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Management of Variation Orders in Gaza Strip: Impacts and Minimization

إدارة الأوامر التغييرية في قطاع غزة: تأثيرها وتقليلها

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إقـــــــــرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Management of Variation Orders in Gaza Strip: Impacts and Minimization

إدارة الأوامر التغييرية في قطاع غزة: تأثيرها وتقليلها

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نتيجة الحكم على أطروحة ماجستير

بناءً على موافقة شئون البحث العلمي والدراسات العليا بالجامعة الإسلامية بغزة على تشكيل لجنة الحكم على أطروحة الباحثة/ **ساميه رسمي خالد نصار** لنيل درجة الماجستير في **كلية *الهندسة*** **قسم الهندسة المدنية- إدارة المشروعات الهندسية** وموضوعها:

إدارة الأوامر التغييرية في قطاع غزة: تأثيرها وتقليلها

Management of Variation Orders in Gaza Strip: Impacts and Minimization

وبعد المناقشة العلنية التي تمت اليوم السبت 20 ذو القعدة 1438هـ، الموافق 2017/08/12م الساعة الثانية مساءً، اجتمعت لجنة الحكم على الأطروحة والمكونة من:

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

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نائب الرئيس لشئون البحث العلمي والدراسات العليا

أ.د. عبدالرؤوف علي المناعمة

Abstract

Background and Problem: Nowadays construction of new projects is becoming an essential demand to improve the condition of Palestinian where during the lifecycle of the construction projects most of the clients and consultants are striving to obtain the ideal projects with a minimum margin of conflicts, minimum cost and time overrun and with maximum value added over each stage so, one of the real challenges that face the parties operating in construction projects is how to manage and mitigate the negative impact of the consecutive variation orders (VOs).

Aim and Objectives: The aim of this research is to study the management of the VOs. To achieve the aim of this research many objectives exist, these objectives can be summarized as to investigate the prevalence of the VOs in the construction projects, to assess the current practices of the VOs management in Gaza Strip, to investigate the non-value adding activities associated with the variations during the construction stage, to identify the predominant origin agent as well as the direct causes of the VOs, to identify the impact of the VOs on overall project performance and to recommend strategies to minimize the VOs.

Methodology: First, review the literature to extract the causes and impact of the VOs and recommended strategies to minimize it. This was fulfilled by conducting a desk study and interviews and using questionnaire. Secondly, a desk study on six of the finished projects was conducted to extract the real causes and impact of the VOs. Thirdly, interviews with their projects' managers to understand the causes and impacts of the VOs not seen at their projects documents and gather information about the current practices of the VOs management in their companies as well as look for recommendation and strategies if any to minimize the occurrence of the VOs. Finally, a questionnaire was developed to assess the perception of clients, consultants, and contractors on the factors causing the VOs, impact of thr VOs, and recommended strategies to minimize it in the construction projects in Gaza Strip.

Results: The most occurred factors caused the VOs were Israeli restriction in terminals and siege, discrepancies between contract documents, internal political problems, change in specification by the client and budget allocated constraints. In addition, the most influential factors impact the VOs were completion schedule delay, increase in duration of individual activities, delay in payment, suspend work in other activities, a dispute among professionals, and increase in project cost.

Conclusions: It was concluded that there are some similarities and differences between real data from desk study and interviews compared to the questionnaire result. The differences between the study and real data are mainly because the completed project has a special nature where these projects faced several difficulties of closure and severe siege after the Israeli war on the Gaza Strip in 2014. Not to forget to mention that the interviews included the perception of the contrctors (the managers of the selected projects in the desk study) while the questionnaire result included the perception of the client, consultant, and contractors.

Keywords: Variation Orders, Gaza Strip, Construction projects, Client, Consultant, Contractor.

الملخص

خلفية عن الموضوع مع استعراض للمشكلة: في الوقت الحاضر أصبح بناء مشاريع جديدة متطلباً أساسياً لتحسين حالة الفلسطينيين حيث يسعى معظم المالكين والاستشاريين خلال دورة حياة المشروع الحصول على المشاريع المثالية بأقل حد من النزاعات وأقل تكلفة مع أقصى قيمة مضافة في كل مرحلة من مراحل المشروع لذلك تعتبر كيفية إدارة وتخفيف الأثر السلبي للأوامر التغييرية من التحديات الحقيقية التي تواجه الأطراف العاملة في المشاريع الإنشائية.

الأهداف المرجوة من موضوع الرسالة: الهدف من هذا البحث هو دراسة إدارة الأوامر التغييرية. لتحقيق الهدف العام من هذا البحث توجد العديد من الأهداف التي يمكن تلخيصها على النحو التالي: البحث عن انتشار الأوامر التغييرية في المشاريع الإنشائية، تقييم الممارسات الحالية لإدارة الأوامر التغييرية في قطاع غزة، البحث عن الأنشطة غير ذات القيمة المضافة المصاحبة للتغييرات خلال مرحلة الإنشاء، تحديد العامل المنشأ السائد للأوامر التغييرية بالإضافة إلى استخراج الأسباب المباشرة للأوامر التغييرية، تحديد أثر الأوامر التغييرية على الأداء العام للمشروع والتوصية باستراتيجيات للحد من اللأوامر التغييرية.

طريقة ومنهجية العمل لتحقيق الأهداف: أولاً، مراجعة الأبحاث السابقة لاستخراج أسباب وتأثير الأوامر التغييرية والاستراتيجيات الموصى بها لتقليلها في جميع أنحاء العالم ومن ثم تحديد قابليتها للتطبيق في قطاع غزة وقد تحقق ذلك من خلال إجراء دراسة مكتبية ومقابلات واستبيان. ثانياً، أجريت دراسة مكتبية عن ستة من المشاريع الإنشائية المنفذة بشكل نهائي لاستخراج الأسباب الحقيقية للأوامر التغييرية وتأثيرها. ثالثاً، إجراء مقابلات مع مدراء المشاريع لفهم أسباب وآثار الأوامر التغييرية التي لم يتم رؤيتها في وثائق المشاريع وجمع المعلومات عن الممارسات الحالية لإدارة الأوامر التغييرية في شركاتهم وكذلك البحث عن الاستراتيجيات الموصى بها للحد من حدوث الأوامر التغييرية. وأخيراً، إعداد استبيان لتقييم تصور المالكين والاستشاريين والمقاولين حول العوامل المسببة للأوامر التغييرية، تأثير الأوامر التغييرية، والاستراتيجيات الموصى بها للتقليل منها في المشاريع الإنشائية في قطاع غزة.

النتائج وإلى أي مدى تم تحقيق الأهداف: أكثر العوامل تسبباً في حدوث الأوامر التغييرية هي: القيود إسرائيلية وإغلاق المعابر والحصار، التناقضات بين وثائق العقد، المشاكل السياسية الداخلية، تغيير في مواصفات من قبل المالك، والقيود المفروضة على ميزانية المشروع. وبالإضافة إلى ذلك، فإن العوامل الأكثر تأثيراً على الأوامر التغييرية هي: التأخير في الجدول الزمني، زيادة في مدة الأنشطة الفردية، التأخر في الدفعات للمقاول، وقف العمل في أنشطة أخرى، النزاع بين أطراف المشروع، وزيادة في تكلفة المشروع.

الخلاصة: أستنتج أن هناك بعض أوجه التشابه والاختلاف بين البيانات الحقيقية من الدراسة المكتبية والمقابلات مقارنة بنتيجة الاستبيان. وتعزى الاختلافات بين الدراسة والبيانات الحقيقية إلى أن المشاريع المكتملة لها طابع خاص حيث واجهت هذه المشاريع عقبات عدة مثل الإغلاق والحصار الخانق بعد الحرب الإسرائيلية على قطاع غزة عام 2014. لا ننسى أن المقابلات شملت تصور المقاولين (مدراء المشاريع المختارة في الدراسة المكتبية) في حين أن نتائج الاستبيان شملت تصور المالك والاستشاري والمقاولين.

