack of effective planning, and absence of constructability implementation.

4.2 The inferential statistics method

In order to be able to select the appropriate method of analysis, the level of measurement must be understood. For each type of measurement, there is an appropriate method that can be applied and not others. In this research, interval scales were used. The scale was divided into 5 points ranged from 1 (not important) to 5 (very important). The inferential statistics method was applied on the survey data collection in section 3 of the questionnaire. Frequency distribution and the percentage of different items are presented.

4.2.1 Relative Importance Index

The interviewers were asked to provide their opinions on the factors that hamper the implementation of Constructability in the Gaza strip by scores 1 to 5, where importance aims to measure the importance of the different factors listed with respect to point of view. Rating of answers related to the importance and affect of factors that hamper constructability are as follows:

1	Item	Not important	Low important	Medium important	Important	Very important
	Scale	1	2	3	4	5

Rating of answers related to the degree of existence of factors that hamper the implementation of constructability in the project under study are as follows:

2	Item	Does not exist at all	Low existence	Medium existence	Exist	Intensively exist
	Scale	1	2	3	4	5

To determine the relative ranking of the factors, these scores were then transformed to importance indices based on the formula bellow (Daniel, 1991):

$$\textbf{Relative Importance Index} = \frac{\sum w}{A.N} = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{5N}$$

Where W is the weighting given to each factor by the respondent, ranging from 1 to 5, (n_1 = number of respondents for not important or does not exist at all,…., n_5 = number of respondents for very important or intensively exist). A is the highest weight (that means 5 in the study) and N is the total number of samples. The relative importance index ranges from 0 to 1.

The tables below show the relative importance index and the rank of each factor.

4.2.1.1 Mean and ranking of factors related to project management

The mean, importance index and rank of the factors related to project management (all respondents' answers and case studies findings) are illustrated in Table 4.10.

Table 4.10 Mean and ranking of factors related to project management

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Owner is not supporting and committed throughout the project	4.75	0.9500	1	2.04	0.4071	20
2	Construction phases are not analyzed by the consultant	4.14	0.8286	12	2.46	0.4929	13
3	Design stages are not reviewed by the consultant	4.54	0.9071	7	2.36	0.4714	15
4	The contractor is not involved in the preparation and the design of the project	3.43	0.6857	20	3.29	0.6571	2
5	Ambiguity or contradiction of project documents	4.64	0.9286	3	2.14	0.4286	19
6	Overlapping of the contractor's team roles	4.36	0.8714	9	3.00	0.6000	6
7	Some parties of the project are not serious in resolving disputes	4.29	0.8571	11	2.36	0.4714	15
8	The project is not implemented in accordance with the planned implementation schedule	4.61	0.9214	5	2.61	0.5214	12
9	None of the parties applying lessons learned from previous projects	3.96	0.7929	17	2.82	0.5643	8
10	The contractor has no objective in the project or it is limited to making profit	4.14	0.8286	12	3.18	0.6357	4
11	The contractor is not interested in quality during project execution	4.64	0.9286	3	2.61	0.5214	11
12	Safety and health measures are not followed	4.61	0.9214	5	2.71	0.5429	10
13	Lack or absence of the contractors' project management support	4.39	0.8786	8	2.29	0.4571	18

14	Lack or absence of workers' training	4.14	0.8286	12	3.04	0.6071	5
15	Finishing subcontractors are not involved from the beginning of project execution	3.64	0.7286	19	3.29	0.6571	2
16	Latest technology is not used in the project	4.11	0.8214	15	2.86	0.5714	7
17	Project management is not willing to accept any risk related to workers	4.04	0.8071	16	2.36	0.4714	15
18	Absence of motivation for project's employees	3.96	0.7929	17	3.43	0.6857	1
19	Lack or absence of project risk control from the contractor	4.36	0.8714	9	2.82	0.5643	8
20	Insufficient number of employees required in project activities.	4.68	0.9357	2	2.41	0.4815	14
	Total	**4.27**	**0.8543**		**2.70**	**0.5404**	

1. The relative importance index for item (1) "Owner is not supporting and committed throughout the project" equals 0.9500 with rank equals "1" for the importance and affect in construction industry and 0.4071 with rank equals "20" for degree of existence in the projects under study. This item has scored the highest barrier factor related to management, in terms of the importance and affect of the construction industry in spite of its weak existence in the case studies. This indicates that the owners in the Gaza strip show great support and commitment to their project. This is in contrary of Eldin's (1999) findings in his five case studies concerning lack of top management support which he considered as one of constructability barriers.

2. The relative importance index for item (2) "Construction phases are not analyzed by the consultant" equals 0.8286 with rank equals "12" for the importance and affect in construction industry and 0.4929 with rank equals "13" for degree of existence in the projects under study. It is noted that the respondents gave medium importance to this factor in spite that its existence was less than medium in the case studies.

3. The relative importance index for item (3) "Design stages are not reviewed by the consultant" equals 0.9071 with rank equals "7" for the importance and affect in construction industry and 0.4714 with rank equals "15" for degree of existence in the projects under study.

This item has a high score as a barrier factor related to management, in terms of the importance and affect of the construction industry in spite of its weak existence in the case studies, which confirms that most designers review the design stage.

4. The relative importance index for item (4) "The contractor is not involved in the preparation and the design of the project" equals 0.6857 with rank equals "20" for the importance and affect in construction industry and 0.6571 with rank equals "2" for degree of existence in the projects under study. The respondents described this item as very weak in the construction industry. This indicates that the respondents are not fully aware of benefits of involving the contractor in the preparation and design phase. The researcher believes that getting the contactor involved from the first beginning solve many issues before it happens.

It fair enough for this item to highly exist in the case studies, which means contractors are not being involved in the preparation and design stages in most if not all of projects in the Gaza strip.

Chasey and Schexnayder (2000) pointed that construction persons are unaccustomed to being involved during project planning and working in architect/engineering offices which confirms the researcher findings.

5. The relative importance index for item (5) "Ambiguity or contradiction of project documents" equals 0.9286 with rank equals "3" for the importance and affect in construction industry and 0.4286 with rank equals "19" for degree of existence in the projects under study. Respondents considered this item as the most hampering factor of constructability. It is noted from the documents of the case studies, it was barely exist or its existence is weak. This confirms that the designer does review the overall design process.

6. The relative importance index for item (6) "Overlapping of the contractor's team roles" equals 0.8714 with rank equals "9" for the importance and affect in construction industry and 0.6000 with rank equals "6" for degree of existence in the projects under study. This item is considered as the most "trouble maker" amongst the contractor's team. It existence was relatively intensive in the case studies. This is due to unclear job description of each member of the team in one hand and lack of disciplinary measures applied against violators of their roles by the project management in the other hand.

7. The relative importance index for item (7) "Some parties of the project are not serious in resolving disputes" equals 0.8571 with rank equals "11" for the importance and affect in construction industry and 0.4714 with rank equals "15" for degree of existence in the projects under study. This existence of this item is less than medium in the case studies as all parties involved are fully aware of the negative impact of this item in terms of the project output and achievements.

8. The relative importance index for item (8) "The project is not implemented in accordance with the planned implementation schedule" equals 0.9214 with rank equals "5" for the importance and affect in construction industry and 0.5214 with rank equals "12" for degree of existence in the projects under study.
The respondents gave a high importance to this item as a barrier factor of constructability in the construction industry, while its existence slightly more than medium in the case studies.
This refers to some reasons such as the research population is first grade classified and they are the most contractors comply with the time schedule to keep good reputation. In addition, they are implementing relatively huge projects that entail big amount of penalties in case of delay.

9. The relative importance index for item (9) "None of the parties applying lessons learned from previous projects" equals 0.7929 with rank equals "17" for the importance and affect in construction industry and 0.5643 with rank equals "8" for degree of existence in the projects under study. The respondents considered this item relatively weak as a hampering factor in constructability. The researcher believes that this item should have been given a higher important index than 0.7929 because lessons learned are cost free training to avoid any previous similar barriers that might be encountered in the new projects. It is existence in the case studies was more than medium. This means most of the project parties do not apply lessons learned.

10. The relative importance index for item (10) "The contractor has no objective in the project or it is limited to making profit " equals 0.8286 with rank equals "12" for the importance and affect in construction industry and 0.6357 with rank equals "4" for degree of existence in the projects under study.

The researchers experience confirms that most if not all contractors are engaged in implementing project for a sole reason which is making profit. This goes a long with what exist in the case studies, where this item existence is relatively high.

11. The relative importance index for item (11) "The contractor is not interested in quality during project execution" equals 0.9286 with rank equals "3" for the importance and affect in construction industry and 0.5214 with rank equals "11" for degree of existence in the projects under study. The respondents gave this item a high score as a barrier factor in the construction industry in general, while it has a medium existence in the case studies as some contractors bottom-line is making profit and completing the project on time on the expense of quality.

12. The relative importance index for item (12) "Safety and health measures are not followed" equals 0.9214 with rank equals "5" for the importance and affect in construction industry and 0.5429 with rank equals "10" for degree of existence in the projects under study.
The researcher confirms that the score given by the respondent to this factor is logical as a barrier factor in importance and affect in the construction industry. It appeared more than medium in the case studies which indicate weak commitment of the safety and health measures in the projects of the Gaza strip, despite the fact that all contracts requires the contractor to abide with the safety and health measures without actual follow up by the owner and/or his representatives. In his study, Eldin (1999) considered enforcing safety practices as one of the common success factors to implement constructability.

13. The relative importance index for item (13) "Lack or absence of the contractors' project management support" equals 0.8786 with rank equals "8" for the importance and affect in construction industry and 0.4571 with rank equals "18" for degree of existence in the projects under study. This item appeared less than medium in the case studies as most of the construction management realizes the importance of their support on the profit and on time completion of their projects.

14. The relative importance index for item (14) " Lack or absence of workers' training" equals 0.8286 with rank equals "12" for the importance and affect in construction industry and 0.6071 with rank equals "5" for degree of existence in the projects under study.

This item highly existed in the case studies which mean most of the companies ignore workers' training because it takes time and it is costly. They prefer to deal with already trained workers. In addition to that, most companies do not believe in investing in the future by providing proper training for their workers. This is confirms with Eldin (1999) in his five case studies regarding lack of training, who considered it one of constructability barriers.

15. The relative importance index for item (15) "Finishing subcontractors are not involved from the beginning of project execution" equals 0.7286 with rank equals "19" for the importance and affect in construction industry and 0.6571 with rank equals "2" for degree of existence in the projects under study.
The respondents did not consider this item as one of the most important factor that hamper the constructability implementation. However, this item does highly exist in the case studies which confirm the reality on the ground of the construction industry in the Gaza strip. Its worth to mention here that the "Finishing subcontractors are not involved from the beginning of project execution" limits the finishing alternatives.

16. The relative importance index for item (16) "Latest technology is not used in the project" equals 0.8214 with rank equals "15" for the importance and affect in construction industry and 0.5714 with rank equals "7" for degree of existence in the projects under study. This item has appeared more than medium due to the fact that using latest technology is costly despite it saves time and efforts. At the same time not all related technologies found out side of the Gaza strip is available to the parties involved to be used in the projects.

17. The relative importance index for item (17) "Project management is not willing to accept any risk related to workers" equals 0.8071 with rank equals "16" for the importance and affect in construction industry and 0.4714 with rank equals "15" for degree of existence in the projects under study. The respondents considered this item as of the barrier factor and it was ranked by them in the middle as a management factor. While this item appeared less than medium in the case studies, because most of risks related to workers is the contractor's responsibility by tradition in the construction industry of the Gaza strip.

According to Eldin (1999) one common significant lessons learned in his five case studies is to convince management to accept the calculated risk taken by employees, because he considered the lack of willingness to accept risk of empowering employees, in his five case studies, as one of constructability barriers.

18. The relative importance index for item (18) "Absence of motivation for project's employees" equals 0.7929 with rank equals "17" for the importance and affect in construction industry and 0.6857 with rank equals "1" for degree of existence in the projects under study. Despite of the employee motivation has an important effect on work in terms of on time completion with high quality, yet the respondents considered this item as of the barrier factor and it was ranked by them in the middle as a management factor.

Nevertheless, the absence of employee motivation in the case studies appeared as the most important factor that hamper the constructability in the Gaza strip in relation to project management.

The researcher believes that motivation in our culture usually means giving extra money to distinguished employees, which is costly for the contractor. Other reason might be the absence of established motivation schemes in almost all companies, which makes hard to apply.

19. The relative importance index for item (19) "Lack or absence of project risk control from the contractor" equals 0.8714 with rank equals "9" for the importance and affect in construction industry and 0.5643 with rank equals "8" for degree of existence in the projects under study. This item appeared in the case studies more than medium which means there is a clear absence of project risk control from the contractor.

20. The relative importance index for item (20) "Insufficient number of employees required in project activities" equals 0.9357 with rank equals "2" for the importance and affect in construction industry and 0.4815 with rank equals "14" for degree of existence in the projects under study. The respondents gave an advanced rank for this item as a barrier factor that hamper the constructability in the construction industry. While the appearance of this item in the case studies was less than medium which indicates that most contractors are aware that insufficient number of employees required in project activities would lead to project delay and eventually paying a penalty.

In general, the relative importance index for all items equals 0.8543 for the importance and affect in construction industry and 0.5404 for degree of existence in the projects under study. The respondents gave an advanced rank for factor "Owner is not supporting and committed throughout the project" and factor "Insufficient number of employees required in project activities" as a barrier factors that hamper the constructability in the construction industry in general. However, the most appearance hampering factors founded in the case studies are "Absence of motivation for project's employees", "The contractor is not involved in the preparation and the design of the project" and "Finishing subcontractors are not involved from the beginning of project execution".

4.2.1.2 Mean and ranking of factors related to employees

The mean, importance index and rank of the factors related to employees (all respondents' answers and case studies findings) are illustrated in Table 4.11.

Table 4.11 Mean and ranking of factors related to employees

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Lack of employees' experience in the project	4.61	0.9214	2	2.43	0.4857	1
2	Lack of employees' skills in the project	4.64	0.9286	1	2.21	0.4429	2
	Total	**4.63**	**0.9250**		**2.32**	**0.4643**	

1. The relative importance index for item (1) "Lack of employees' experience in the project" equals 0.9214 with rank equals "2" for the importance and affect in construction industry and 0.4857 with rank equals "1" for degree of existence in the projects under study.

2. The relative importance index for item (2) "Lack of employees' skills in the project" equals 0.9286 with rank equals "1" for the importance and affect in construction industry and 0.4429 with rank equals "2" for degree of existence in the projects under study.

The respondents gave the above 2 items high (almost similar) scores as a barrier factor that affects the construction industry in general. At the same time, the two factors were found less than medium (almost similar) in the case studies, which indicates that contractors prefer to employ experienced and skilled employees mainly for achieving quality at a reasonable cost and there is no huge gap in wages between employees in the same profession.
Unlike Eldin (1999) in his five case studies concerning lack of skilled employees, Eldin considered it as one of constructability barriers. Moreover, Eldin (1999) considered possession of technical skills among the individuals of the project teams as a success factors in his five case studies. Contractors are also interested in employing professional employees to keep their good reputation in order to map the way a head to be awarded more new projects.

In general, the relative importance index for all items equals 0.9250 for the importance and affect in construction industry and 0.4643 for degree of existence in the projects under study.

4.2.1.3 Mean and ranking of factors related to relations and communications

The mean, importance index and rank of the factors related to relations and communications (all respondents' answers and case studies findings) are illustrated in Table 4.12.

Table 4.12 Mean and ranking of factors related to relations and communications

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Bad relations between one party or more in the project	4.46	0.8929	3	1.96	0.3929	6
2	Miscommunication between one party or more in the project	4.43	0.8857	5	2.04	0.4071	5
3	Existence of claims between project's parties	4.44	0.8889	4	2.79	0.5571	1
4	Existence of disputes between one party or more in the project	4.64	0.9286	2	2.43	0.4857	2
5	Absence of mutual confidence between the project parties	4.78	0.9556	1	2.11	0.4214	4
6	Bad relation among the project's employees	4.37	0.8741	6	2.21	0.4429	3
	Total	**4.51**	**0.9012**		**2.26**	**0.4512**	

1. The relative importance index for item (1) "Bad relations between one party or more in the project" equals 0.8929 with rank equals "3" for the importance and affect in construction industry and 0.3929 with rank equals "6" for degree of existence in the projects under study. The respondents confirmed that this item is an important barrier factor of constructability. Yet, its appearance in the case studies was weak. This shows that all parties are aware to the fact that bad relations negatively affect the whole project stages. Uhlik and Lores (1998) mentioned that, the adversarial attitude between designers and contractors as a recurring barrier to constructability.

In his study, Eldin (1999) considered creation of long-term relationships between owners, designers and contractors as one of the common success factors to implement constructability.

Also Arditi et al. (2002) indicated that the designers consider developing good relationships with contractors and clients and avoiding litigation to be the best rewards of a highly constructable design.

2. The relative importance index for item (2) "Miscommunication between one party or more in the project" equals 0.8857 with rank equals "5" for the importance and affect in construction industry and 0.4071 with rank equals "5" for degree of existence in the projects under study. In the case studies "Miscommunication between one party or more in the project" was below medium, which indicates that communication was relatively good between the parties. Eldin (1999) believes that strong communication routines must be established early and maintained throughout the process.

3. The relative importance index for item (3) "Existence of claims between project's parties" equals 0.8889 with rank equals "4" for the importance and affect in construction industry and 0.5571 with rank equals "1" for degree of existence in the projects under study. This item scored the highest among factors related to relations and communications in the case studies. This means most projects under study had claims between the parties of the project. It is noted in the case studies that the projects with claims are usually in delay as a result of disputes that arises out these claims. Most of these claims are caused by change orders and ambiguous bid documents.

4. The relative importance index for item (4) "Existence of disputes between one party or more in the project" equals 0.9286 with rank equals "2" for the importance and affect in construction industry and 0.4857 with rank equals "2" for degree of existence in the projects under study. This item was given a high rank by respondents as a barrier factor that affects the construction industry. It was also ranked the same in the case studies, which shows its extensive existence and affect in the projects. According the researcher's experience, most disputes in projects are caused by bad timing of change order, low prices offered in the contractor's bid, little attention to quality by the contractor and bad payment system.

5. The relative importance index for item (5) "Absence of mutual confidence between the project parties" equals 0.9556 with rank equals "1" for the importance and affect in construction industry and 0.4214 with rank equals "4" for degree of existence in the projects under study. The respondents got the highest score as a barrier factor in construction industry in terms of relations and communication factors. But in the case studies, this item was found to be less than medium. This means that a mutual confidence between the project parties in the Gaza strip is relatively good.

The researcher thinks that mutual confidence starts with good reputation of all parties and to which extend each party contribute to solving out difficulties and working towards smooth project implementation in accordance to the contract terms and conditions without any complexities.

6. The relative importance index for item (6) "Bad relation among the project's employees" equals 0.8741 with rank equals "6" for the importance and affect in construction industry and 0.4429 with rank equals "3" for degree of existence in the projects under study. This item was not given a high rank by respondents as a barrier in terms of relations and communication factors despite the researcher believes that this item should be given a higher rank within the same group. In the case studies, this item has appeared as less than medium, which might be explained by the existence of a strong and firm management that is able to handle dispute among its employees because management is aware of negative affect of bad relations amongst its employees on the project.

In general, the relative importance index for all items equals 0.9012 for the importance and affect in construction industry and 0.4512 for degree of existence in the projects under study. The respondents gave an advanced rank for factor "Absence of mutual confidence between the project parties" and factor "Existence of disputes between one party or more in the project" as a barrier factors that hamper the constructability in the construction industry in general. However, the most appearance hampering factors founded in the case studies are "Existence of claims between project's parties" and "Existence of disputes between one party or more in the project".

4.2.1.4 Mean and ranking of factors related to knowledge and experience

The mean, importance index and rank of the factors related to knowledge and experience (all respondents' answers and case studies findings) are illustrated in Table 4.13.

Table 4.13 Mean and ranking of factors related to knowledge and experience

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Lack of experience and practice of the owner or his/her representative	4.79	0.9571	2	1.82	0.3643	4
2	Ignorance of latest technology	4.43	0.8857	4	2.14	0.4286	3
3	Lack of experience and practice of the contractor or his/her representative	4.82	0.9643	1	2.18	0.4357	2
4	Lack of experience and efficiency of the project's executing team	4.71	0.9429	3	2.36	0.4714	1
	Total	**4.69**	**0.9375**		**2.13**	**0.4250**	

1. The relative importance index for item (1) "Lack of experience and practice of the owner or his/her representative" equals 0.9571 with rank equals "2" for the importance and affect in construction industry and 0.3643 with rank equals "4" for degree of existence in the projects under study. The respondents consider this item an one of the most important factor that affect in the construction industry as a barrier factor, however, its existence in the case study was weak because most of big projects' owners or their representative are experienced. This is in contrary of Uhlik's and Lores's (1998) findings in their study concerning designers' lack of construction experience which they considered as one of the most common barriers to constructability.

2. The relative importance index for item (2) "Ignorance of latest technology" equals 0.8857 with rank equals "4" for the importance and affect in construction industry and 0.4286 with rank equals "3" for degree of existence in the projects under study. This item was found in the case study less than medium because of lack of access to latest technology and also because technology is relatively costly.

3. The relative importance index for item (3) "Lack of experience and practice of the contractor or his/her representative" equals 0.9643 with rank equals "1" for the importance and affect in construction industry and 0.4357 with rank equals "2" for degree of existence in the projects under study.

The respondents gave this item the most important factor that hampers constructability in the construction industry, while its appearance in the case studies was less than medium. This means the contractor or his/her representative is always experienced, which could also be verified by their classification by the PCU as grade "A".

4. The relative importance index for item (4) "Lack of experience and efficiency of the project's executing team" equals 0.9429 with rank equals "3" for the importance and affect in construction industry and 0.4714 with rank equals "1" for degree of existence in the projects under study. The respondents gave this item a high importance as a barrier factor. Meanwhile, it has scored the highest rank in terns of knowledge and experience in the case studies. This shows that lack of experience and efficiency relatively exist in the execution team due to lack or absence of formal training and also because the contractor sometimes employee cheaper labor with insufficient experience to save money. Chasey and Schexnayder (2000) in their study concerning shortages of qualified personnel, they considered it as one of constructability barriers.

In general, the relative importance index for all items equals 0.9375 for the importance and affect in construction industry and 0.4250 for degree of existence in the projects under study.
The respondents gave an advanced rank for factor "Lack of experience and practice of the contractor or his/her representative" and factor "Lack of experience and practice of the owner or his/her representative" as a barrier factors that hamper the constructability in the construction industry in general. However, the most appearance hampering factors founded in the case studies are "Lack of experience and efficiency of the project's executing team" and "Lack of experience and practice of the contractor or his/her representative".

4.2.1.5 Mean and ranking of factors related to project executing process

The mean, importance index and rank of the factors related to project executing process (all respondents' answers and case studies findings) are illustrated in Table 4.14.

Table 4.14 Mean and ranking of factors related to project executing process

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Lack of knowledge of the used codes and specifications in the project	4.14	0.8286	8	2.11	0.4214	7
2	Absence of preassembling before project's execution	3.57	0.7143	10	3.61	0.7214	1
3	Absence or lack of project execution process	4.29	0.8571	6	2.07	0.4143	8
4	Absence of evaluation and documentation of the project	4.11	0.8214	9	1.89	0.3786	9
5	Bad procurement method	4.21	0.8429	7	2.43	0.4857	4
6	Intensive and bad timing of change orders	4.57	0.9143	2	2.39	0.4786	5
7	Absence or not following execution plan of the project	4.68	0.9357	1	2.43	0.4857	3
8	Priorities are not applied in the project	4.37	0.8741	4	2.32	0.4643	6
9	Rework of some activities of the project	4.39	0.8786	3	1.82	0.3643	10
10	Interruption of project activities	4.32	0.8643	5	2.71	0.5429	2
	Total	**4.26**	**0.8529**		**2.38**	**0.4757**	

1. The relative importance index for item (1) "Lack of knowledge of the used codes and specifications in the project" equals 0.8286 with rank equals "8" for the importance and affect in construction industry and 0.4214 with rank equals "7" for degree of existence in the projects under study. This item appeared in the case studies less than medium, which refers to most designers use strong codes and specifications.

2. The relative importance index for item (2) "Absence of preassembling before project's execution" equals 0.7143 with rank equals "10" for the importance and affect in construction industry and 0.7214 with rank equals "1" for degree of existence in the projects under study.

The respondents gave this item a weak rank as a barrier factor of constructability in the construction industry, yet it was ranked the highest factor in the case studies. This means most of projects in the Gaza strip, if not all, do not undergo preassembling before the project execution, despite the fact that preassembling provide an accurate implementation time and actual cost, it also highlights executions problems before it face us before actual execution.

3. The relative importance index for item (3) "Absence or lack of project execution process" equals 0.8571 with rank equals "6" for the importance and affect in construction industry and 0.4143 with rank equals "8" for degree of existence in the projects under study. This item appeared less than medium in the case studies because the contractor most often knows the project execution's process.

4. The relative importance index for item (4) "Absence of evaluation and documentation of the project" equals 0.8214 with rank equals "9" for the importance and affect in construction industry and 0.3786 with rank equals "9" for degree of existence in the projects under study. Despite this item is given a very weak rank in the case studies, yet the researcher confirm that the evaluation and documentation of the project are extremely weak amongst the contracting companies in the Gaza strip.

5. The relative importance index for item (5) "Bad procurement method" equals 0.8429 with rank equals "7" for the importance and affect in construction industry and 0.4857 with rank equals "4" for degree of existence in the projects under study. The respondents gave this item a medium rank as a barrier factor in the construction industry, but it's ranked as medium in the case studies which means there are cases of bad procurement methods.

6. The relative importance index for item (6) "Intensive and bad timing of change orders" equals 0.9143 with rank equals "2" for the importance and affect in construction industry and 0.4786 with rank equals "5" for degree of existence in the projects under study. The respondents considered this item as one of the most important factors that hamper constructability in terms of project execution process because it has an effect on the interruption and delay of the project.

It also opens a floodgate of disputes and claims. It has appeared almost medium in the case studies which indicate that the construction phases are not analyzed in some projects.

7. The relative importance index for item (7) "Absence or not following execution plan of the project" equals 0.9357 with rank equals "1" for the importance and affect in construction industry and 0.4857 with rank equals "3" for degree of existence in the projects under study. The respondents gave this item the highest rank as a barrier factor of constructability in terms of the execution process because absence or not following an execution plan will not achieve the desired objective on time. This item appeared as medium in the case studies which indicate that some projects in the Gaza strip do not follow an execution plan. This can be affirmed by the delay of their project as noted in the case studies.

8. The relative importance index for item (8) "Priorities are not applied in the project" equals 0.8741 with rank equals "4" for the importance and affect in construction industry and 0.4643 with rank equals "6" for degree of existence in the projects under study. This item appeared less than medium in the case studies which indicate that there is lack of management skills in some companies in the Gaza strip. Chasey and Schexnayder (2000) pointed that construction integration has a low priority on many projects because owners are unaware of the potential savings in their identified seven barriers that reduce the effectiveness of construction integration.

9. The relative importance index for item (9) "Rework of some activities of the project" equals 0.8786 with rank equals "3" for the importance and affect in construction industry and 0.3643 with rank equals "10" for degree of existence in the projects under study. The respondents gave an advanced rank to this item as a barrier factor of constructability in terms of project executing process because the rework of some activities means loss of time and money. This factor appeared weak in the case studies which indicate that there are management and execution teams with knowledge and experience working in most of the contracting companies in the Gaza strip.

10. The relative importance index for item (10) "Interruption of project activities" equals 0.8643 with rank equals "5" for the importance and affect in construction industry and 0.5429 with rank equals "2" for degree of existence in the projects under study.

This item appeared more than medium in the case studies which means that most projects had interruption due to perhaps disputes amongst the parties involved or lack of project's resources in general (money, machine, material, manpower). According to Eldin (1999) in his five case studies concerning lack of continuity (interruption), he considered it as one of constructability barriers which verify the researcher findings.

In general, the relative importance index for all items equals 0.8529 for the importance and affect in construction industry and 0.4757 for degree of existence in the projects under study. The respondents gave an advanced rank for factor "Absence or not following execution plan of the project" and factor "Intensive and bad timing of change orders" as a barrier factors that hamper the constructability in the construction industry in general. However, the most appearance hampering factors founded in the case studies are "Absence of preassembling before project's execution" and "Interruption of project activities".

4.2.1.6 Mean and ranking of factors related to nature of project

The mean, importance index and rank of the factors related to nature of project (all respondents' answers and case studies findings) are illustrated in Table 4.15.

Table 4.15 Mean and ranking of factors related to nature of project

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Project's difficulties and complexities	4.25	0.8500	1	2.39	0.4786	1
2	Project remoteness and lack of utilities	4.18	0.8357	2	1.68	0.3357	2
	Total	**4.21**	**0.8429**		**2.04**	**0.4071**	

1. The relative importance index for item (1) "Project's difficulties and complexities" equals 0.8500 with rank equals "1" for the importance and affect in construction industry and 0.4786 with rank equals "1" for degree of existence in the projects under study. This item appeared in the case studies as medium.

This refers to the fact that most of the Gaza strip projects are medium sized and are not very difficult and complex compared to those in the Arab World.

2. The relative importance index for item (2) "Project remoteness and lack of utilities" equals 0.8357 with rank equals "2" for the importance and affect in construction industry and 0.3357 with rank equals "2" for degree of existence in the projects under study. This item appeared in the case studies as weak. The reason behind is related to the fact that the area of the Gaza strip is relatively small and all utilities are nearby any given project.

In general, the relative importance index for all items equals 0.8429 for the importance and affect in construction industry and 0.4071 for degree of existence in the project under study.

4.2.1.7 Mean and ranking of factors related to financial issues

The mean, importance index and rank of the factors related to financial issues (all respondents' answers and case studies findings) are illustrated in Table 4.16.