كلمات مفتاحية: الأوامر التغييرية، قطاع غزة، المشاريع الإنشائية، مالك المشروع، الاستشاري، المقاول.

Dedication

Firstly, this research is lovingly dedicated to my beloved Father and my beloved Mother who have been my constant source of inspiration. They have given me the drive and discipline to tackle any difficulty in this life with enthusiasm and determination. Without their prayers, endless love, encouragement and support, this work would not have been made possible. Their constant love has sustained me throughout my life. Thank you for giving me a chance to prove and improve myself through all my walks of life.

And without a doubt, I dedicate this thesis to my beloved brothers, sisters, uncles, aunts, cousins and best friends as well as the entire special people who have supported me throughout the process to make this thesis real. Their love, prayers, and encouragement have had a great impact to give me the power to achieve this work.

I also dedicate my work to myself because I have kept trying to learn new things as well as I have been keen on fidelity and accuracy in achieving my thesis

Samia Rasmy Nassar

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List of Abbreviations

A/E	Architect/Engineer
AGC	The Associated General Contractors of America
AIA	The American Institute of Architects
ANOVA	Analysis of variance
BOQ	Bill of Quantities
CM@R	Construction management at risk
DABs	Dispute Adjudication Boards
DB	Design-Build
DBB	Design-Bid-Build
DBIA	The Design Build Institution of America
DF	Degree of freedom
FIDIC	The International Federation of Consulting Engineers
GEDCO	Gaza Electricity Distribution Corporation
JBCC	The Joint Building Contracts Committee
KACC	Kenya Anti Corruption Commission
PCU	Palestinian Contractors Union
PPOA	Public Procurement Oversight Authority
PT	Palestinian territories
RII	Relative Importance Index
SD	Standard deviation
SPSS	Statistical Package for Social Science
VO	Variation Orders

Chapter 1

Introduction

Chapter 1

Introduction

This chapter presents a general introduction to the research providing a background about the variation orders (VOs) in the construction projects in general and especially in Gaza Strip. In addition, it provides a problem statement, aim and objectives, research questions and hypotheses, justification of the study, scope and limitations, assumptions, key concepts, ethical considerations, research methodology and the structure of the thesis.

1.1 Background

Construction projects are long process having more complicated small tasks and different stakeholder's involvement that make them complex. For completion of large construction projects, we have to complete small construction tasks in a regular manner. However, sometimes unfortunate conditions affect the flow of construction activity. The VO is one of them that disturb the flow of construction process that may result in the delay in the construction project. The VOs involve alteration, addition, omission, and substitution in terms of quality, quantity, and schedule of work (Enshassi, Arain, & Al-Raee, 2010).

Needs of the client may change the course of design or construction, market conditions may impose changes to the parameters of the project, and technological developments may alter the design and the choice of the engineer. The engineer's review of the design may bring about changes to improve or optimize the design and hence the operation of the project. Further, errors and omissions in engineering or construction may force a change (Al-Dubaisi, 2000). All these factors and many others necessitate changes that are costly and generally disliked by all parties. The VOs have an impact on overall project performance (Ndihokubwayo, 2008). This is because variations can cause substantial adjustment to the contract duration, total direct and indirect cost, or both.

As the number of VOs on the project increases so does, the possibility of misunderstanding among the contracting parties. Such a misunderstanding may occur because one or more of the parties lack full knowledge of the VOs process itself, the

costs involved in implementing changes, or the delays, conflicts, and interruption of the construction sequence and schedule which can undesirably impact project coordination. For the time being, little attention has been directed at flow activities this leading to uncertain flow processes, expansion of non-value-adding activities associated with the variations during the construction stage. According to Wu, Low, and Jin (2013), the Non-value-adding activity is an activity that produces costs, direct or indirect, and take time, resources or require storage but do not add value or progress to the project. In general, non-value-adding activities are known as waste. The desire to reduce non-value-adding activities on construction projects emanated from the recognition of the need to reduce waste and the resultant optimization of the use of resources (Ndihokubwayo & Haupt, 2009).

It is relatively difficult to deliver a project without any VOs during the design stage, or even the construction stage. Therefore, the management of the variation is skill; in what manner we manage that change without affecting our goal. Managing change is the greatest importance to the success of construction project (Jadhav & Bhirud, 2015). Previous studies on the VOs are mainly focused on the sources and causes of the VOs. The sources of the variations include the performance of construction parties, resources availability, environmental conditions, the involvement of other parties, and contractual relation. Many times delays, cost overrun and quality defects of a construction can be attributed to variation at various stages of the project (Burati, Farrington, & Ledbetter, 1992). Variations and conflicts in construction projects, at work, and even in our daily lives are very common (Arain & Pheng, 2006).

In Gaza Strip where new infrastructure and buildings are being built, the occurrence of the VOs on the construction projects seems usual. Most construction projects in Gaza Strip were delayed with a certain amount of the VOs increasing from the original value of the contract sum. Due to the general background of the problem in the construction industry, there is a cause for a study to be made on the VOs management, assessment of the impact of the VOs on the construction projects performance and recommendation of the strategies to minimize it in Gaza Strip.

1.2 Problem Statement

Nowadays construction of new projects is becoming an essential demand to improve the condition of the Palestinian. The needs to construct new schools, health centers, shelters, housing units and others are becoming a key driver to continue development and enhancement for all parties operating in the construction projects including clients, consultants, contractors, subcontractors, and other stakeholders. The construction project has been described as complicated and uncertain in nature, as each construction project has its own unique circumstances and conditions. The complexity of construction projects means that it is hardly possible to deliver a project without any change in its lifecycle, that is, every construction project is unique in many respects, but the liability to change is an attribute that generally characterizes almost all project. Charoenngam, Coquinco, & Hadikusumo (2003) described the VO as a complex information transfer that need to be managed carefully, otherwise, disputes between a client and a contractor related to cost and time of the work might occur. Charoenngam et al. (2003) also stated that the VO is complex because it involves all the construction team, together with a voluminous amount of information that either has to be sent, checked, corrected, approved, requested, clarified, transmitted or submitted, among many other things.

One of the main challenges that may face clients who operate in the construction field is the frequent occurrence of the VOs. The VOs issued during construction of the project are considered one of the most significant sources of delay, disputes and sometimes generate significant cost and environmental impacts. The VOs on construction projects have the potential to unnecessarily increase the cost of construction without adding value to the project in which case they may be regarded as waste. Waste of time, cost, and resources. Yet, no unique method is available for minimizing the VOs effectively. However, their impact can be minimized with an appropriate study about the causes. Therefore, the identification of their causes might lead to their reduction, possible elimination and subsequent improvement in overall project performance in the time that the change management is not fully understood and not well applied in Palestinian construction industry as

the risk and uncertainties associated with project changes make predictions and planning for changes a difficult task.

1.3 Research aim and objectives

The aim of this research is to study the management of the VOs: Impacts and Minimization.

To achieve the aim of this research many objectives exist, these objectives can be summarized as below:

1. To investigate the prevalence of the VOs on construction projects.
2. To assess the current practices of the VOs management in Gaza Strip.
3. To investigate the non-value adding activities associated with the variations during the construction stage.
4. To identify the predominant origin agent as well as the direct causes of the VOs.
5. To identify the impact of the VOs on overall project performance.
6. To recommend strategies to minimize the VOs.

1.4 Research Questions

The following research questions pertain to the construction project in Gaza Strip. The overall purpose of this research is to minimize the impact of the VOs on construction projects, thereby increasing the effectiveness of the project. Thus, formulating and answering the following research questions could define the overall purpose:

1. Do the VOs prevail on the construction project?
2. What are the current practices of the VOs management?
3. What are the non-value-adding activities associated with the variations during the construction stage?
4. Who is the predominant origin agent and what are the causes of the VOs?
5. What is the impact of the VOs on overall project performance?
6. How can we reduce the level of changes in construction projects?