Table 4.16 Mean and ranking of factors related to financial issues

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Limited project budget	4.39	0.8786	3	2.29	0.4571	4
2	No review of project cost before execution	4.29	0.8571	4	2.04	0.4071	5
3	Wrong cost estimates of project	4.75	0.9500	1	2.32	0.4643	3
4	Inadequate system of interim and final payments	4.71	0.9429	2	2.36	0.4714	2
5	Existence of damages in the project	4.25	0.8500	5	2.39	0.4786	1
	Total	**4.48**	**0.8957**		**2.28**	**0.4557**	

1. The relative importance index for item (1) "Limited project budget" equals 0.8786 with rank equals "3" for the importance and affect in construction industry and 0.4571 with rank equals "4" for degree of existence in the projects under study. The respondents ranked this item as medium barrier that hamper constructability in term of financial issues, while in the case studies it appeared less than medium because most of owners allocate aside 5-10% as contingencies for their project which does not make this factor as a significant barrier. This is in close proximity with Arditi et al. (2002) were he states that budget limitations are perceived by designers as having a trivial effect on constructability.

2. The relative importance index for item (2) "No review of project cost before execution" equals 0.8571 with rank equals "4" for the importance and affect in construction industry and 0.4071 with rank equals "5" for degree of existence in the projects under study. This item appeared in the case studies less than medium because most of owners (or their representatives) such as governmental and international institutions conduct more than one cost review especially in the final design and the procurement process.

3. The relative importance index for item (3) "Wrong cost estimates of project" equals 0.9500 with rank equals "1" for the importance and affect in construction industry and 0.4643 with rank equals "3" for degree of existence in the projects under study. The respondents gave this item the highest rank as a barrier factor related to financial issues. This refers to the fact that wrong cost estimates has a huge impact on projects in general which might lead to disputes and interruption of the project. In the case studies, this item appeared less than medium perhaps because this factor did not highly appeared in project documents due to the contingencies budget allocation and the design review as mentioned above.

4. The relative importance index for item (4) "Inadequate system of interim and final payments" equals 0.9429 with rank equals "2" for the importance and affect in construction industry and 0.4714 with rank equals "2" for degree of existence in the projects under study.
The respondents considered this item as one of the most factors that hamper constructability in terms of financial issues for their recognition that inadequate system of payment may lead to project interruption and disputes.

In the case study, this item appearance was almost medium as some of the Gaza strip projects are funded by outside donor and therefore it has a complex payment system. What even make this more complex is the communication difficulties with the outside donors due to restrictions and repeated closures of the Gaza strip.

5. The relative importance index for item (5) "Existence of damages in the project" equals 0.8500 with rank equals "5" for the importance and affect in construction industry and 0.4786 with rank equals "1" for degree of existence in the projects under study. This item appeared in the case studies as the highest rank which refers to the unstable situation of the Gaza strip in term of damages in the projects and also the insufficient experience in usage of machines & equipments and bad storage of construction materials.

In general, the relative importance index for all items equals 0.8957 for the importance and affect in construction industry and 0.4557 for degree of existence in the projects under study. The respondents gave an advanced rank for factor "Wrong cost estimates of project" and factor "Inadequate system of interim and final payments" as a barrier factors that hamper the constructability in the construction industry in general. However, the most appearance hampering factors founded in the case studies are "Existence of damages in the project" and "Inadequate system of interim and final payments".

4.2.1.8 Mean and ranking of factors related to political issues

The mean, importance index and rank of the factors related to political issues (all respondents' answers and case studies findings) are illustrated in Table 4.17.

Table 4.17 Mean and ranking of factors related to political issues

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Recurrent closure of crossings	4.89	0.9786	1	3.93	0.7857	1
2	Existence of political interruption and disputes	4.54	0.9071	2	3.36	0.6714	2
	Total	**4.71**	**0.9429**		**3.64**	**0.7286**	

1. The relative importance index for item (1) "Recurrent closure of crossings" equals 0.9786 with rank equals "1" for the importance and affect in construction industry and 0.7857 with rank equals "1" for degree of existence in the projects under study.

2. The relative importance index for item (2) "Existence of political interruption and disputes" equals 0.9071 with rank equals "2" for the importance and affect in construction industry and 0.6714 with rank equals "2" for degree of existence in the projects under study.

The respondents ranked the above two items as a major factor that hamper constructability implementation in the Gaza strip because most if not all construction material is imported and crossings to the Gaza strip are completely controlled by the occupation. These two factors also appeared in the case studies as distinguished for their recurrent occurrences. It is known that these two factors are uncontrollable, yet the contractor could make some precautionary measures to minimize closure and political interruption negative effects such as storing a considerable amount of construction materials.

In general, the relative importance index for all items equals 0.9429 for the importance and affect in construction industry and 0.7286 for degree of existence in the project under study.

4.2.1.9 Mean and ranking of factors related to other miscellaneous issues

The mean, importance index and rank of the factors related to other miscellaneous issues (all respondents' answers and case studies findings) are illustrated in Table 4.18.

Table 4.18 Mean and ranking of factors related to other miscellaneous issues

No.	Sub-factors hampering constructability	The importance and affect in construction industry			Degree of existence in the projects under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Type of contract	4.29	0.8571	2	1.75	0.3500	5
2	Lack of equipment for project use	4.46	0.8929	1	2.50	0.5000	3
3	Existence of environmental issues and bad weather	4.21	0.8429	3	2.64	0.5286	2
4	Weak project's productivity	4.46	0.8929	1	2.86	0.5714	1
5	Extensive regulations, legislations and licenses required	4.14	0.8286	4	1.82	0.3643	4
	Total	**4.31**	**0.8629**		**2.31**	**0.4629**	

1. The relative importance index for item (1) "Type of contract" equals 0.8571 with rank equals "2" for the importance and affect in construction industry and 0.3500 with rank equals "5" for degree of existence in the projects under study. This item appeared weak in the case studies because contracts in the Gaza strip is limited to unit price and the lump sum contract and most contractors got used to these two types and they know the pros and cons of each. Despite the obvious cons of the lump sum contracts. This is agrees with Jergeas and Put (2001) who pointed out that limitations of lump sum competitive contracting tends to create adversarial conditions between the constructors and the designers. It is also agrees with O'Connor and Miller (1995) who mentioned that limitations of lump-sum competitive contracting as one of seven most common barriers to constructability. Either Uhlik and Lores (1998) mentioned that, the limitation of lump-sum competitive contracting as a recurring barriers to constructability.

2. The relative importance index for item (2) "Lack of equipment for project use" equals 0.8929 with rank equals "1" for the importance and affect in construction industry and 0.5000 with rank equals "3" for degree of existence in the projects under study. The respondents gave this item as the highest rank as a barrier factor related to miscellaneous issues.

In the case studies it appearance was medium due to there are some companies are aware of the importance of equipments and apparatus for project use and some others reduce equipments to save money which is a wrong believe. There is no excuse to any contractor for not availing the equipment and apparatus as they could easily be rented in the Gaza strip.

3. The relative importance index for item (3) "Existence of environmental issues and bad weather" equals 0.8429 with rank equals "3" for the importance and affect in construction industry and 0.5286 with rank equals "2" for degree of existence in the projects under study. This item appearance was more than medium in the case studies which refer to the fact that all projects implemented during winter were faced with some days of bad weather that is uncontrollable. Average prediction days of bad weather should be considered when preparing the time schedule.

4. The relative importance index for item (4) "Weak project's productivity" equals 0.8929 with rank equals "1" for the importance and affect in construction industry and 0.5714 with rank equals "1" for degree of existence in the projects under study. The respondents ranked this item as the one of the most important factor that hamper the implementation of constructability in terms of miscellaneous issues because it is defiantly leads to project delay. It also appeared in the case studies the highest rank in the group that is related to miscellaneous issues. According to the researcher's experience, this is explained by the complexities of procedure to have a green line to start activities, the project's employees are not well paid for their skills and absence of employee motivation.

5. The relative importance index for item (5) "Extensive regulations, legislations and licenses required" equals 0.8286 with rank equals "4" for the importance and affect in construction industry and 0.3643 with rank equals "4" for degree of existence in the projects under study. This item appeared weak in the case studies because of the projects in the Gaza strip are owned by governmental and international organizations institutions that solve regulations, legislations and licenses related issues before commencing the project. Unlike Eldin (1999) in his five case studies concerning regulatory requirements which was identified as one of constructability barriers.

In general, the relative importance index for all items equals 0.8629 for the importance and affect in construction industry and 0.4629 for degree of existence in the projects under study.

The respondents gave an advanced rank for "Lack of equipment for project use" and factor "Weak project's productivity" as a barrier factors that hamper the constructability in the construction industry in general. However, the most appearance hampering factors founded in the case studies are "Weak project's productivity" and "Existence of environmental issues and bad weather".

4.2.1.10 Mean and ranking of all main factors

The mean, importance index and rank of all main factors (all respondents' answers and case studies findings) are illustrated in Table 4.19.

Table 4.19 Mean and ranking of all main factors

No.	Main factors	The importance and affect in construction industry			Degree of existence in the project under study		
		Mean	Relative importance index	Rank	Mean	Relative importance index	Rank
1	Related to project management	4.27	0.8543	7	2.70	0.5404	2
2	Related to employees	4.63	0.9250	3	2.32	0.4643	4
3	Related to relations and communications	4.51	0.9012	4	2.26	0.4512	7
4	Related to knowledge and experience	4.69	0.9375	2	2.13	0.4250	8
5	Related to project executing process	4.26	0.8529	8	2.38	0.4757	3
6	Related to nature of project	4.21	0.8429	9	2.04	0.4071	9
7	Related to financial issues	4.48	0.8957	5	2.28	0.4557	6
8	Related to political issues	4.71	0.9429	1	3.64	0.7286	1
9	Related to other miscellaneous issues	4.31	0.8629	6	2.31	0.4629	5
	Total	**4.51**	**0.9012**		**2.38**	**0.4753**	

It is noted that the respondents gave all major factors a high score of the important index that ranges from 0.8429 - 0.9429 with an average of 0.9012 which confirms the importance of all major factors and its sub-factors as influential factors that hamper constructability. While in the case studies, the same major factors range from 0.4071 - 0.7286 with an average of 0.4753 which indicates that most factors appeared in the medium range which shows that there is an opportunity to all contracting companies in the Gaza strip to smoothly implement constructability in an effective manner to save time, money and effort.

In Table 4.19 it is noted that the political factors in the Gaza strip was the highest factor that hampers constructability in the case studies with an important index of 0.7286 followed by factor related to project management with an important index of 0.5404. On the other side, factors related to nature of project in the case studies with an important index of 0.4071 and knowledge and experience with an important index of 0.4250 appeared in a lower ranks. This refers to the fact that nature of projects in the Gaza strip are not complex and they could be easily implemented and the construction industry employees' knowledge and experience is relatively good. These results were confirmed by some experts in the field of the construction industry.

4.2.1.11 Mean and ranking of all Sub-factors hampering constructability in the case studies

The results of existence in the case studies such as mean, important index and rank of all sub-factors hampering constructability in the Gaza strip are illustrated in Table 4.20.

Table 4.20 Ranking for all Sub-factors hampering constructability in the Gaza strip

No.	Sub-factors hampering constructability	Degree of existence in the project under study		
		Mean	Relative importance index	Rank
1	Recurrent closure of crossings	3.93	0.7857	1
2	Absence of preassembling before project's execution	3.61	0.7214	2
3	Absence of motivation for project's employees	3.43	0.6857	3
4	Existence of political interruption and disputes	3.36	0.6714	4
5	The contractor is not involved in the preparation and the design of the project	3.29	0.6571	5
6	Finishing contractors are not involved from the beginning of project execution	3.29	0.6571	5
7	The contractor has no objectives in the project or it is limited in making profit	3.18	0.6357	7
8	Lack or absence of workers' training	3.04	0.6071	8
9	Overlapping of the contractor's team roles	3.00	0.6000	9
10	Latest technology is not used in the project	2.86	0.5714	10
11	Weak project's productivity	2.86	0.5714	10
12	None of the parties applying lesson learned from previous projects	2.82	0.5643	12
13	Lack or absence of project risk control from the contractor	2.82	0.5643	12
14	Existence of claims between project's parties	2.79	0.5571	14
15	Safety and health measures are not followed	2.71	0.5429	15
16	Interruption of project's activities	2.71	0.5429	15
17	Existence of environmental issues and bad weather	2.64	0.5286	17
18	The project is not implemented in accordance with the planned implementation schedule	2.61	0.5214	18
19	The contractor is not interested in quality during project execution	2.61	0.5214	18
20	Lack of equipment and apparatus for project use	2.50	0.5000	20
21	Construction phases are not analyzed by the consultant	2.46	0.4929	21
22	Lack of employee's experience in the project	2.43	0.4857	22
23	Existence of disputes between one party or more in the project	2.43	0.4857	22
24	Bad procurement method	2.43	0.4857	22
25	Absence or not following execution plan of the project	2.43	0.4857	22
26	Insufficient number of employees required in project activities.	2.41	0.4815	26

No.	Sub-factors hampering constructability	Degree of existence in the project under study		
		Mean	Relative importance index	Rank
27	Project's difficulties and complexities	2.39	0.4786	27
28	Intensive and bad timing of change orders	2.39	0.4786	27
29	Existence of damages in the project	2.39	0.4786	27
30	Design stages are not reviewed by the consultant	2.36	0.4714	30
31	Some parties of the project are not serious in resolving disputes	2.36	0.4714	30
32	Project management is not willing to accept any risk related to workers	2.36	0.4714	30
33	Lack of experience and efficiency of the project's executing team	2.36	0.4714	30
34	Inadequate system of interim and final payments	2.36	0.4714	30
35	Priorities are not applied in the project	2.32	0.4643	35
36	Wrong cost estimates of project	2.32	0.4643	35
37	Lack or absence of the contractors' project management support	2.29	0.4571	37
38	Limited project budget	2.29	0.4571	37
39	Lack of employee's skills in the project	2.21	0.4429	39
40	Bad relation among the project's employees	2.21	0.4429	39
41	Lack of experience and practice of the contractor or his/her representative	2.18	0.4357	41
42	Ambiguity or contradiction of Project documents	2.14	0.4286	42
43	Ignorance of latest technology	2.14	0.4286	42
44	Absence of mutual confidence between the project parties	2.11	0.4214	44
45	Lack of the used codes and specifications in the project	2.11	0.4214	44
46	Absence or lack of project execution's process	2.07	0.4143	46
47	Owner is not supported and committed throughout the project	2.04	0.4071	47
48	Miscommunication between one party or more in the project	2.04	0.4071	47
49	No review of project cost before execution	2.04	0.4071	47
50	Bad relations between one party or more in the project	1.96	0.3929	50
51	Absence of evaluation and documentation of the project	1.89	0.3786	51
52	Lack of experience and practice of the owner or his/her representative	1.82	0.3643	52
53	Rework of some activities of the project	1.82	0.3643	52
54	Extensive regulations, legislations and licenses required	1.82	0.3643	52
55	Type of contract	1.75	0.3500	55
56	Project remoteness and lack of utilities	1.68	0.3357	56

4.2.2 Kruskal Wallis Test and Mann-Whitney Test

1. There is a significant difference at $\alpha \leq 0.05$ among the respondents in the importance and affect in construction industry due to type of the implementing company

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the respondents in the importance and affect in construction industry due to type the implementing company. The results illustrated in Table 4.21 show that the p-values for each main factor are greater than 0.05 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 affect in construction industry due to type of the implementing company. Table 4.22 illustrated the descriptive statistics (mean of answers) for each category of the respondents in terms of the importance and affect in construction industry due to the type of the implementing company.

Table 4.21 Kruskal Wallis Test due to "Type of the implementing company"

Main factors	Mean ranks				Chi-Square	p-value
	Buildings Only	Water and Sewage only	Buildings and Water &Sewage only	Buildings, roads and water & sewage		
Related to project management	15.75	15.94	9.50	11.83	2.366	0.500
Related to employees	15.21	12.22	16.13	16.33	1.411	0.703
Related to relations and communications	14.79	13.67	15.00	15.17	0.145	0.986
Related to knowledge and experience	14.04	16.83	10.88	14.17	1.707	0.635
Related to project executing process	14.58	15.11	14.13	12.83	0.187	0.980
Related to nature of project	13.08	15.22	15.25	17.00	0.806	0.848
Related to financial issues	15.08	14.11	12.38	16.17	0.489	0.921
Related to political issues	16.29	14.06	13.13	10.50	1.770	0.622
Related to other miscellaneous issues	13.17	14.61	17.63	15.33	0.957	0.812
Total	**14.50**	**15.11**	**13.25**	**14.33**	**0.143**	**0.986**

The critical value of chi-square at degrees of freedom "3" equal 7.814

Table 4.22 Descriptive statistics "Type of the implementing company"

Main factors	Mean of answers			
	Buildings Only	Water and Sewage only	Buildings and Water &Sewage only	Buildings, roads and water & sewage
Related to project management	4.3333	4.3500	3.9875	4.1667
Related to employees	4.7083	4.3889	4.7500	4.8333
Related to relations and communications	4.5278	4.4444	4.5417	4.5556
Related to knowledge and experience	4.6667	4.8056	4.4375	4.7500
Related to project executing process	4.3093	4.2111	4.2250	4.3000
Related to nature of project	4.0833	4.3889	4.0000	4.5000
Related to financial issues	4.5667	4.5778	4.0000	4.4667
Related to political issues	4.7917	4.7222	4.6250	4.5000
Related to other miscellaneous issues	4.2667	4.4000	4.2000	4.4000
Total	**4.5282**	**4.5488**	**4.3366**	**4.5154**

2. There is a significant difference at $\alpha \leq 0.05$ among the respondents in the importance and affect in construction industry due to number of projects executed in the last five years

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the respondents in the importance and affect in construction industry due to number of projects executed in the last five years. The results illustrated in Table 4.23 show that the p-values for each main factor are greater than 0.05 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 affect in construction industry due to number of projects executed in the last five years. Table 4.24 illustrated the descriptive statistics (mean of answers) for each category of the respondents in terms of the importance and affect in construction industry due to number of projects executed in the last five years.

Table 4.23 Kruskal Wallis Test due to "Number of projects executed in the last five years"

Main factors	Mean ranks				Chi-Square	p-value
	Les than 10 projects	10 to 20 projects	21 to 30 projects	More than 30 projects		
Related to project management	20.83	15.82	12.33	10.63	4.155	0.245
Related to employees	20.00	17.32	16.33	6.81	13.179	0.004
Related to relations and communications	17.00	17.89	15.67	7.19	9.243	0.026
Related to knowledge and experience	16.00	15.04	16.33	12.31	0.966	0.809
Related to project executing process	19.83	15.96	14.33	10.00	4.202	0.240
Related to nature of project	20.17	16.54	8.83	10.94	5.705	0.127
Related to financial issues	18.17	16.00	16.17	9.88	3.856	0.277
Related to political issues	21.00	11.14	14.67	17.88	6.937	0.074
Related to other miscellaneous issues	16.00	16.68	13.83	10.38	3.222	0.359
Total	**21.50**	**16.82**	**12.00**	**8.75**	**7.477**	**0.058**

The critical value of chi-square at degrees of freedom "3" equal 7.814

Table 4.24 Descriptive statistics "Number of projects executed in the last five years"

Main factors	Mean of answers			
	Les than 10 projects	10 to 20 projects	21 to 30 projects	More than 30 projects
Related to project management	4.4833	4.3036	4.1333	4.1875
Related to employees	5.0000	4.8571	4.8333	4.0000
Related to relations and communications	4.6111	4.6548	4.5556	4.1875
Related to knowledge and experience	4.5833	4.7143	4.8333	4.6250
Related to project executing process	4.5333	4.3651	4.3333	3.9625
Related to nature of project	4.6667	4.3571	3.3333	4.1250
Related to financial issues	4.7333	4.5000	4.4667	4.3500
Related to political issues	5.0000	4.5714	4.6667	4.8750
Related to other miscellaneous issues	4.4667	4.3429	4.3333	4.2000
Total	**4.7327**	**4.5641**	**4.4469**	**4.3417**

3. There is a significant difference at $\alpha \leq 0.05$ among the respondents in the importance and affect in construction industry due to value of projects implemented in the last five years

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the respondents in the importance and affect in construction industry due to value of projects implemented in the last five years. The results illustrated in Table 4.25 show that the p-values for each main factor are greater than 0.05 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 affect in construction industry due to value of projects implemented in the last five years. Table 4.26 illustrated the descriptive statistics (mean of answers) for each category of the respondents in terms of the importance and affect in construction industry due to value of projects implemented in the last five years.

Table 4.25 Kruskal Wallis Test due to "Value of projects implemented in the last five years**"**

Main factors	Mean ranks			Chi-Square	p-value
	Les than 20 projects	21 to 30 projects	More than 30 projects		
Related to project management	17.73	10.88	12.00	3.827	0.148
Related to employees	17.12	16.13	10.82	4.782	0.092
Related to relations and communications	17.88	18.38	9.09	8.020	0.018
Related to knowledge and experience	16.54	10.00	13.73	2.314	0.314
Related to project executing process	16.35	12.25	13.14	1.288	0.525
Related to nature of project	17.65	7.13	13.45	5.813	0.055
Related to financial issues	16.77	13.75	12.09	2.041	0.360
Related to political issues	14.27	8.38	17.00	4.052	0.132
Related to other miscellaneous issues	17.73	9.00	12.68	4.482	0.106
Total	**18.69**	**8.75**	**11.64**	**6.668**	**0.036**

The critical value of chi-square at degrees of freedom "2" equal 5.99

Table 4.26 Descriptive statistics "Value of projects implemented in the last five years"

Main factors	Mean of answers		
	Les than 20 projects	21 to 30 projects	More than 30 projects
Related to project management	4.4038	4.0625	4.1909
Related to employees	4.8462	4.7500	4.3182
Related to relations and communications	4.6538	4.6667	4.2727
Related to knowledge and experience	4.7692	4.4375	4.6818
Related to project executing process	4.4162	4.1750	4.1182
Related to nature of project	4.5385	3.0000	4.2727
Related to financial issues	4.6769	4.0500	4.4000
Related to political issues	4.7308	4.3750	4.8182
Related to other miscellaneous issues	4.4923	3.8000	4.2909
Total	**4.6719**	**4.1949**	**4.4232**

4. There is a significant difference at $\alpha \leq 0.05$ among the respondents in the importance and affect in construction industry due to the heard of the concept of constructability

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 importance and affect in construction industry due to the heard of the concept of constructability. The results illustrated in Table 4.27 show that the p-values for each main factor are greater than 0.05 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 affect in construction industry due to the heard of the concept of constructability. Table 4.28 illustrated the descriptive statistics (mean of answers) for each category of the respondents in terms of the importance and affect in construction industry due to the heard of the concept of constructability.

Table 4.27 Mann-Whitney Test due to "The heard of the concept of Constructability"

Main factors	Mean ranks		Chi-Square	p-value
	yes	No		
Related to project management	15.04	14.03	-0.3237	0.746
Related to employees	14.85	14.20	-0.23651	0.813
Related to relations and communications	14.58	14.43	-0.04658	0.963
Related to knowledge and experience	12.77	16.00	-1.08999	0.276
Related to project executing process	14.69	14.33	-0.11659	0.907
Related to nature of project	15.08	14.00	-0.36169	0.718
Related to financial issues	11.96	16.70	-1.54904	0.121
Related to political issues	13.27	15.57	-0.82379	0.410
Related to other miscellaneous issues	14.96	14.10	-0.28116	0.779
Total	**14.27**	**14.70**	**-0.13823**	**0.890**

Table 4.28 Descriptive statistics "The heard of the concept of constructability"

Main factors	Mean of answers	
	yes	No
Related to project management	4.2654	4.2767
Related to employees	4.6538	4.6000
Related to relations and communications	4.5256	4.4889
Related to knowledge and experience	4.6154	4.7500
Related to project executing process	4.3393	4.2000
Related to nature of project	4.3846	4.0667
Related to financial issues	4.3692	4.5733
Related to political issues	4.6538	4.7667
Related to other miscellaneous issues	4.3846	4.2533
Total	**3.5384**	**3.3292**

5. There is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to nature of work

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to nature of work. The results illustrated in Table 4.29 show that the p-values for each main factor are greater than 0.05 which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to nature of work. Table 4.30 illustrated the descriptive statistics (mean of answers) for each category of the answers in terms of the degree of existence in the projects under study due to nature of work.

Table 4.29 Kruskal Wallis Test due to "Nature of work"

Main factors	Mean ranks			Chi-Square	p-value
	Buildings	Roads	Water and Sewage		
Related to project management	11.89	18.50	14.60	3.5439	0.170
Related to employees	15.14	14.00	13.60	0.1994	0.905
Related to relations and communications	13.75	15.61	14.60	0.2837	0.868
Related to knowledge and experience	14.14	15.72	13.30	0.3377	0.845
Related to project executing process	12.43	18.83	12.50	3.7278	0.155
Related to nature of project	13.36	14.50	17.70	1.0663	0.587
Related to financial issues	14.32	13.89	16.10	0.2477	0.883
Related to political issues	14.54	13.00	17.10	0.8311	0.660
Related to other miscellaneous issues	11.89	18.78	14.10	3.9033	0.142
Total	**13.93**	**15.33**	**14.60**	**0.1607**	**0.923**

The critical value of chi-square at degrees of freedom "2" equal 5.99

Table 4.30 Descriptive statistics "Nature of work"

Main factors	Mean of answers		
	Buildings	Roads	Water and Sewage
Related to project management	2.5179	2.9833	2.7116
Related to employees	2.4643	2.1111	2.3000
Related to relations and communications	2.1786	2.3704	2.2667
Related to knowledge and experience	2.1250	2.2500	1.9000
Related to project executing process	2.2500	2.6667	2.2200
Related to nature of project	1.9286	2.0000	2.4000
Related to financial issues	2.2143	2.2889	2.4400
Related to political issues	3.6429	3.4444	4.0000
Related to other miscellaneous issues	2.0571	2.7111	2.3200
Total	**2.3179**	**2.4516**	**2.4052**

6. There is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to planned duration of the project

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to due to planned duration of the project. The results illustrated in Table 4.31 show that the p-values for each main factor are greater than 0.05 which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to planned duration of the project. Table 4.32 illustrated the descriptive statistics (mean of answers) for each category of the answers in terms of the degree of existence in the projects under study due to planned duration of the project.

Table 4.31 Kruskal Wallis Test due to "Planned duration of the project"

Main factors	Mean ranks			Chi-Square	p-value
	Less than 7 months	7-10 months	More than 10 months		
Related to project management	12.83	14.15	17.75	1.3323	0.514
Related to employees	14.00	15.27	13.58	0.2472	0.884
Related to relations and communications	11.83	15.19	17.00	1.6053	0.448
Related to knowledge and experience	16.28	12.96	15.17	0.9316	0.628
Related to project executing process	13.89	13.46	17.67	1.1606	0.560
Related to nature of project	15.67	16.50	8.42	4.3932	0.111
Related to financial issues	16.50	14.77	10.92	1.7003	0.427
Related to political issues	14.72	15.58	11.83	0.8944	0.639
Related to other miscellaneous issues	15.11	16.04	10.25	2.1340	0.344
Total	**14.33**	**15.77**	**12.00**	**0.8674**	**0.648**

The critical value of chi-square at degrees of freedom "2" equal 5.99

Table 4.32 Descriptive statistics "Planned duration of the project"

Main factors	Mean of answers		
	Less than 7 months	7-10 months	More than 10 months
Related to project management	2.6009	2.6962	2.8667
Related to employees	2.1667	2.4615	2.2500
Related to relations and communications	2.0741	2.3077	2.4167
Related to knowledge and experience	2.2500	1.9808	2.2500
Related to project executing process	2.3333	2.3154	2.5833
Related to nature of project	2.2222	2.1923	1.4167
Related to financial issues	2.4667	2.3077	1.9333
Related to political issues	3.6667	3.8077	3.2500
Related to other miscellaneous issues	2.3556	2.4462	1.9667
Total	**2.3558**	**2.4671**	**2.2111**

7. There is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to actual duration of project

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to actual duration of project. The results illustrated in Table 4.33 show that the p-values for each main factor are greater than 0.05 which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to actual duration of project.

Table 4.34 illustrated the descriptive statistics (mean of answers) for each category of the answers in terms of the degree of existence in the projects under study due to actual duration of project.

Table 4.33 Kruskal Wallis Test due to "Actual duration of project**''**

Main factors	Mean ranks			Chi-Square	p-value
	Less than 10 months	10-15 months	More than 15 months		
Related to project management	9.77	18.88	14.40	7.0453	0.030
Related to employees	14.55	14.04	15.50	0.1245	0.940
Related to relations and communications	8.36	17.79	20.10	10.4457	0.005
Related to knowledge and experience	11.36	15.29	19.50	3.6240	0.163
Related to project executing process	9.50	17.54	18.20	6.8019	0.033
Related to nature of project	13.68	14.50	16.30	0.3616	0.835
Related to financial issues	11.41	15.58	18.70	3.0934	0.213
Related to political issues	12.05	14.13	20.80	4.0951	0.129
Related to other miscellaneous issues	10.59	17.42	16.10	4.2376	0.120
Total	**10.73**	**16.25**	**18.60**	**4.0990**	**0.129**

The critical value of chi-square at degrees of freedom "2" equal 5.99

Table 4.34 Descriptive statistics "Actual duration of project"

Main factors	Mean of answers		
	Less than 10 months	10-15 months	More than 15 months
Related to project management	2.3598	3.0125	2.7100
Related to employees	2.1818	2.4167	2.4000
Related to relations and communications	1.7879	2.5278	2.6333
Related to knowledge and experience	1.7955	2.1875	2.7000
Related to project executing process	2.0364	2.5833	2.6400
Related to nature of project	2.0000	2.0000	2.2000
Related to financial issues	1.8727	2.4333	2.8000
Related to political issues	3.3636	3.5833	4.4000
Related to other miscellaneous issues	1.9455	2.5833	2.4800
Total	**2.0891**	**2.5258**	**2.6504**

8. There is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to budgeted amount for the project

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to budgeted amount for the project.