1.5 Research hypotheses

The following five hypotheses were established in this study.

H1. There is a significant difference among the respondents, statistically at sα ≤ 0.05, toward impacts and minimization of the VOs in Gaza Strip due to general information and the information of the project that the respondents managed.

H2. There is a significant effect of the prevalence of the VOs, statistically at α ≤ 0.05, on impacts and minimization of the VOs in Gaza Strip.

H3. There is a significant effect of the current practices of the VOs management, statistically at α ≤ 0.05, on impacts and minimization of the VOs in Gaza Strip.

H4. There is a significant effect of non-value adding activities associated with the variations during the construction stage, statistically at α ≤ 0.05, on impacts and minimization of the VOs in Gaza Strip.

H5. There is a significant effect of the origin agent of the VOs and factors causing it, statistically at α ≤ 0.05, on impacts and minimization of the VOs in Gaza Strip.

1.6 Justification of the study

During the lifecycle of the construction projects in Gaza Strip, most of clients and consultants are striving to obtain the ideal projects with a minimum margin of conflict, minimum cost and time overrun and with maximum value added over each stage in the construction project life cycle. One of the real challenges that face clients, contractors and other parties operating in construction projects is how to manage and mitigate the negative impact of the consecutive VOs. Sun and Meng (2009) argued that the VOs result in time and cost overrun, quality defects and other negative impacts. Since the VOs can have numerous negative impacts to projects cost and schedule, it will be important to identify the major causes those contribute to the VOs and to study the impacts of the VOs and possible strategies to minimize them during the implementation of the construction projects.

The study will be supportive for the construction project stakeholders to increase the awareness of a clearer view of the causes of the VOs, which enable the project team to understand the root causes. This will contribute towards the better control of the VOs and enable the professionals to take advantage of beneficial

variations when the opportunity arises without an inordinate fear of the negative impacts. Furthermore, because variations are common in all types of the construction projects, this study will contribute to the effective management of the VOs as these findings can be used by professionals to understand the causes and impact of the VOs and take proactive measures to reduce and control them in the construction projects.

1.7 Scope and Limitations

The scope and limitations of the study as follows:

1. The research was conducted only on a population who is living in Gaza strip in Palestine. Because of the geographical limit, it was hard to think about a sample from the same population in West Bank.
2. The research survey was limited to Gaza strip contracting companies that are classified under a first and second class which have a valid registration in Palestinian Contractor Union (PCU) and high-experienced clients and consultants.
3. This study was limited to the construction project practitioners in Gaza Strip in the last five years.

1.8 Assumptions

There were several assumptions established in this study as follows:

- Construction projects in Gaza Strip adopt the traditional design bid and build procurement system where construction risks are almost equally shared between the client and contractor also, the consultant is the client's agent.
- Proposed participant companies for case studies will cooperate and allow access to their documentation records as required by the study.
- Records from the projects documentation regarding the VOs will be accurate and participants will be honest in providing correct information.

1.9 Key concepts

- **VO:** is any modification to the contractual guidance provided to the contractor by the client or client's representative (Msallam, Abojaradeh, Jrew, & Zaki, 2015).

- **Non-value-adding activity:** is an activity that produces costs, direct or indirect, and take time, resources or require storage but do not add value or progress to the project (Wu, Low, & Jin, 2013).
- **Value-adding activity:** An activity is value-added if it is judged to contribute to customer value or satisfy an organizational need (Tsai, 1998).

1.10 Ethical Considerations

Precautions were taken to ensure that the study was carried out in an ethical manner. First and foremost the study was carried out with the full consent of the board of postgraduate studies of the Islamic University of Gaza.

Secondly, the study ensured that the participant's anonymity and confidentiality were preserved by not requesting for information that would reveal their identity. Moreover, the information provided was used for academic purposes only.

Last but not least, the study encouraged voluntary participation and respondents were not coerced or enticed to participate in the study.

1.11 Research Methodology

The objectives of this research will be achieved as follows:

First Stage: Problem identification. It includes defining the problem, demonstrates the aim and objectives, research questions and hypotheses. In addition, promote a research approach and a suitable technique.

Second Stage: Literature Review. Literature and previous studies related to the area of research will be extensively reviewed.

Third Stage: Desk Study. An initial desk study will be done on six construction projects to identify the causes, and impacts of the VOs in construction projects and strategies to minimize it. The findings of this study will provide the basis for the research design of the main study.

Fourth Stage: Interviews with the projects' managers of the selected construction projects

Fifth Stage: Questionnaire

Sixth Stage: Results and discussions. Gathered data will be analyzed using appropriate statistical analysis tools. Both quantitative and qualitative methods will be used. Hypotheses will be tested and the findings will be summarized

Seventh Stage: Conclusions and recommendations. Conclusions will be drawn from the analyzed data and recommendations for improvement and future study will be formulated.

Eighth Stage: Documentation**.** It includes formatting, editing the final text and spelling and grammatical review.

1.12 Thesis structure

This research was organized into the following six chapters:

- **Chapter 1: Introduction**

This chapter presents a general introduction to the subject of the thesis. It comprised the background of the study, problem statement, aim, objectives, and hypotheses, justification and limitations of the study, assumptions, key concepts, ethical considerations, research methodology and structure of the research.

- **Chapter 2: Literature review**

This chapter presents an extensive literature about the VOs and related studies to non-value-adding activities and waste associated with the VOs. The origin agent, causes and impact of the VOs on the projects performance and strategies to minimize it will be discussed.

- **Chapter 3: Methodology**

This chapter discusses the tools and methods used for data collection.

- **Chapter 4: Data Analysis and Discussion:**

This chapter constitutes the analysis of data gathered with the research instruments. It analyzes data from the desk study, interviews and the questionnaire.

- **Chapter 5: Conclusions and Recommendations**

This chapter states the conclusions and recommendations drawn based upon data analysis, linking them to the problem statement, hypotheses, and objectives of the subject under investigation. It also includes the recommendation for future studies.

Generally, the research was written following a certain structure. Though step order may vary depending on the subject matter and researcher, the steps outlined in Figure (1.1).

- **Chapter summary**

This chapter outlined the framework of the entire research study. The preliminary literature review focused on the background. Subsequently, a problem statement was formulated. The aim of the study was to study the management of the VOs, their impact on the construction projects in Gaza Strip and recommendations of strategies to minimize it. Justification, limitations, and assumptions of the study were mentioned. Key concepts included non-value-adding activities, value-adding activities, and the VOs. The research data gathering complied with internationally accepted ethical standards. The research methodology discussed the tools and methods used for data collection. The thesis structure provided an overview set up of each chapter of the study.