The results illustrated in Table 4.35 show that the p-values for each main factor are greater than 0.05 which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to budgeted amount for the project. Table 4.36 illustrated the descriptive statistics (mean of answers) for each category of the answers in terms of the degree of existence in the projects under study due to budgeted amount for the project.

Table 4.35 Kruskal Wallis Test due to "Budgeted amount for the project**"**

Main factors	Mean ranks			Chi-Square	p-value
	Less than $500 000	$500 000 - $1000 000	More than $1000 000		
Related to project management	10.83	16.64	14.36	1.9419	0.379
Related to employees	14.50	14.64	14.36	0.0067	0.997
Related to relations and communications	6.50	13.32	20.05	0.9913	0.004
Related to knowledge and experience	13.33	14.09	15.55	0.3317	0.847
Related to project executing process	10.08	14.45	16.95	2.7440	0.254
Related to nature of project	12.83	13.09	16.82	1.4980	0.473
Related to financial issues	12.25	14.00	16.23	0.9837	0.611
Related to political issues	12.67	14.14	15.86	0.6468	0.724
Related to other miscellaneous issues	9.67	15.86	15.77	2.6721	0.263
Total	**9.67**	**14.18**	**17.45**	**3.5069**	**0.173**

The critical value of chi-square at degrees of freedom "2" equal 5.99

Table 4.36 Descriptive statistics "Budgeted amount for the Project**"**

Main factors	Mean of answers		
	Less than $ 500 000	$500 000 - $1000 000	More than $1000 000
Related to project management	2.4346	2.8409	2.7091
Related to employees	2.2500	2.3636	2.3182
Related to relations and communications	1.6389	2.1212	2.7273
Related to knowledge and experience	1.9583	1.9773	2.3636
Related to project executing process	2.0667	2.4000	2.5273
Related to nature of project	2.0000	1.8636	2.2273
Related to financial issues	1.9000	2.2545	2.5091
Related to political issues	3.4167	3.5909	3.8182
Related to other miscellaneous issues	1.8667	2.4364	2.4364
Total	**2.0108**	**2.3544**	**2.5980**

9. There is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to percentage of profit when pricing

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to percentage of profit when pricing. The results illustrated in Table 4.37 show that the p-values for each main factor are greater than 0.05 which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to percentage of profit when pricing. Table 4.38 illustrated the descriptive statistics (mean of answers) for each category of the answers in terms of the degree of existence in the projects under study due to percentage of profit when pricing.

Table 4.37 Kruskal Wallis Test due to "Percentage of profit when pricing %"

Main factors	Mean ranks			Chi-Square	p-value
	Less than 8 %	8%-12%	More than 12%		
Related to project management	19.75	12.92	15.75	2.4407	0.295
Related to employees	15.75	13.86	15.58	0.3405	0.843
Related to relations and communications	20.00	11.39	20.17	7.2699	0.026
Related to knowledge and experience	19.75	12.42	17.25	3.5190	0.172
Related to project executing process	18.63	12.72	17.08	2.4694	0.291
Related to nature of project	15.00	12.06	21.50	6.1773	0.046
Related to financial issues	19.25	11.39	20.67	7.3488	0.025
Related to political issues	15.50	12.50	19.83	3.7916	0.150
Related to other miscellaneous issues	17.50	12.31	19.08	3.7246	0.155
Total	**19.75**	**11.44**	**20.17**	**6.9602**	**0.031**

The critical value of chi-square at degrees of freedom "2" equal 5.99

Table 4.38 Descriptive statistics "Percentage of profit when pricing %"

Main factors	Mean of answers		
	Less than 8 %	8%-12%	More than 12%
Related to project management	3.0375	2.5611	2.9013
Related to employees	2.3750	2.2222	2.5833
Related to relations and communications	2.7083	2.0093	2.6944
Related to knowledge and experience	2.4375	1.9444	2.4583
Related to project executing process	2.6750	2.2333	2.6167
Related to nature of project	2.0000	1.8056	2.7500
Related to financial issues	2.8000	1.9333	2.9667
Related to political issues	3.7500	3.3889	4.3333
Related to other miscellaneous issues	2.5500	2.1111	2.7667
Total	**2.6995**	**2.1708**	**2.7781**

10. There is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to percentage of profit after implementation

The researcher used Kruskal Wallis Test (non parametric test) to test the hypothesis if there is a significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to percentage of profit after implementation. The results illustrated in Table 4.39 show that the p-values for each main factor are greater than 0.05 which means the null hypothesis is rejected. As such, there is no significant difference at $\alpha \leq 0.05$ among the answers in the degree of existence in the projects under study due to percentage of profit after implementation.

Table 4.40 illustrated the descriptive statistics (mean of answers) for each category of the answers in terms of the degree of existence in the projects under study due to percentage of profit after implementation.

Table 4.39 Kruskal Wallis Test due to "Percentage of profit after implementation %"

Main factors	Mean ranks			Chi-Square	p-value
	Less than 4 %	4%-8%	More than 8%		
Related to project management	14.29	14.14	15.43	0.1206	0.941
Related to employees	18.43	15.36	8.86	5.6296	0.060
Related to relations and communications	18.50	11.18	17.14	4.6988	0.095
Related to knowledge and experience	18.43	13.96	11.64	2.5471	0.280
Related to project executing process	15.00	12.64	17.71	1.8313	0.400
Related to nature of project	14.79	14.11	15.00	0.0688	0.966
Related to financial issues	16.86	14.00	13.14	0.8247	0.662
Related to political issues	17.29	11.79	17.14	3.1720	0.205
Related to other miscellaneous issues	15.71	12.96	16.36	1.0105	0.603
Total	**18.14**	**12.79**	**14.29**	**1.9856**	**0.371**

The critical value of chi-squire at degrees of freedom "2" equal 5.99

Table 4.40 Descriptive statistics "Percentage of profit after implementation %"

Main factors	Mean of answers		
	Less than 4 %	4%-8%	More than 8%
Related to project management	2.6286	2.7613	2.6571
Related to employees	2.8571	2.3571	1.7143
Related to relations and communications	2.6190	1.9762	2.4524
Related to knowledge and experience	2.4643	2.0536	1.9286
Related to project executing process	2.4000	2.2929	2.5286
Related to nature of project	2.0000	2.0357	2.0714
Related to financial issues	2.5714	2.1714	2.2000
Related to political issues	3.9286	3.3571	3.9286
Related to other miscellaneous issues	2.4000	2.1714	2.5143
Total	**2.6299**	**2.2604**	**2.3550**

4.2.3 Correlation coefficients between the main factors

The aim of this test is to investigate the relationship between the main factors. The nine main factors presented in the questionnaire were intercorrelated. Correlation coefficient test was conducted between the nine main factors that hamper the constructability implementation in the Gaza strip to determine the relationship between one main factor to other main factors and the results are illustrated in Table 4.41, 4.42.

4.2.3.1 Main factors correlation regarding "the importance and affect of the factors in construction industry"

Table 4.41 shows that when Sig. (2-tailed) decreases, the Pearson Correlation increases. If Sig. (2-tailed) in the correlation matrix is less than 0.05 that means there is a relation between the compared two main factors. If Sig. (2-tailed) in the correlation matrix is more than 0.05 that means there is no relation between the compared two main factors.

Table 4.41 Pearson correlation matrix between all main factors regarding "the importance and affect of the factors in construction industry"

Main factors	Analysis	Related to project management	Related to employees	Related to relations and communications	Related to knowledge and experience	Related to project executing process	Related to nature of project	Related to financial issues	Related to political issues	Related to other miscellaneous issues	All the main factors
Related to project management	Pearson Correlation		.511	.623	.469	.687	.511	.559	.292	.475	**.786**
	Sig. (2-tailed)		.005	.000	.012	.000	.005	.002	.131	.011	**.000**
	N		28	28	28	28	28	28	28	28	**28**
Related to employees	Pearson Correlation	.511		.515	.313	.482	.378	.450	-.140	.395	**.598**
	Sig. (2-tailed)	.005		.005	.105	.009	.048	.016	.476	.037	**.001**
	N	28		28	28	28	28	28	28	28	**28**
Related to relations and communications	Pearson Correlation	.623	.515		.192	.622	.392	.671	.040	.527	**.720**
	Sig. (2-tailed)	.000	.005		.327	.000	.039	.000	.841	.004	**.000**
	N	28	28		28	28	28	28	28	28	**28**
Related to knowledge and experience	Pearson Correlation	.469	.313	.192		.256	.329	.500	.188	.252	**.547**
	Sig. (2-tailed)	.012	.105	.327		.188	.087	.007	.339	.196	**.003**
	N	28	28	28		28	28	28	28	28	**28**
Related to project executing process	Pearson Correlation	.687	.482	.622	.256		.589	.592	.068	.533	**.810**
	Sig. (2-tailed)	.000	.009	.000	.188		.001	.001	.732	.004	**.000**
	N	28	28	28	28		28	28	28	28	**28**
Related to nature of project	Pearson Correlation	.511	.378	.392	.329	.589		.571	.286	.661	**.773**
	Sig. (2-tailed)	.005	.048	.039	.087	.001		.001	.140	.000	**.000**
	N	28	28	28	28	28		28	28	28	**28**
Related to financial issues	Pearson Correlation	.559	.450	.671	.500	.592	.571		.306	.555	**.781**
	Sig. (2-tailed)	.002	.016	.000	.007	.001	.001		.114	.002	**.000**
	N	28	28	28	28	28	28		28	28	**28**
Related to political issues	Pearson Correlation	.292	-.140	.040	.188	.068	.286	.306		.102	**.264**
	Sig. (2-tailed)	.131	.476	.841	.339	.732	.140	.114		.605	**.175**
	N	28	28	28	28	28	28	28		28	**28**
Related to other miscellaneous issues	Pearson Correlation	.475	.395	.527	.252	.533	.661	.555	.102		**.698**
	Sig. (2-tailed)	.011	.037	.004	.196	.004	.000	.002	.605		**.000**
	N	28	28	28	28	28	28	28	28		**28**
All the main factors	**Pearson Correlation**	**.786**	**.598**	**.720**	**.547**	**.810**	**.773**	**.781**	**.264**	**.698**	
	Sig. (2-tailed)	**.000**	**.001**	**.000**	**.003**	**.000**	**.000**	**.000**	**.175**	**.000**	
	N	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	

4.2.3.2 Main factors correlation regarding "degree of existence of the factors in the projects under study"

Table 4.42 shows that when Sig. (2-tailed) decreases, the Pearson Correlation increases. If Sig. (2-tailed) in the correlation matrix is less than 0.05 that means there is a relation between the compared two main factors. If Sig. (2-tailed) in the correlation matrix is more than 0.05 that means there is no relation between the compared two main factors.

Table 4.42 Pearson correlation matrix between all main factors regarding "degree of existence of the factors in the projects under study"

Main factors	Analysis	Related to project management	Related to employees	Related to relations and communications	Related to knowledge and experience	Related to project executing process	Related to nature of project	Related to financial issues	Related to political issues	Related to other miscellaneous issues	All the main factors
Related to project management	Pearson Correlation		.228	.460	.432	.788	.180	.422	-.016	.556	**.536**
	Sig. (2-tailed)		.244	.014	.022	.000	.359	.025	.934	.002	**.003**
	N		28	28	28	28	28	28	28	28	**28**
Related to employees	Pearson Correlation	.228		.246	.426	.177	.105	.198	-.068	.350	**.372**
	Sig. (2-tailed)	.244		.207	.024	.369	.594	.311	.733	.068	**.051**
	N	28		28	28	28	28	28	28	28	**28**
Related to relations and communications	Pearson Correlation	.460	.246		.613	.614	.374	.645	.244	.574	**.777**
	Sig. (2-tailed)	.014	.207		.001	.001	.050	.000	.212	.001	**.000**
	N	28	28		28	28	28	28	28	28	**28**
Related to knowledge and experience	Pearson Correlation	.432	.426	.613		.623	.179	.632	-.042	.464	**.593**
	Sig. (2-tailed)	.022	.024	.001		.000	.361	.000	.833	.013	**.001**
	N	28	28	28		28	28	28	28	28	**28**
Related to project executing process	Pearson Correlation	.788	.177	.614	.623		.273	.525	.130	.670	**.648**
	Sig. (2-tailed)	.000	.369	.001	.000		.160	.004	.509	.000	**.000**
	N	28	28	28	28		28	28	28	28	**28**
Related to nature of project	Pearson Correlation	.180	.105	.374	.179	.273		.682	.663	.482	**.725**
	Sig. (2-tailed)	.359	.594	.050	.361	.160		.000	.000	.009	**.000**
	N	28	28	28	28	28		28	28	28	**28**
Related to financial issues	Pearson Correlation	.422	.198	.645	.632	.525	.682		.404	.629	**.814**
	Sig. (2-tailed)	.025	.311	.000	.000	.004	.000		.033	.000	**.000**
	N	28	28	28	28	28	28		28	28	**28**
Related to political issues	Pearson Correlation	-.016	-.068	.244	-.042	.130	.663	.404		.290	**.547**
	Sig. (2-tailed)	.934	.733	.212	.833	.509	.000	.033		.134	**.003**
	N	28	28	28	28	28	28	28		28	**28**
Related to other miscellaneous issues	Pearson Correlation	.556	.350	.574	.464	.670	.482	.629	.290		**.766**
	Sig. (2-tailed)	.002	.068	.001	.013	.000	.009	.000	.134		**.000**
	N	28	28	28	28	28	28	28	28		**28**
All the main factors	**Pearson Correlation**	**.536**	**.372**	**.777**	**.593**	**.648**	**.725**	**.814**	**.547**	**.766**	
	Sig. (2-tailed)	**.003**	**.051**	**.000**	**.001**	**.000**	**.000**	**.000**	**.003**	**.000**	
	N	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	**28**	

Chapter 5
Constructability Framework

5.1 Implementation of constructability

5.1.1 Introduction

According to constructability definition which is "the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives" (Uhlik and Lores 1998), the implementation of constructability should be started from the planning phase of the project life cycle all the way through the end of field operation phase.

For the implementation of constructability, everyone involved in the process must understand the constructability concepts and its benefits.

Constructability can be implemented in the Gaza strip by various degrees of formality which is related to the involved firms' management. The presence of constructability coordinator with, specific responsibilities is very efficient for constructability implementation and constructability barriers overcoming.

5.1.2 Success factors for implementation of constructability

As pointed in Eldin (1999) and reported at the literature review, there were common success factors for the implementation of constructability. These success factors are:

1- Possession of technical skills among the individuals of the project teams.
2- Possession of interpersonal skills of individuals.
3- Management's demonstration of visible support for achievers.
4- Creation of an environment in which employees develop sense of ownership of their tasks.
5- Creation of long-term relationships between owners, designers, and contractors.
6- Establishment of strong communication routines among project participants.
7- Involvement of end-users in early project decisions.
8- Enforcing safety practices.

The researcher believes that these success factors could be useful to be implemented in the construction field in the Gaza strip because these success factors represent a solution to some constructability barriers identified in this study.

5.2 Overcoming the constructability barriers

5.2.1 Introduction

In this study, the researcher described nine main factors that hamper the implementation of constructability which are divided into 56 sub-factors. The study reported that these hampering factors (barriers) had different "relative important index", based on the factors' existence in the case studies.