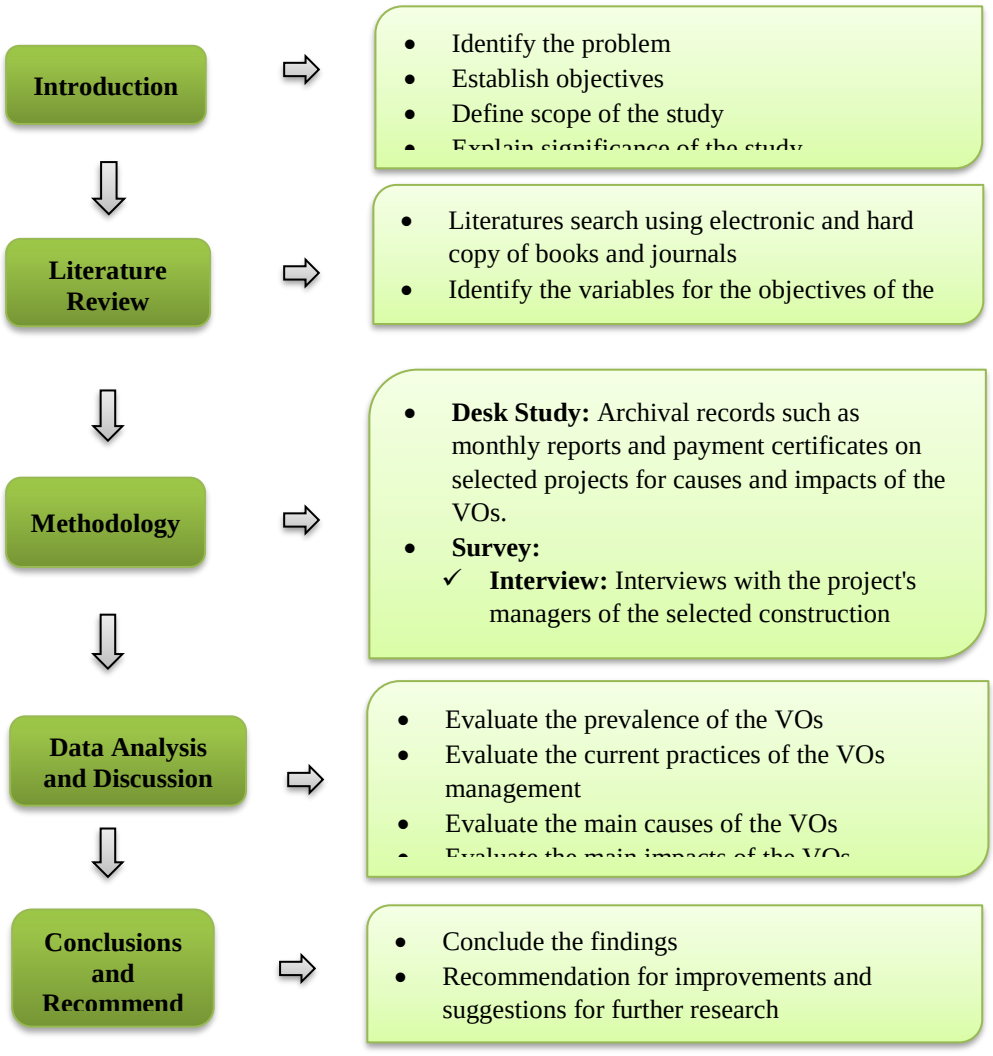

Figure (1.1): Structure of the research

Chapter 2

Literature review

Chapter 2

Literature review

This chapter discusses the literature review that has been aimed to establish an understanding of the concept of the VOs with emphasis on the existence of the non-value-adding activities associated with the VOs. It covers the VOs definition, VOs types, the prevalence of the VOs on the construction projects, contractual provisions relative to the VOs, VOs and project delivery systems, management of the VOs, origin agents of the VOs, causes of the VOs, factors influencing the occurrence of the VOs, impacts of the VOs and waste associated with the VOs. The sources have mainly been refereed academic research journals, dissertation/theses, publications, conferences, and websites.

2.1 Introduction

The construction project is a mission, undertaken to create a unique facility, product or service within the specified scope, quality, time and cost (Yadeta, 2014). It includes a multitude of professions, occupations, and organizations. The processes embrace design and production information documentation, financial and legal considerations, an interaction of expertise, contracts procurement, and site operations (Eigbe, 2016). Construction project works are often subject to variability of soil, site and weather conditions. These phenomena make construction projects prone to variations to the construction plans: designs, drawings, quantities, and specifications for a project earmarked for a specific site. These changes occur after the award of the initial contract or after work might have commenced at the construction sites (Ismail, Pourrostam, Soleymanzadeh, & Ghouyounchizad, 2012). Variations are one of the most important problems in the construction project. They occur in every construction project and the magnitude of these variations varies considerably from project to project. Hence, the VOs bear great importance right from the inception to completion in the construction project.

Several researchers (Staiti, Othman, & Jaaron, 2016; Hanif, Bilal Khurshid, Munch Lindhard, & Aslam, 2016; Smith, 2016; Yadeta, 2016; Assbeihat & Sweis, 2015) reported that variations are inevitable in any construction projects. Alsuliman,

Bowles, & Chen (2012) noted that every construction project is unique in many respects, but the liability to change is an attribute that generally characterizes almost all projects. This led Ubani, Nwachukwu, & Nwokonkwo (2010) to claim that change is "a fact of life" for a construction project. Nothing is more constant than variation during the course of a construction project (Kudus, 2005). Despite the best efforts of all concerned during the planning, implementation, and administration of the contract, variation will almost certainly occur. The variations and the VOs can be detrimental in any project, if not considered collectively by all participants (Arain & Pheng, 2005).

Variations in construction projects are very common and likely to occur from different sources, by various causes, at any stage of a project, and may have considerable negative impacts on items such as costs and schedule delays (Hao, Shen, Neelamkavil, & Thomas, 2008). According to Hao et al. (2008), a critical variation may cause consecutive delays in the project schedule, re-estimation of work statement, and extra demands of equipment, materials, labor, and over time. Variations, if not resolved through a formalized variation management process, can become the major source of contract disputes, which is a severe risk contributing to project failure.

2.2 Definition of the Variation

There is no particular definition of what constitutes a variation. The term “variation” as described and defined by various standard forms of contract differs from one to another but in principle the definition and meaning are similar. Generally, any standard form of building contract will contain a definition of a variation in terms of specific actions and activities (Mohammad, Ani, Rakmat, & Yusof, 2010). Ibrahim (2006) described that each standard form of building contract has its own definition but clearly, variation, in a generic sense, refers to any alteration to the basis upon which the contract was let. This means the term embraces not only variations to the work or matters pertaining to the work in accordance with the provisions of the contract but also variations to the contract conditions themselves.

According to the International Federation of Consulting Engineers (FIDIC, 1999), variation means any change to the works, which is instructed or approved as a variation. As defined in Public Procurement Act. (PPA, 2006), variation is an instruction given by the engineer, which varies the works.

Variation can be taken to be any a combination of the following:

1. Variation in the construction projects may mean the alteration or modification of the design, quality or quantity of the works, as shown in the contract drawings and described by or referred to in the contract bills, and includes the addition, omission or substitution of any work, the alteration of the kind or standard of any of the materials as goods to be used in the works, and the removal from the site of any work materials or goods executed or brought thereon by the contractor for the purposes of the works other than work or material or goods which are not in accordance with the contract (Harbans & Kandan, 2005; Ibrahim, 2006; Mohammad et al., 2010)
2. Variations in the construction projects with instructions concerning the nature of the works that are not specifically termed as variation in the contract documents (Ibrahim, 2006).
3. Variation of contract in law, i.e. if both parties alter a contract document by agreement after execution of the original contract this is a variation of the contract terms or conditions (Ibrahim, 2006).
4. Variation of price clause which enables the contract sum to be adjusted for rises and falls in the cost of labor or materials (Ibrahim, 2006).

Keane, Sertyesilisik, & Ross (2010) and Karthick, Malathi, & Umarani (2015) stated that variations can emerge due to change of scope. In contrast, Kudus (2005) mentioned that VOs do not change the scope of work; actually, the requirement of the VO must be within the original scope of work. The VO directives issued by the client to change the contract by adding or subtracting features within the scope of the work. Changes that are outside the scope of work requires a supplementary agreement. The VOs change the details or conditions of the work and they are used to add extra or delete work.

Clearly, in construction terms, variability is referred to as VO (Ndihokubwayo, 2008). Arain and Pheng (2005) pointed out that the VO is a formal document that is used to modify the original contractual agreement provided to the contractor by the client or the client's representative and becomes part of the project's documents and Halwatura and Ranasinghe (2013) pointed out that the VO is an official document that states the changes made in the original agreement between the client and the contractor. Charoenngam et al. (2003) mentioned that the VO has several characteristics: a) it is a written document covering authorization of the requested change, b) the change is brought about through no fault of the contractor, and c) the changed work is not included in the original contract and therefore it is not included in the contract price.

2.3 Types of the Variations and VOs

2.3.1 Type of the VOs by referring to both the reasons for their occurrence and subsequent effect.

Several researcher (Arain & Pheng, 2005; Ogunsanmi, 2013; Ibbs, Wong, & Kwak, 2001) distinguished two types of VOs, namely: beneficial and detrimental VOs.

2.3.1.1 Beneficial VOs

A beneficial VO is one issued to improve the quality standard, reduce cost, schedule, or degree of difficulty in a project. It is a VO initiated for value analysis purposes to realize a balance between the cost, functionality and durability aspects of a project to the satisfaction of clients by eliminating unnecessary cost from the project. A beneficial VO eliminates unnecessary costs from a project and as a result, it optimizes the client's benefits against the resource input by eliminating unnecessary costs. However, it should be noted that regardless of how beneficial a VO might be, non-value-adding costs are likely to accrue as a result. For example, Ndihokubwayo and Haupt (2008) stated that a VO to solve the discrepancies between contract documents involves the abortion of works that have already been executed. The cost for aborted works should not have been incurred if discrepancies were not found between contract documents.

Ndihokubwayo and Haupt (2009) investigated the nature of the VOs in building construction projects in South Africa using questionnaire survey. Their study found that 95% of VOs issued were beneficial to the project's performance. Apparently, Ndihokubwayo and Haupt (2009) also stated that there was no VO issued that negatively affected the quality of the end product.

2.3.1.2 Detrimental VOs

A detrimental VO is one that negatively affects the client's value or project performance. A detrimental VO compromises the client's value system. A client who is experiencing financial problems may require the substitution of quality standard expensive materials to sub-standard cheap materials. For example, Ndihokubwayo and Haupt (2008) stated that a construction project situated in a salty environment, steel window frames result in steel oxidation if selected in lieu of timber, aluminum or PVC frames.

2.3.2 Type of the VOs by referring to procedures introducing them

Cox (1997) identified three kinds of VOs:

2.3.2.1 A formal VO

According to Cox (1997), a formal VO is an actual document called ‘Vriation order’ issued by a client which modifies the contract terms, plans or specifications. Charoenngam et al. (2003) identified the formal VOs are those that originate from either the client or client's representative in the presence of the architect/engineer (A/E). It can be described as a directive issued by the client to conduct changes in the scope of work.

Osman, Omran, & Foo (2009) mentioned that the directed change occurs when the client directs the contractor to perform works that are different from the specified in the contract or an addition to the original scope of work. A directed change can also be deductive in nature, that is, it may reduce the scope of work called for in the contract. Disagreements tend to center on questions of financial compensation and the effect of the change on the construction schedule for directed changes.

2.3.2.2 A constructive VO

A constructive change is an informal act authorizing or directing a modification to the contract caused by an act or failure to act. In contrast to the mutually recognized need for change, certain acts or failure to act by the client that increases the contractor's cost and/or time of performance may also be considered grounds for a VO. This is termed as a constructive change and must be claimed in writing by the contractor within the time specified in the contract documents in order to be considered (Osman et al., 2009).

According to Cox (1997), a constructive VO is an extra contract work performed pursuant either to oral or implied client directives or as a result of problems for which the client is responsible such as inaccurate or incomplete contract documents. Bu-Bshait and Manzanera (1990) stated that the constructive VOs originate from either the contractor or subcontractor. The contractor files a constructive change when the authorized representative gives or fails to give directions that interfere with the normal contract development and has such an effect as if a formal change has been issued. Bu-Bshait and Manzanera (1990) also added that constructive changes are sometimes found after the fact when reviewing schedules, records, letters or minutes of meetings. This does not negate the contractor's right to a claim. Contractors are advised to train their construction teams to recognize constructive changes since this can make the difference between a profit and a loss situation.

2.3.2.3 A cardinal VO

According to Cox (1997), a cardinal VO occurs whenever there is a substantial amount of work required outside the scope of the original contract. According to Ayalew (2009), Cardinal change is a change which is out of the scope of the contract and they are executed after the complete redefinition of the scope and re-negotiation of the contract. Because of this, this type of change is called “scope” change. This may not necessarily be a single change it can be the result of a number of changes that have a net effect of modifying the original scope. Al-Hams (2010) indicated that the change of plans or scope by

the client is considered as a cardinal change though; it is dealt with in the Gaza Strip as a constructive change.

2.3.3 Type of the VOs by referring to the time

The research team Sun et al. (2004) reported that project variations can be classified as “anticipated variations” and “emergent variation”.

Anticipated variations are planned in advance and occur as intended whereas emergent variations arise spontaneously and are not originally anticipated or intended.

2.3.4 Type of the VOs by referring to its necessity

In this way, Sun et al. (2004) classified project variations as “elective variations” and “required variations”.

Elective changes are those that are proposed to enhance the project but are not required to meet the original project objectives. Therefore, elective changes may or may not be implemented. This type of change is not mandated whereas the required variation must be implemented, and typically include those changes that are necessary to meet:

- The basic, defined venture/business objectives;
- Regulatory or legal requirements; and/or
- Defined safety and engineering standards.

2.3.5 Type of the VOs by referring to phases in the construction projects

With this basis, Burati et al. (1992) classified changes based on major phases in construction projects as; Design, Construction, Fabrication, Transportation and Operability

2.3.5.1 Design Phase

Mendelsohn (1997) observed that probably 75% of the problems encountered on the site was generated at the design phase. This is not to say that contractors do not create a slew of problems of their own but that these problems were often compounded by inherent design flaws. If one were to seriously consider ways to reduce problems on the site, an obvious place to

begin is to focus on what the project team can do to eliminate these problems at the design phase.

According to Burati et al. (1992), the causes or the circumstances under which the VOs could be initiated at design phase:

1. Design change/improvement includes only design revisions, modifications, and improvements initiated through the design process. Examples of this, the changes that are the result of design reviews, model reviews, and technological advances.
2. Design change/construction: changes in design made at the request of the field or construction personnel. An example of this, the addition of concrete pads to permit proper installation of equipment.
3. Design change/field: design changes due to field conditions in retrofit and upgrade projects. An example of this is when the existing structure, equipment, or pipe location differs from the details given on available drawings, and the deviation could not have been foreseen by the designer.
4. Design Change/Client is design changes in the project design initiated by the client. Examples of this, a change in project scope or additional electrical outlets in an office.
5. Design Change/Process is design changes in the process portion of the facility initiated by an client's representative or consultant familiar with the expected operations and processes to be fulfilled by the facility. An example of this, the addition of valves, pumps, electrical equipment, or instrumentation that affect the operation of the completed facility.
6. Design Change/Fabrication: is design changes initiated or requested by the fabricator or supplier. An example of this, a fabricator request for a change in vessel dimensions
7. Design Change/Unknown is design changes for which the description does not yield enough information regarding the reason or source of change, and discussion with the project representative affords no insight. An example of this, a change with a description such as "structural steel design change." While this change may have been an improvement in

design or the result of a model review, it may also have been a redesign due to an error.

Burati et al. (1992) and Love and Sohal (2003) also added to the causes or the circumstances under which the VOs could be initiated at design phase:

1. Design errors result of mistakes or errors made in the project design
2. Design omissions: result when a necessary item or component is omitted from the design.

2.3.5.2 Construction Phase

According to Burati et al. (1992) and Love and Sohal (2003), the causes or the circumstances under which the VOs could be initiated at construction phase:

1. Construction change: a change in method of construction in order to improve constructability or due to site conditions. For example, placing concrete by pump rather than by bucket. Change may be made by the client, the consultant or the occupier after some work has been performed on site. Change may be made if the process or product needs to be altered/rectified or if there is a need to improve quality.
2. Construction error is the result of erroneous construction methods procedures.
3. Construction omission is those activities that occur due to the omission of some activities during the construction.