The most effective approach to constructability implementation in the Gaza strip is owner, architect/engineer, and constructor integration from the project inception. This approach creates an atmosphere in which team participants can integrate the constructability implementation by executing their responsibilities and liabilities towards constructability.

In addition, this atmosphere can form the essential bonds of trust, mutual confidence, and professional relationships necessary for a successful project.

5.2.2 Determining the vital factors hampering constructability in Gaza strip

Vilfredo Pareto studied the distributions of wealth in different countries, concluding that a fairly consistent minority – about 20% – of people controlled the large majority – about 80% – of a society's wealth. This same distribution has been observed in other areas and has been termed the Pareto effect.

The Pareto effect even operates in quality improvement: 80% of problems usually stem from 20% of the causes (Simon, 2007).

Pareto analysis is a statistical technique in decision making that is used for selection of a limited number of tasks that produce significant overall effect. It uses the Pareto principle - the idea that by doing 20% of work you can generate 80% of the advantage of doing the entire job. Or in terms of quality improvement, a large majority of problems 80% are produced by a few key causes 20% (Wikipedia, 2007).

According to Pareto analysis, the framework should be focused on 20% of the highest weighted factors founded in the cases of this research which is about 12 factors. Yet, for a wider coverage of the subject with no cost, the researcher studied the highest weighted 21 factors in terms of degree of existence in the case studies. Table 5.1 describes the important 21 factors that hamper the implementation of constructability in the Gaza strip.

Table 5.1 The important 21 factors that hamper the implementation of constructability in the Gaza strip.

No.	Sub-factors hampering constructability	Degree of existence in the project under study		
		Mean	Relative importance index	Rank
1	Recurrent closure of crossings	3.93	0.7857	1
2	Absence of preassembling before project's execution	3.61	0.7214	2
3	Absence of motivation for project's employees	3.43	0.6857	3
4	Existence of political interruption and disputes	3.36	0.6714	4
5	The contractor is not involved in the preparation and the design of the project	3.29	0.6571	5
6	Finishing subcontractors are not involved from the beginning of project execution	3.29	0.6571	5
7	The contractor has no objective in the project or it is limited to making profit	3.18	0.6357	7
8	Lack or absence of workers' training	3.04	0.6071	8
9	Overlapping of the contractor's team roles	3.00	0.6000	9
10	Latest technology is not used in the project	2.86	0.5714	10
11	Weak project's productivity	2.86	0.5714	10
12	None of the parties applying lessons learned from previous projects	2.82	0.5643	12
13	Lack or absence of project risk control from the contractor	2.82	0.5643	12
14	Existence of claims between project's parties	2.79	0.5571	14
15	Safety and health measures are not followed	2.71	0.5429	15
16	Interruption of project's activities	2.71	0.5429	15
17	Existence of environmental issues and bad weather	2.64	0.5286	17
18	The project is not implemented in accordance with the planned implementation schedule	2.61	0.5214	18
19	The contractor is not interested in quality during project execution	2.61	0.5214	18
20	Lack of equipment for project use	2.50	0.5000	20
21	Construction phases are not analyzed by the consultant	2.46	0.4929	21

5.2.3 Developing a constructability framework

The development of the constructability framework began with generating ideas to overcome the factors that hamper the implementation of constructability.

To overcome the constructability barriers and to achieve the benefits of constructability in construction projects in the Gaza strip, the researcher followed the four constructability implementation phases in any project life cycle, which are planning phase, design phase, procurement phase and field operations phase. The following figures are advised to be followed:

- ✓ Figure 5.1 describes the factors that hamper the implementation of constructability in the Gaza strip in each phase of the project life cycle (listed in Table 5.1). The reason behind the repetition of some hampering factors in Figure 5.1 is due to their appearance in more than one phase.
- ✓ Figure 5.2 describes the actions that would overcome constructability barriers in the Gaza strip in each phase of the project life cycle. Identified actions are drawn from literature review and the researcher's experience.

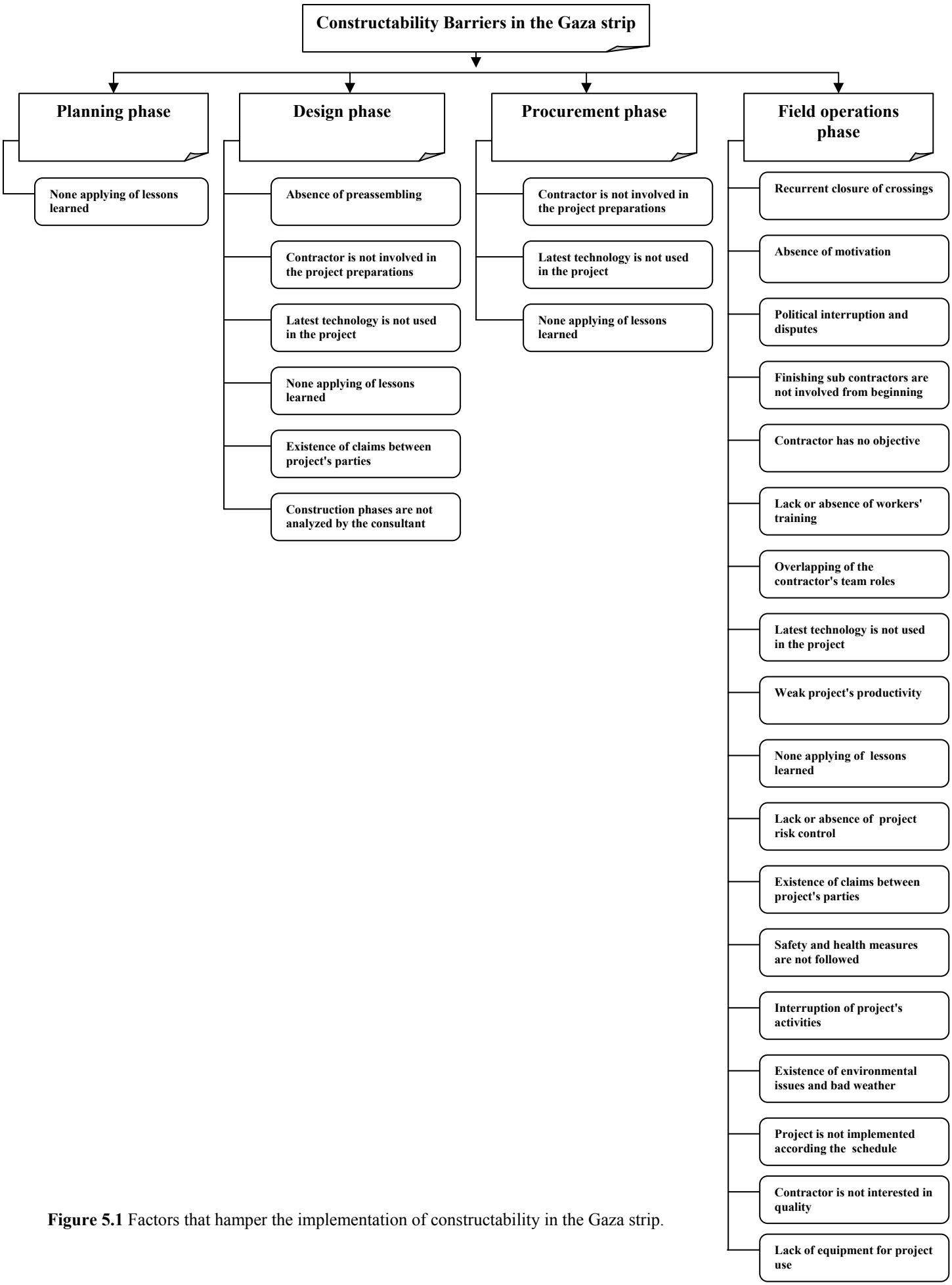


Figure 5.1 Factors that hamper the implementation of constructability in the Gaza strip.

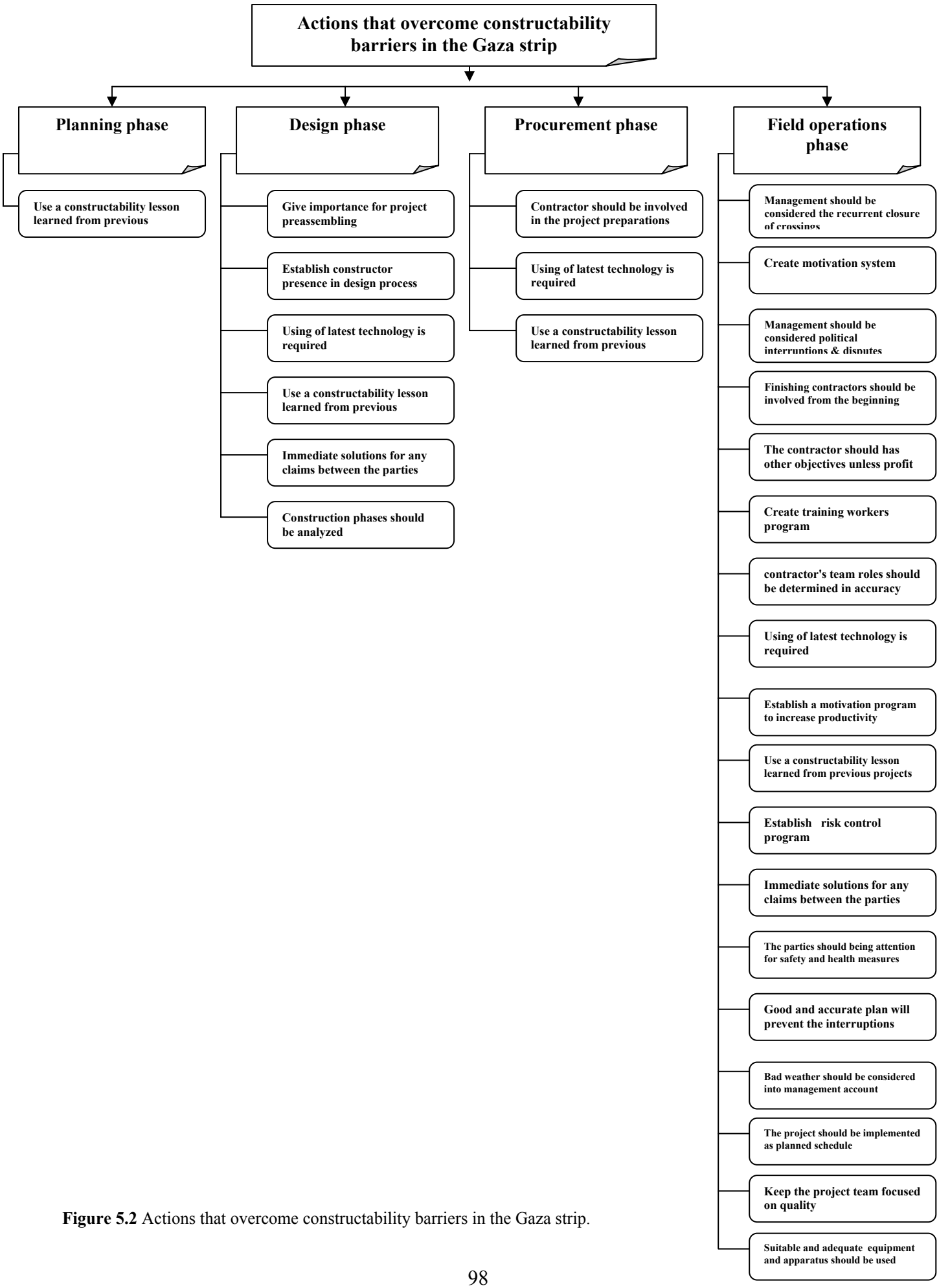


Figure 5.2 Actions that overcome constructability barriers in the Gaza strip.

5.3 Implementation of constructability framework

The implementation of constructability framework should conducted by the project's team who should take into consideration accuracy and fairness, by using the proposed excel sheet as evaluation sheet, to maximize benefits for all parties.

The evaluation should be conducted in two different timings as follows:

- ❖ First evaluation, should be conducted by the team involved (Owner, Construction Manager, Designer, Contractor and Constructability Coordinator) as early as possible before the field operations phase started. This evaluation aims to arrive at informed decisions in regards to processes that might weaken the constructability implementation to amend whenever necessary and also to stimulate the efforts for constructability implementation in order to overcome the barriers. In addition, evaluation acts as a planned chart to determine the success percentage in comparison to the evaluation model which will be conducted at the end of field operations phase.

- ❖ Second evaluation, should be conducted by the team involved (Owner, Construction Manager, Designer, Contractor and Constructability Coordinator) at the end of field operations phase. This evaluation aims to determine the success percentage of constructability barriers that have been overcome during the project life cycle and it also acts as lessons learned to all the parties involved.

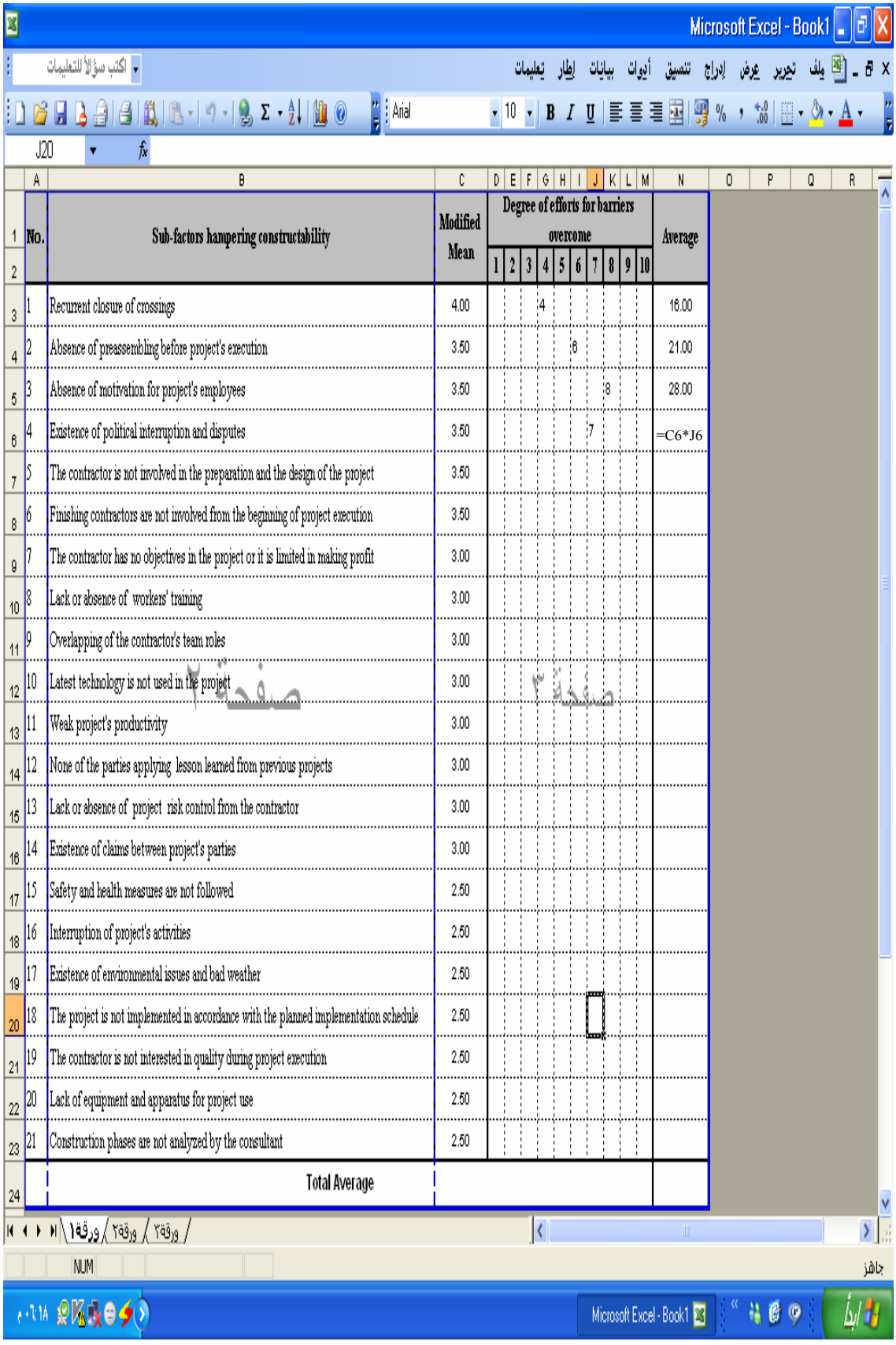
5.3.1 Evaluation method

By using excel sheet (before or after field operations field) as in Figure 5.3, the evaluators should:

- ✓ Provide accurate and fair scores from 1 - 10 to the constructability barrier factors mentioned in the excel sheet to express the constructability barriers overcome efforts.
- ✓ Multiply the suggested scores of each factor with the modified mean of the same factor.

- ✓ Obtain the total averages by the summation of all factors average, which fall between 63 and 630.
- ✓ Determine the success percentage of constructability barriers that has been overcome by using the following formula:

Success Percentage (SP) = $\frac{\sum Average}{630} * 100 =$ ……..… %



No.	Sub-factors hampering constructability	Modified Mean	Degree of efforts for barriers overcome										Average
			1	2	3	4	5	6	7	8	9	10	
1	Recurrent closure of crossings	4.00				4							16.00
2	Absence of preassembling before project's execution	3.50						6					21.00
3	Absence of motivation for project's employees	3.50								8			28.00
4	Existence of political interruption and disputes	3.50							7				=C6*J6
5	The contractor is not involved in the preparation and the design of the project	3.50											
6	Finishing contractors are not involved from the beginning of project execution	3.50											
7	The contractor has no objectives in the project or it is limited in making profit	3.00											
8	Lack or absence of workers' training	3.00											
9	Overlapping of the contractor's team roles	3.00											
10	Latest technology is not used in the project	3.00											
11	Weak project's productivity	3.00											
12	None of the parties applying lesson learned from previous projects	3.00											
13	Lack or absence of project risk control from the contractor	3.00											
14	Existence of claims between project's parties	3.00											
15	Safety and health measures are not followed	2.50											
16	Interruption of project's activities	2.50											
17	Existence of environmental issues and bad weather	2.50											
18	The project is not implemented in accordance with the planned implementation schedule	2.50											
19	The contractor is not interested in quality during project execution	2.50											
20	Lack of equipment and apparatus for project use	2.50											
21	Construction phases are not analyzed by the consultant	2.50											
	Total Average												

Figure 5.3 Constructability hampering factors evaluation sheet

Chapter 6

Conclusion and Recommendations

6.1 Conclusion

This chapter includes the conclusions and the practical recommendations that would contribute to the development of constructability implementation in the Gaza strip. The main objective of this study is to clarify the essential factors that hamper the implementation of constructability in the Gaza strip. The study also aimed at identifying the current implementation of constructability in Gaza strip. It also aimed at clarifying solutions that would help the participants to apply the constructability principles as much as possible. Lastly, the study aimed at developing guidelines for the construction industry's practioners to implement the constructability concepts.

The differences between constructability and value engineering are the analysis objectives and the point of application within the total project life cycle. The analysis objective of value engineering is to reduce the facilities total life cycle cost, whereas constructability focuses upon optimization of the construction process. Value engineering is performed during the document development phase (Chasey and Schexnayder, 2000).
Constructability definition makes clear that constructability is performed during planning, design, procurement and field operations phases.

According to the review of literature and after interviewing experts who deal with the construction management at different levels, nine major factors and 56 sub-factors that hamper the implementation of constructability were determined.

The results of this study confirm that the constructability principles are considered a new subject in the construction industry in the Gaza strip and the participants do not apply any other techniques.

The rating process in terms of importance and affect in the construction industry showed that the political factors, knowledge & experience factors, employees' factors and relations and communications factors are the most important factors that hamper constructability as main factors. While the least rated main factors are nature of the project factors, project executing process factors and project management factors.

The rating process in terms of degree of existence in the case studies showed that the political factors, project management factors, project executing process factors and employees' factors are the most factors that hamper constructability in the Gaza strip as main factors. While the least rated main factors are nature of project factors, knowledge & experience factors and relations & communications factors.

The rating process in terms of degree of existence in the case studies showed that the most sub-factors that hamper constructability in the Gaza strip are as follows:

1- Recurrent closure of crossings.
2- Absence of preassembling before project's execution.
3- Absence of motivation for project's employees.
4- Existence of political interruption and disputes.
5- The contractor is not involved in the preparation and the design of the project.
6- Finishing sub-contractors are not involved from the beginning of project execution.

The rating process in terms of degree of existence in the case studies showed that the least sub-factors that hamper constructability in the Gaza strip are as follows:

1- Project remoteness and lack of utilities.
2- Type of contract.
3- Extensive regulations, legislations and licenses required.
4- Rework of some activities of the project.
5- Lack of experience and practice of the owner or his/her representative.
6- Absence of evaluation and documentation of the project.

When properly implemented, constructability does have a positive impact on the overall projects performance in regards to identifying and overcoming factors that hamper constructability.

One of the important outputs of this research are establishing a guideline and a framework was also developed to be used by practioners in the Gaza strip to apply the constructability principles and to overcome factors that hamper the implementation of constructability in order to obtain the optimum benefits of their projects.

6.2 Recommendations

6.2.1 Practical recommendations

1. The use of the framework designed in this research is recommended as appropriate tool to overcome the vital factors that would hamper the implementation of constructability in the Gaza strip.

2. Owners, designers, and contractors should be aware of their responsibilities and liabilities towards constructability.

3. In order to maximize benefits of constructability in any project, full cooperation of all the parties involved in the construction industry is required.

4. A constructability coordinator is recommended to be assigned in every project in the Gaza strip with specific duties and responsibilities such as:

A. Follow up actions that ensure proper implementation of constructability.
B. Act as a planner for constructability issues (concept, implementation, barriers, .etc)
C. Keep a record of documentation related to constructability to be benefited from in later projects.
D. Organize and supervise constructability meetings.
E. Share in critical decision making.

5. It is recommended that the contracting companies and the consultant firms are to develop its overall management system that would ensure overcoming factors that hamper constructability in their projects.

6. Contractors in the Gaza strip should embrace constructability in their different types of projects, because it is logical to think that the same benefits will be achieved in different projects by using constructability.

7. The Palestinian Contractors Union (PCU) should circulate researches and papers about constructability to educate their members about constructability's concept (benefits, implementation, barriers of constructability, etc.).

6.2.2 Proposed further research studies

1. There is a vital need for more investigations about practical actins that overcome constructability barriers in the Gaza strip.
2. There is a need for more determining of participant's roles (responsibilities and liabilities) toward the constructability.

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List of Appendices

Appendix (1)

English language checklist of case studies

Dear, Projects' owners, Consultants, Contractors Greetings,

Construction industry is considered one of the most important industries in the Gaza strip, yet it needs further development. It needs to be conducted in better scientific manners so that all parties involved could be benefited. As such, this study, which is considered part of the industry's development, has examined the factors that hamper constructability in the Gaza strip not only it highlights and presents it, but also it suggests possible solutions. This evaluation is part of the required scientific study to avail more data needed that the researcher is collecting for accurate study output.

We do highly appreciate your time and efforts in answering the attached questionnaire assuring you that the collected data will be used solely for scientific purposes and all personal information will remain absolutely confidential.

Thanking you in advance for your assistance in this matter.

Questionnaire's Guidelines:

1. Constructability definitions: "Optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve the overall project objective".

2. Evaluation is divided into three parts:

A. Institution profile.

B. Data on the project under study.

C. Questions on factors that hamper constructability in terms of; importance and affect in construction industry and degree of existence in the project under study.

3. Rating of answers related to importance and affect of factors that hamper constructability are as follows:

1= Not important, 2= Low important, 3= Medium important, 4= Important 5= Very important

4. Answers evaluation in terms of existence of factor that hamper project's constructability degree of existence in the project under study

1= Does not exist at all, 2= Low exist, 3= Medium exist, 4= Exist, 5= Intensively exist.

A. Institution profile:

1. Institution type

☐ Owner ☐ Consultant ☐ Contractor

2. Date of establishment **……**

3. Implementing company (First Class) in

☐ Buildings Only ☐ Water and Sewage only

☐ Buildings and Water &Sewage only ☐ Buildings, roads and water & sewage

4. Managerial position of respondent……

5. Average number of employees in the institution……..…….

6. Number of projects executed in the last five years

☐ Les than 10 ☐ 10 to 20 ☐ 21 to 30

☐ More than 30

7. Value of projects implemented in the last five years

☐ Less than 2 Millions USD ☐ 2 to 5 Millions USD ☐ 5 to 8 Millions USD

☐ More than 8 Millions USD

8. Have you ever heard of the concept of Constructability?

☐ Yes

☐ No

B. Data regarding the projects under study:

Name of the Project ……

Nature of work

☐ Buildings ☐ Roads ☐ Water and Sewage

Planned duration of the Project……. Actual duration of Project ……..

Budgeted amount for the Project……. Actual implementation cost.....

Year of implementation…….....….. Funded by…….....…….

Owner…….....……

Percentage of profit when pricing..% Percentage of profit after implementation.....%.

Delay Penalties (according to the contract)…….....……

Actual delay penalties (if any)…….....……..

C. Questions on factors that hamper constructability in terms of; importance and affect in construction industry and degree of existence in the project under study.

Please do answer the questions below as accurate as you could in accordance with the following classification:

The importance and affect of factors that hamper constructability:

1= Not important 2= Low important 3= Medium important 4= Important 5= Very important

The existence of factor that hamper project's constructability:

1= Does not exist at all 2= Low exist 3= Medium exist 4= Exist 5= Intensively Exists

S/N	Main factors	Sub-factors hampering constructability	The importance and affect in construction industry					Degree of existence in the project under study				
			1	2	3	4	5	1	2	3	4	5
1	Related to project management	Owner is not supported and committing throughout the project										
2		Construction phases are not analyzed by the consultant										
3		Design stages are not reviewed by the consultant										
4		The contractor is not involved in the preparation and the design of the project										
5		Ambiguity or contradiction of project documents										
6		Overlapping of the contractor's team roles										
7		Some parties of the project are not serious in resolving disputes										
8		The project is not implemented in accordance with the planned implementation schedule										
9		None of the parties applying lessons learned from previous projects										
10		The contractor has no objective in the project or it is limited to making profit										
11		The contractor is not interested in quality during project execution										
12		Safety and health measures are not followed										
13		Lack or absence of the contractors' project management support										
14		Lack or absence of workers' training										
15		Finishing subcontractors are not involved from the beginning of project execution										
16		Latest technology is not used in the project										
17		Project management is not willing to accept any risk related to workers										
18		Absence of motivation for project's employees										
19		Lack or absence of project risk control from the contractor										
20		Insufficient number of employees required in project activities.										

S/N	Main factors	Sub-factors hampering constructability	The importance and affect in construction industry						Degree of existence in the project under study				
			1	2	3	4	5		1	2	3	4	5
21	**Related to employees**	Lack of employees' experience in the project											
22		Lack of employees' skills in the project											
23	**Related to relations and communications**	Bad relations between one party or more in the project											
24		Miscommunication between one party or more in the project											
25		Existence of claims between project's parties											
26		Existence of disputes between one party or more in the project											
27		Absence of mutual confidence between the project parties											
28		Bad relation among the project's employees											
29	**Related to knowledge and experience**	Lack of experience and practice of the owner or his/her representative											
30		Ignorance of latest technology											
31		Lack of experience and practice of the contractor or his/her representative											
32		Lack of experience and efficiency of the project's executing team											
33	**Related to project executing process**	Lack of knowledge of the used codes and specifications in the project											
34		Absence of preassembling before project's execution											
35		Absence or lack of project execution's process											
36		Absence of evaluation and documentation of the project											
37		Bad procurement method											
38		Intensive and bad timing of change orders											
39		Absence or not following execution plan of the project											
40		Priorities are not applied in the project											
41		Rework of some activities of the project											
42		Interruption of project activities											
43	**Related to nature of project**	Project's difficulties and complexities											
44		Project remoteness and lack of utilities											

S/N	Main factors	Sub-factors hampering constructability	The importance and affect in construction industry						Degree of existence in the project under study				
			1	2	3	4	5		1	2	3	4	5
45	Related to financial issues	Limited project budget											
46		No review of project cost before execution											
47		Wrong cost estimates of project											
48		Inadequate system of interim and final payments											
49		Existence of damages in the project											
50	Related to political issues	Recurrent closure of crossings											
51		Existence of political interruption and disputes											
52	Related to other miscellaneous issues	Type of contract											
53		Lack of equipment for project use											
54		Existence of environmental issues and bad weather											
55		Weak project's productivity											
56		Extensive regulations, legislations and licenses required											

Appendix (2)

Arabic language checklist of case studies

بسم الله الرحمن الرحيم

الأخوة الكرام / مالكو المشاريع – الإستشاريون – المقاولون ،،،

السلام عليكم و رحمة الله وبركاته

تعتبر صناعة الإنشاءات من الصناعات الهامة في قطاع غزة وهي بحاجة إلى تطوير و ممارسة بطرق علمية صحيحة ليتمكن الجميع من جني ثمارها بشكل مثالي وعليه فإن هذه الدراسة والتي تعتبر جزء من هذا التطوير قد تناولت العوامل التي تعيق قابلية الإنشاء في قطاع غزة بهدف إلقاء الضوء عليهـا وإظهارها ووضع حلول مناسبة لها ما أمكن ، لذا كان هذا التقييم كجزء من الدراسة العلمية اللازمـة لإستكمال المعلومات لدى الباحث مثمنين جهدكم بإيجاباتكم عن أسئلة الإستبيان واعدينكم بأن لا تستخدم المعلومات إلا للأغراض العلمية وأن تبقى معلوماتكم الشخصية التي يتم الحصول عليها سرية .

شاكرين حسن تعاونكم .

إرشادات خاصة بالإجابة على الأسئلة/

1- تعريف قابلية الإنشاء (Constructability):

هي الإستخدام الأفضل للمعرفة والخبرة الإنشائية في مراحل المشروع المختلفة (التخطيط والتـصميم والجلب والتنفيذ) للحصول على كل أهداف المشروع.