2.3.5.3 Fabrication Phase

According to Burati et al. (1992), the causes or the circumstances under which the VOs could be initiated at fabrication phase:

1. Fabrication Change: A change made in or during fabrication
2. Fabrication Error: Fabricated parts that are not in accordance with the specifications
3. Fabrication Omission: Parts or pieces that are included in the specifications but are not supplied.
4.

2.3.5.4 Transportation

According to Burati et al. (1992), the causes or the circumstances under which the VOs could be initiated at transportation phase:

1. A transportation change: indicates a change in the method of shipment, e.g., shipping by air to expedite delivery rather than shipping by truck.
2. Transportation errors: denote errors made in transporting a product, e.g., shipping an article in separate pieces when the specifications require the shipment of an assembled product.
3. Transportation omissions occur when a required part or item is not included in the appropriate shipment.

2.3.5.5 Operability

According to Burati et al. (1992), the causes or the circumstances under which the VOs could be initiated at operability phase:

1. Operations change: changes made in the operation or process portion of the facility. For example, the use of two pumps instead of one, or the addition of check valves in a required line; while an operability improvement might be relocating valve handles to improve operator access.
2. There is no need for error or omission categories for operability since errors and omissions in operability are the result of an error or omission made in design, fabrication, or construction.

2.3.6 Type of the VOs by referring to the identity of the initiators

Arain and Pheng (2006) classified changes based on their initiator or originators as follows: Client related, Consultant related, Contractor related, and Others or miscellaneous, which consists of a cause that cannot be categorized under client, contractor, and consultant.

With this general idea, Classification basis is summarized in Table (2.1).

Table (2.1): Classification of the variations

No.	Classification basis	Types
1	**Reasons for their occurrence and subsequent effect**	• Beneficial • Detrimental
2	**Procedures Introducing them**	• Formal or direct variation • Constructive variation • Cardinal variation
3	**Time**	• Anticipated • Emergent
4	**Necessity**	• Elective • Required
5	**Phase**	• Design • Construction • Fabrication • Transportation or operability
6	**Initiator**	• Client • Contractor • Consultant • Miscellaneous

2.4 Prevalence of the VOs on the construction projects

A construction contract is a business agreement that is subject to variability. Contractual clauses relating to changes allow parties involved in the contract to freely initiate VOs within the ambit of the scope of the works without alteration of the original contract (Ndihokubwayo & Haupt, 2008). Without contractual clauses, the building contractor would have to agree to erect the building shown on the drawings and represented in the bills for a contract sum. Any minor change that the client or his/her architect wished to make later would mean that the contract had to be canceled and a new one was drawn. Once a contract has been concluded, its terms cannot be changed unless the contract itself contains provisions for variation and then the only permitted variations are those that fall clearly within the contractual terms.

A clause permitting variation of works is an essential feature of any construction contract because without it the contractor is not bound to execute additional work or to make omissions or changes (Ndihokubwayo & Haupt, 2009). Ssegawa, Mfolwe, Makuke, and Kutua (2002) asserted that the presence of the variation clauses in contracts amounts to admitting that no project can be completed

without changes. Even if carefully planned, it is likely that there will be changes to the scope of the contract as the work progresses.

Under contractual provisions, the client has the right to vary the extent and nature of the performance to be rendered by the contractor. Furthermore, the contractor could not refuse to carry out the varied obligation with the only remedy being an adjustment of price to be paid for the performance, and in appropriate circumstances, an extension of time in which to execute such performance. Ndihokubwayo and Haupt (2008) argued that the spirit in which the VOs are permitted allows the contract to proceed without compiling another contract to cater for the changes.

The nature and frequency of variations occurrence vary from one project to another (Memon, Rahman, & Memon, 2014). In general, construction project includes many stages from planning, architectural drawing, engineering designs, cost estimation, bidding, contracting to the actual implementation of the project. During these phases, many decisions have to be made based on incomplete information, assumptions and personal experience of construction professionals (Staiti et al., 2016). Arain (2005) identified the design phase as the most likely area on which to focus to reduce the variations in future institutional projects. If one were to seriously consider ways to reduce problems on the site, an obvious place, to begin with, is to focus on what the project team can do to eliminate these problems at the design phase. In addition, Oloo (2015) explained that construction plans exist in form of designs, drawings, quantities, and specifications earmarked for a specific construction site and it is hardly possible to complete a project without changes to the plans or the construction process itself due to the complexity of construction activities.

Staiti et al. (2016) mentioned that whatever the scope of projects, the size of construction processes may vary significantly, they tend to have one common element which is "a change".

Arguably, VOs cannot be avoided completely (Halwatura & Ranasinghe, 2013). Hence, various authors (Arain, 2005; Oladapo, 2007; Yadeta, 2014; Yadeta, 2016; Staiti et al., 2016; Eigbe, 2016) stated that the VOs very common and likely to

occur at any stage of construction. Variations are, regardless of source, undesirable but remain common in all types of construction projects (Hanif et al., 2016).

2.5 Contractual provisions relative to VOs

In the most form of contract used today for construction work, provision must be made for possible variations. At the same time when tenders are issued, the employer and his architect and engineer should have crystallized all their ideas into a set of contract documents (Yunus, 2007).

2.5.1 Classification of site or contract instructions

The Joint Building Contracts Committee (JBCC, 2007) defined a site instruction as a written instruction which may include drawings and other construction information signed and issued by or under the authority of the principal agent (The principal agent who is appointed by the employer with full authority and obligation to act in terms of the agreement) to the contractor. However, not all instructions vary the contractual arrangements or the way the works are being undertaken. Consequently, some contract instructions may be considered as VOs while others are not. Clause (17) of the Principal Building Agreement issued by JBCC (2007) discusses the contract instructions. With reference to this clause, there are five categories of contract instructions:

2.5.1.1 Instructions to vary the works

Clause (17.1.1) permits the principal agent to initiate variations regarding alteration to design, quality or quantity of the works provided that such contract instructions do not substantially change the scope of the works. It is unclear how substantial a change must be to substantially change the scope of the works. The consultant may issue the instruction to add or omit a considerable portion of a building, but the instruction may not have the effect of changing the building from one type to another such as, for example, from a hospital to an office building.

2.5.1.2 Instructions to resolve discrepancies

Clause (17.1.2) allows the principal agent to issue instructions in terms of rectification of discrepancies, errors in description or omissions in contract documents.

2.5.1.3 Instructions to enforce contractual provisions

Ndihokubwayo (2008) stated that these instructions enforce the contractual conditions. However, these instructions may be considered as VOs where they were not part of the original contract as mentioned under clause (17.1.3) to clause (17.1.8) and clause (17.1.18) to clause (17.1.20) as follows.

1. Removal of any materials and goods from the site and the substitution of any other materials;
2. Removal or re-execution of any work;
3. Opening up work for inspection;
4. Testing of samples of materials and goods, specimens of finishes and assemblies of elements of the works;
5. Protection of the works;
6. Making good physical loss and repairing damage to the works;
7. The list for practical completion, works completion, final completion, and defects;
8. Compliance with laws, regulations, and bylaws; and
9. Access for previous contractors and subcontractors to remedy defective works.

2.5.1.4 Instructions to deal with the monetary allowance

Ndihokubwayo (2008) stated that the instructions dealing with monetary allowance do not alter the contractual arrangements. They give authority to the principal agent to indicate how to spend money budgeted under prime cost amounts for nominated subcontractors and suppliers. However, such instructions become VOs if, for example, an adjustment made to the prime cost sum for materials supplied by a nominated supplier where the original quality is changed such as the supply of clay bricks instead of cement bricks.

These instructions mentioned under clause (17.1.11) to clause (17.1.16) as follows:

1. The appointment of nominated and selected subcontractors, the nominated and selected subcontract amounts and the work to be executed.
2. Proof of payment to nominated and selected subcontractors;
3. Notice to subcontractors;
4. Prime cost amounts and the purchase of materials and goods covered;
5. Budgetary allowances and work executed by the contractor; and
6. Contingency and other monetary provisions included in the contract sum.