2- يتكون التقييم من 3 أجزاء:

أ- السيرة الذاتية للمؤسسة.

ب- معلومات خاصة بالمشروع المراد دراسته.

ج- أسئلة تقييم العوامل المعوقة لقابلية الإنشاء في درجة أهميتها وتأثيرها في صناعة الإنشاءات وفي درجة وجودها بالمشروع المراد دراسته.

3- تقييم الإجابات على مدى أهمية و تأثير العوامل المعوقة في صناعة الإنشاءات إلى:

غير مهم = 1 مهم بدرجة قليلة = 2 مهم لدرجة ما = 3

مهم = 4 مهم جداً = 5 .

4- تقييم الإجابات على مدى وجود العوامل المعوقة بالمشروع المراد دراسته إلى:

غير موجود = 1 موجود بدرجة قليلة = 2 موجود لدرجة ما = 3

موجود = 4 موجود بكثرة = 5 .

أ- السيرة الذاتية للمؤسسة :

1- نوع المؤسسة ☐ صاحب العمل ☐ استشاري ☐ مقاول

2- سنة التأسيس .....

3- تصنيف الشركة المنفذة للمشروع (درجة أولى) في مجال:

☐ أبنية فقط ☐ مياه ومجاري فقط ☐ أبنية + مياه ومجاري

☐ أبنية + طرق + مياه ومجاري.

4- المركز الإداري لمن يقوم بالإجابة على الأسئلة .....

5- متوسط عدد العاملين بالمؤسسة .....

6- عدد المشاريع خلال الخمس سنوات الأخيرة للمؤسسة

☐ أقل من 10 مشاريع ☐ 10-20 مشروع ☐ 21-30 مشروع

☐ أكثر من 30 مشروع

7- قيمة المشاريع المنفذة خلال الخمس سنوات الأخيرة

☐ أقل من 2 مليون دولار ☐ 2-5 مليون دولار ☐ 5-8 مليون دولار

☐ أكثر من 8 مليون دولار.

8- هل سمعت عن مصطلح (قابلية الإنشاء) أو ما يعرف بال (Constructability) ؟

☐ نعم

☐ لا

ب- معلومات خاصة بالمشروع المراد دراسته:

اسم المشروع .....

طبيعة أعمال المشروع ☐ أبنية ☐ طرق ☐ مياه و مجاري

مدة المشروع الأصلية ..... مدة المشروع بعد التنفيذ .....

قيمة المشروع الأصلية ..... قيمة المشروع بعد التنفيذ .....

سنة التنفيذ ..... الجهة الممولة للمشروع .....

الجهة المالكة.....

نسبة الأرباح عند التسعير .....% نسبة الأرباح بعد التنفيذ .....%

عقوبات التأخير حسب العقد .....

عقوبات التأخير الفعلية (إن وجد) .....

ج- أسئلة تقييم العوامل المعوقة لقابلية الإنشاء في درجة أهميتها وتأثيرهـا فـي صـناعة الإنشاءات وفي درجة وجودها بالمشروع المراد دراسته.

برجاء الإجابة على الأسئلة التي يحتويها الإستبيان بالحقائق المناسبة و الدقة قدر الإمكان حسب التدرج التالي :

درجة الأهمية و التأثير في صناعة الإنشاءات/

غير مهم = 1 مهم بدرجة قليلة = 2 مهم لدرجة ما = 3 مهم = 4 مهم جداً = 5

درجة وجوده بالمشروع المراد دراسته/

غير موجود = 1 موجود بدرجة قليلة = 2 موجود لدرجة ما =3 موجود = 4 موجود بكثرة = 5

رقم	العوامل الرئيسية	العوامل المعوقة الفرعية	درجة الأهمية و التأثير في صناعة الإنشاءات					درجة وجوده بالمشروع المراد دراسته				
			5	4	3	2	1	5	4	3	2	1
1	عوامل تعود لإدارة المشروع	عدم مساندة و دعم وإلتزام المالك طوال المشروع										
2		عدم تحليل مراحل الإنشاء من قبل الإستشاري										
3		عدم عمل مراجعة لمراحل التصميم من قبل الإستشاري										
4		عدم اشراك المقاول بمرحلة إعداد و تصميم المشروع										
5		عدم وضوح وثائق المشروع أو تضاربها										
6		تداخل أدوار فريق عمل المقاول أثناء التنفيذ										
7		عدم جدية بعض أطراف المشروع لحل المنازعات										
8		عدم السير حسب الجدول الزمني المعد للمشروع										
9		عدم تطبيق أي طرف للدروس المستفادة من المشاريع السابقة										
10		عدم وجود أهداف للمقاول في المشروع أو حصر الأهداف بالربح										
11		عدم اهتمام المقاول بالجودة عند تنفيذ المشروع										
12		عدم إتباع عوامل الأمن و السلامة بالمشروع										
13		قلة أو عدم وجود دعم من إدارة المشروع التابعة للمقاول										
14		قلة أو عدم وجود تدريب للعاملين بالمشروع										
15		عدم اشراك مقاولي التشطيب للمقاول في بداية تنفيذ المشروع										
16		عدم استخدام التقنيات الحديثة بالمشروع										
17		عدم عزم إدارة المشروع لدى المقاول بتحمل المخاطر الناجمة عن العاملين										
18		عدم وجود حوافز للعاملين بالمشروع										
19		قلة أو عدم التحكم بمخاطر المشروع من قبل المقاول										
20		قلة عدد العمالة المطلوبة في كل فعالية بالمشروع										

رقم	العوامل الرئيسية	العوامل المعوقة الفرعية	درجة الأهمية و التأثير في صناعة الإنشاءات						درجة وجوده بالمشروع المراد دراسته				
			5	4	3	2	1		5	4	3	2	1
21	عوامل تعود للعمال	ضعف خبرة العمال بالمشروع											
22		ضعف مهارة العمال بالمشروع											
23	عوامل تعود للعلاقات و الإتصالات	سوء العلاقات بين طرف أو أكثر بالمشروع											
24		سوء الإتصالات بين طرف أو أكثر بالمشروع											
25		وجود مطالبات بين أطراف المشروع											
26		وجود منازعات بين طرف أو أكثر بالمشروع											
27		عدم وجود ثقة متبادلة بين أطراف المشروع											
28		سوء العلاقات بين العمال بالمشروع											
29	عوامل تعود للمعرفة و الخبرة	قلة خبرة و ممارسة المالك أو من يمثله											
30		عدم المعرفة بالتقنيات الحديثة											
31		قلة خبرة و ممارسة المقاول أو من يمثله											
32		قلة خبرة وكفاءة طواقم التنفيذ بالمشروع											
33	عوامل تعود لطرق تنفيذ المشروع	ضعف المعرفة بالكود و المواصفات القياسية المستخدمة											
34		عدم تمثيل المشروع قبل البدء											
35		عدم أو قلة فهم مراحل وخطوات تنفيذ المشروع											
36		عدم وجود تقييم وتوثيق للمشروع											
37		سوء طريقة جلب المقاولين للعطاء											
38		كثرة الأوامر التغييرية وسوء توقيتها											
39		عدم وجود أو عدم إتباع خطة عمل للتنفيذ بالمشروع											
40		عدم تطبيق الأولويات بالمشروع											
41		إعادة تنفيذ بعض الأعمال بالمشروع											
42		عدم وجود استمرارية بفعاليات المشروع											
43	عوامل تعود لطبيعة للمشروع	صعوبة و تعقيدات المشروع											
44		بعد موقع المشروع وقلة الخدمات حوله											

رقم	العوامل الرئيسية	العوامل المعوقة الفرعية	درجة الأهمية و التأثير في صناعة الإنشاءات						درجة وجوده بالمشروع المراد دراسته				
			5	4	3	2	1		5	4	3	2	1
45	عوامل مالية	محدودية ميزانية المشروع											
46		عدم مراجعة التكاليف الخاصة بالمشروع قبل التنفيذ											
47		التقديرات الخاطئة لتكاليف المشروع											
48		سوء نظام الدفعات الجارية و النهائية											
49		وجود أضرار مادية بالمشروع											
50	عوامل سياسية	كثرة إغلاقات المعابر بالقطاع											
51		وجود العوائق و الخلافات السياسية											
52	عوامل متفرقة أخرى	نوع العقد											
53		قلة المعدات و الأجهزة المستخدمة بالمشروع											
54		وجود المشاكل البيئية أو سوء الأحوال الجوية											
55		ضعف الإنتاجية بالمشروع											
56		كثرة المتطلبات القانونية والتشريعية و التراخيص											

Appendix 3

Spearman Correlation Coefficients between the items

A) Factors related to project management

Table A3.1 clarifies the correlation coefficients between the items of "Factors related to project management" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.1 Correlation coefficients between items and their related section "Factors related to project management"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
1	Owner is not supporting and committed throughout the project	0.548	0.003	0.659	0.000
2	Construction phases are not analyzed by the consultant	0.472	0.011	0.511	0.005
3	Design stages are not reviewed by the consultant	0.378	0.047	0.532	0.004
4	The contractor is not involved in the preparation and the design of the project	0.375	0.049	0.659	0.000
5	Ambiguity or contradiction of project documents	0.385	0.043	0.461	0.014
6	Overlapping of the contractor's team roles	0.409	0.031	0.486	0.009
7	Some parties of the project are not serious in resolving disputes	0.415	0.028	0.443	0.018
8	The project is not implemented in accordance with the planned implementation schedule	0.604	0.001	0.457	0.015
9	None of the parties applying lessons learned from previous projects	0.492	0.008	0.679	0.000
10	The contractor has no objective in the project or it is limited to making profit	0.477	0.010	0.554	0.002
11	The contractor is not interested in quality during project execution	0.604	0.001	0.664	0.000
12	Safety and health measures are not followed	0.544	0.003	0.692	0.000
13	Lack or absence of the contractors' project management support	0.366	0.046	0.586	0.001

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
14	Lack or absence of workers' training	0.659	0.000	0.628	0.000
15	Finishing subcontractors are not involved from the beginning of project execution	0.501	0.007	0.526	0.004
16	Latest technology is not used in the project	0.615	0.001	0.489	0.008
17	Project management is not willing to accept any risk related to workers	0.476	0.011	0.791	0.000
18	Absence of motivation for project's employees	0.589	0.001	0.511	0.005
19	Lack or absence of project risk control from the contractor	0.415	0.028	0.814	0.000
20	Insufficient number of employees required in project activities.	0.612	0.001	0.628	0.000

B) Factors related to employees

Table A3.2 clarifies the correlation coefficients between the items of the "Factors related to employees" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.2 Correlation coefficients between items and their related section "Factors related to employees"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
21	Lack of employees' experience in the project	0.906	0.000	0.939	0.000
22	Lack of employees' skills in the project	0.872	0.000	0.916	0.000

C) Factors related to relations and communications

Table A3.3 clarifies the correlation coefficients between the items of the "Factors related to relations and communications" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.3 Correlation coefficients between items and their related section "Factors related to relations and communications"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
23	Bad relations between one party or more in the project	0.587	0.001	0.518	0.005
24	Miscommunication between one party or more in the project	0.601	0.001	0.496	0.007
25	Existence of claims between project's parties	0.707	0.000	0.744	0.000
26	Existence of disputes between one party or more in the project	0.749	0.000	0.832	0.000
27	Absence of mutual confidence between the project parties	0.526	0.005	0.753	0.000
28	Bad relation among the project's employees	0.645	0.000	0.580	0.001

D) Factors related to knowledge and experience

Table A3.4 clarifies the correlation coefficients between the items of the "Factors related to knowledge and experience" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.4 Correlation coefficients between items and their related section "Factors related to knowledge and experience"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
29	Lack of experience and practice of the owner or his/her representative	0.502	0.007	0.765	0.000
30	Ignorance of latest technology	0.767	0.000	0.545	0.003
31	Lack of experience and practice of the contractor or his/her representative	0.582	0.001	0.452	0.016
32	Lack of experience and efficiency of the project's executing team	0.576	0.001	0.765	0.000

E) Factors related to project executing process

Table A3.5 clarifies the correlation coefficients between the items of the "Factors related to project executing process" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.5 Correlation coefficients between items and their related section "Factors related to project executing process"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
33	Lack of knowledge of the used codes and specifications in the project	0.471	0.011	0.481	0.010
34	Absence of preassembling before project's execution	0.745	0.000	0.474	0.011
35	Absence or lack of project execution's process	0.500	0.007	0.427	0.023
36	Absence of evaluation and documentation of the project	0.552	0.002	0.490	0.008
37	Bad procurement method	0.548	0.003	0.611	0.001
38	Intensive and bad timing of change orders	0.426	0.024	0.580	0.001
39	Absence or not following execution plan of the project	0.460	0.014	0.751	0.000
40	Priorities are not applied in the project	0.511	0.006	0.745	0.000
41	Rework of some activities of the project	0.845	0.000	0.474	0.011
42	Interruption of project activities	0.505	0.006	0.609	0.001

F) Factors related to nature of project

Table A3.6 clarifies the correlation coefficients between the items of the "Factors related to nature of project" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.6 Correlation coefficients between items and their related section "Factors related to nature of project"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
43	Project's difficulties and complexities	0.835	0.000	0.906	0.000
44	Project remoteness and lack of utilities	0.841	0.000	0.800	0.000

G) Factors related to financial issues

Table A3.7 clarifies the correlation coefficients between the items of the "Factors related to financial issues" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.7 Correlation coefficients between items and their related section "Factors related to financial issues"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
45	Limited project budget	0.770	0.000	0.648	0.000
46	No review of project cost before execution	0.788	0.000	0.712	0.000
47	Wrong cost estimates of project	0.348	0.070	0.763	0.000
48	Inadequate system of interim and final payments	0.633	0.000	0.819	0.000
49	Existence of damages in the project	0.857	0.000	0.801	0.000

H) Factors related to political issues

Table A3.8 clarifies the correlation coefficients between the items of the "Factors related to political issues" and the average of the related section. Coefficients denoted significance at 0.05 level, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.8 Correlation coefficients between items and their related section "Factors related to political issues"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
50	Recurrent closure of crossings	0.599	0.001	0.894	0.000
51	Existence of political interruption and disputes	0.966	0.000	0.964	0.000

I) Factors related to other miscellaneous issues

Table A3.9 clarifies the correlation coefficients between the items of the "Factors related to other miscellaneous issues) and the average of the related section. Coefficients denoted significance at 0.05 levels, which means a content validity of this section of the questionnaire for what is being measured.

Table A3.9 Correlation coefficients between items and their related section "Factors related to other miscellaneous issues"

No.	Sub-factors hampering constructability	The importance and affect in construction industry		Degree of existence in the project under study	
		Spearman coefficient	p- Value	Spearman coefficient	p- Value
52	Type of contract	0.625	0.000	0.687	0.000
53	Lack of equipment for project use	0.503	0.006	0.765	0.000
54	Existence of environmental issues and bad weather	0.606	0.001	0.760	0.000
55	Weak project's productivity	0.444	0.018	0.770	0.000
56	Extensive regulations, legislations and licenses required	0.778	0.000	0.546	0.003