2.5.1.5 Instructions to protect the client's interest

Ndihokubwayo (2008) stated that these instructions do not change the original contract agreement, but they are targeted employees residing in a site camp. They prevent employees from becoming involved with illegal activities or members of their families to squat on camp. These include:

1. Removal from the site of any person employed on site; and
2. Removal from the site of any person not engaged on or not connected with the works.

It is clear that all contract instructions are not VOs as indicated in Table (2.2). The instruction to vary the design, quality, and quantity of the works and to resolve discrepancies in contract documents are VOs. To some extent, the instructions to enforce the contractual provisions are not VOs. However, they become VOs when they are incidental to the two previous ones or they were omitted in the original contract. The instruction dealing with the monetary allowance is considered as a VO in extreme cases when the monetary adjustments result from the two first kinds of contract instructions. The instructions to protect the client's interest are not VOs because they do not change the original contractual agreement.

Table (2.2): Classification of contract instructions

No	Instruction category	Classification
1	**To vary the design, quality or quantity of the works**	VO
2	**To resolve discrepancies**	VO
3	**To enforce contractual provisions**	In some cases, it may be a VO if incidental to instruction number 1 or 2, or omitted in the original contract.
4	**To deal with monetary allowance**	It may be a VO if monetary adjustments are the result of instruction number 1 and 2
5	**To protect the client's interest**	Not a VO

2.5.2 Conditions of Contract

A form of contract is a legally binding agreement between the parties identified in the agreement to fulfill all the terms and conditions outlined in the agreement. Zakaria, Ismail, and Yusof (2012) said that a prerequisite requirement for the execution of a contract, amongst other things, is the condition that all the parties to the contract accept the terms of the claimed contract. General Conditions are those written to cover conditions that will apply to all of an client's construction contracts but supplemental or special conditions modify existing conditions or add new ones to address subjects not covered. Murtaja (2007) mentioned that the primary benefit of using Standardized General Conditions is that the document has been prepared with the advice of legal counsel and experienced professionals. The articles contained in the general conditions describe the legal rights, responsibilities and contractual requirements of the client, contractor, and engineer.

Most standard forms of contract include a clause under which the employer or his representative is able to issue an instruction to the contractor to vary the works that are described in the contract. Ibbs and Ashley (1987) said that the major objectives of change clauses are control and flexibility, which are achieved by providing a contractual method for dealing with an event that is not part of the original contract. Ibrahim (2006) mentioned that standard forms usually include a mechanism for evaluating the financial effect of the variation and there is normally provision for adjusting the completion date. In the absence of such a clause, Ibrahim (2006) said that the employer could be in a difficulty if a variation to the works be

required. The contractor could either refuse to carry out the work or undertake the work or insist upon payment on a quantum merit or fair valuation basis. Calculation of the price for the extra work applying this method could involve payment in excess of the contract rates.

Several independent organizations have prepared a set of standard general conditions which take care of the contractor's as well as the client's interest (Charoenngam & Yeh, 1999). These contract conditions clearly define the duties and responsibilities of the parties involved in the contract and it describes the guidelines for contract administration.

2.5.2.1 FIDIC (1999) Conditions of Contract relative to the VOs

It is clear that having a standard form of construction contract will make this standard form applicable everywhere, regardless of the location of the site. In Palestine, the FIDIC contract is widely used as a unified formal contract for construction projects.

According to clauses relative to the VOs, The FIDIC (1999) under clause 3.3, it stipulates that the engineer (Engineer means the person appointed by the Employer to act as the Engineer for the purposes of the Contract) may issue to the contractor instructions and additional or modified drawings which may be necessary for the execution of the works and the remedying of any defects, all in accordance with the contract. As stated under clause 13.1 of FIDIC (1999), variations may be initiated by the engineer at any time prior to issuing the taking-over certificate for the works, either by an instruction or by a request for the contractor to submit a proposal and the contractor shall execute and be bound by each variation, unless the contractor promptly gives notice to the engineer stating that the contractor cannot readily obtain the goods required for the variation. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

As FIDIC (1999) stipulates, each variation may include:

1. Changes to the quantities of any item of work included in the contract (however, such changes do not necessarily constitute a variation),
2. Changes to the quality and other characteristics of any item of works,

3. Changes to the levels, positions and/or dimensions of any part of the works,
4. Omission of any work unless it is to be carried out by others,
5. Any additional work, plant, materials or services necessary for the permanent works, including any associated tests on completion, boreholes and other testing and exploratory work,
6. Changes to the sequence or timing of the execution of the works.

The FIDIC (1999), under clause 13.2 (Value Engineering) states that the contractor may, at any time, submit to the engineer a written proposal which (in the contractor's opinion) will, if adopted, (a) accelerate completion, (b) reduce the cost to the employer of executing, maintaining or operating the works, (c) improve the efficiency or value to the employer of the completed works, or (d) otherwise be of benefit to the employer.

Under clause 13.3 (Variation Procedure) of FIDIC (1999), it stipulates that if the engineer requests a proposal, prior to instructing a variation, the contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

1. A description of the proposed work to be performed and a program for its execution,
2. The contractor's proposal for any necessary modifications to the program according to the program stated and to the time for completion, and
3. The contractor's proposal for evaluation of the variation.

The engineer shall, as soon as practicable after receiving such proposal, respond with approval, disapproval or comments. The contractor shall not delay any work whilst awaiting a response. Each instruction to execute a variation, with any requirements for the recording of costs, shall be issued by the engineer to the contractor, who shall acknowledge receipt. Each variation shall be evaluated in accordance with clause 12 (Measurement and Evaluation: It states that the works shall be measured, and valued for payment) unless the engineer instructs or approves otherwise in accordance with this clause.

According to the valuation of the VOs: When the variation is of similar character and executed under similar conditions, the works shall be valued according to the rates and values found in the Bill of Quantity (BOQ). When the works to be varied is not similar, the BOQ shall be used as a basis for valuation. The power of the Engineer to fix rates. On instances where the varied works cannot be valued appropriately by the existing rates and prices on the contract, the Engineer, in consultation with the Employer and Contractor, shall determine a suitable rate or price, which should be agreed upon by the Engineer and Contractor. In the case of disagreements, the Engineer shall fix such rates or prices as in his opinion is appropriate and shall notify the Contractor accordingly, with a copy to the Employer.

2.5.2.2 General Conditions of contract in Palestine

Murtaja (2007) pointed out two stages of Contract General Conditions used in the Palestinian territories (PT) as the following:

1. **Before the year 1994**

At this period, the used general conditions were very concise and consist of a technical, financial and administrative condition. There were three types of general conditions in Gaza strip:

1. General conditions that were used in the municipalities, in Arabic. These conditions were originally quoted from Israeli contracting systems.
2. General conditions used in the public works department were originally quoted from Israeli contracting systems (technical, legal and financial items) and;
3. General conditions that were used in the UNRWA in English.

2. **After the year 1994**

At this period, there were many large scale projects which had been funded by Arab and International Donors. Other types of General Conditions had been introduced by international donors' conditions. This variety of general conditions creates a challenge and source of problems that face the local construction industry since, these types of general conditions of the contract, do not frequently suit the special local circumstances of the PT.

2.5.2.3 General Conditions of contract relative to the VOs in Palestine

In Palestine. There are several types of general conditions available for inclusion in contract documents used by the different institutions. General Conditions of Contract used by United Nations Relief and Works Agency (UNRWA) and United Nations for Development Program (UNDP) are the most used in Gaza Strip. So, it will be mentioned in detail.

1. **General Conditions of Contract used by UNRWA (1968) (last updated on 31 Jan. 2011)**

General conditions of the contract that are used by UNRWA consist of 21 articles based mainly on (FIDIC items), that cover a wide range of important issues. UNRWA described variation in the article (7) as follows:

1. The total cost of the works as shown in the Drawings and BOQ shall not be deviated from to and extent exceeding twenty-five per centum (25%), except by agreement with the Contractor.
2. No variations shall be made by the Contractor until and unless he is so authorized by the Director of works, in writing, and no claims for such varieties shall be considered as valid unless the said authorization is produced by the Contractor.
3. Variations made by UNRWA to the Drawings and BOQ requiring additional work or reducing the amount of work shall be governed by the provisions of the UNRWA Contract just as if they were embodied in the original Drawings and BOQ.
4. The Contractor shall not make any claim for variations in respect of any item mentioned directly or by implication in the Contract Documents. Additional or reduced quantities of work relating to items in the BOQ shall not be considered variations.
5. The rate to be paid for any item of work not mentioned directly or by implication in the Contract Documents shall where possible be related to similar or analogous items in the BOQ and be mutually agreed between the Contractor and the Director of Works and shall be confirmed in

writing before the work is commenced. In the event, these parties fail to agree upon a rate the UNRWA reserves the right to order the work to be carried out in any way it shall deem fit.

6. In the event the UNRWA is of the opinion that the variation does not lend itself readily to the establishment of a rate, the Contractor shall be paid for such work on the basis of actual labor costs and materials used, supported by suitable pay sheets and vouchers duly signed by the Director of Works. The Contractor shall receive, in addition, ten per centum (10%) of the above cost of labor and materials in full settlement of his services.

7. The Contractor shall furnish the Director of Works with a weekly statement of any claim for extra or unforeseen work in order that his claim may be investigated. No claim shall be considered which has not been included in a weekly statement or allowed if the Contractor cannot produce a written order from the Director of Works.

2. General Conditions of Contract used by UNDP (2000)

General conditions of the contract that are used by the UNDP consist of 75 clauses. These General Conditions of the contract are also used by the German projects in Gaza strip that financed by the German government through the (KFW) and supervised by the (UNDP).

UNDP described variation in the following clauses:

- *Clause 15a*: The engineer (Engineer means the person whose services have been engaged by UNDP to administer the Contract as provided therein, as will be notified in writing to the Contractor) may instruct the contractor, with the approval of the employer and by means of VOs, all variations in quantity or quality of the works, in whole or in part, that are deemed necessary by the engineer.

- *Clause 48.1*: The engineer may within his powers introduce any variations to the form, type or quality of the works or any part thereof which he considers necessary and for that purpose or if for any other reasons it shall,

in his opinion be desirable, he shall have the power to order the contractor to do and the contractor shall do any of the follows:

1. Increase or decrease the quantity of any work under the contract;
2. Omit any such work;
3. Change the character or quality or kind of any such work;
4. Change the levels, lines, positions, and dimensions of any part of the works;
5. Execute additional work of any kind necessary for the completion of the works, and no such variation shall in any way vitiate or invalidate the contract.

- *Clause 48.2* (Variations increasing cost of the contract or altering the works) stipulated that the engineer shall, however, obtain the written approval of the employer before giving any order for any variations which may result in an increase in the contract price or in an essential alteration of the quantity, quality or character of the works.
- *Clause 48.3* (Orders for Variations to be in Writing) stipulated that no variations shall be made by the contractor without an order in writing from the engineer. Variations requiring the written approval of the employer under clause 48.2 shall be made by the contractor only upon written order from the engineer accompanied by a copy of the employer's approval.
- Clause 48.4 (Valuation of variations) stipulated that the Engineer shall estimate to the Employer the amount to be added or deducted from the Contract Price in respect of any variation, addition or omission. In the case of any variation, addition or omission which may result in an increase of the Contract Price, the Engineer shall communicate such estimate to the Employer together with his request for the Employer's written approval of such variation, addition or omission. The value of any variation, addition or omission shall be calculated on the basis of the unit prices contained in the BOQ.

3. **General Conditions of used by Palestinian Central Tendering Department (PCTD).**

    1. Contract General Conditions used by Palestinian Economic Council for Reconstruction and Development (PECDAR).
    2. Contract General Conditions used by United States Agency for International Development (USAID).
    3. Contract General Conditions used by the World Bank
    4. Contract General Conditions used by European Union (EU).
    5. Contract General Conditions used by Danish Project "Support to Municipal Development and Management" in the Gaza Middle Area (SMDM).

2.5.3 Rules for Valuation of the Variations.

FIDIC in the red book (Conditions of contract for works of civil engineering construction, 1987) mentioned that the valuation of variations shall be made in accordance with the following rules:

1. The price in the Contract Bills shall determine the valuation of work of similar character executed under similar conditions as work priced therein.
2. Where work is of similar character to work included in the Contract Bills but may not be executed under similar conditions the rates in the Contract Bills shall, as far as may be reasonable, be the basis of valuation, which shall include a fair allowance for the difference in conditions.
3. Where work cannot be properly measured and valued the contractor shall be allowed day work rates at the prices prevailing as far as may be reasonably ascertained at the time that such work is carried out or at the day work rates stated in the Contract Bills or if no such rates are included at the actual prime cost to the contractor of his materials, transport, and labor for the work concerned plus fifteen per cent, which percentage shall include the use of all ordinary plant, tools and scaffolding, supervision overheads and profit. Provided that in any case vouchers specifying the time spent daily on the work, the worker's names, the plant and the materials employed shall be delivered for verification to the architect or to

the quantity surveyor as instructed by the architect not later than seven days after the work had been completed.

4. The prices in the Contract Bills shall determine the valuation of items omitted. If omissions substantially vary the conditions under which any revising items of work are carried out, the prices of such remaining items shall be valued under the second rule previously mentioned.
5. Effect shall be given to measurement and valuation of all variations in interim certificates and by adjustment of the contract sum.

2.6 Management of the VOs

Management of changes is the management of risks. It begins with the allocation of risk in the project clients' selection of a particular construction method, continues in the prime contract, subcontracts and purchase orders. Cox (1997) explained that those who manage risk best are those who do the following four things: (1) recognize that no construction method or risk-shifting contract clauses will be a magic solution for all the risks of construction; (2) know the risks of that construction method or those contract clauses before choosing a particular construction method or risk-shifting clause; (3) plan ahead so as to minimize the allocated risks of the actual construction method or contract clauses; and (4) provide a cost-effective means of resolving changes and claims that will inevitably arise during a project, regardless of all the risk shifting, either by construction method or contract clause. In the end, successful management of changes goes directly to bettering the timing and final cost of your construction project. Cox (1997) also stated that successful management of the VOs begins even before the start of construction. The project client must accept that no construction method is guaranteed to be free of changes. A VO has to be managed carefully. Otherwise, disputes between a client and a contractor related to cost and time of work might occur.

In fact, several strategies have been acknowledged as useful in managing VOs. According to Charoenngam et al. (2003), among the various strategies used to manage variations is that of involving the creation of good communication and cooperation among project team members. Chan and Yeong (1995) asserted that

good contract documentation and good communication and cooperation between building team members are major elements that can make the task of managing the VOs easier. As for good documentation, Chan and Yeong (1995) explained that it is generally facilitated by designing an effective VO system, which should be geared towards understanding the VO process or workflow, which can be collected from the standard forms of contracts. About a good communication, however, it might be facilitated by providing information in a well- timed manner.

Actually, Oloo (2015) explained that **the first and most important step for successfully managing variations** entails identification and understanding of contract requirements and provisions by the respective parties before the project starts. The contract documents as prepared in the planning stage, spell out the requirements for the project in terms of its scope, schedule, and budget. The contract requirements must first be identified so that any variation can be recognized because a variation is essentially a requirement that deviates from the requirements set forth in the contract documents. This step should come in handy in avoiding potential contractual disputes and claims arising from construction variations.

Oloo (2015) also explained that the logical starting points for the identification and administration of variations: the client, consultant, and contractor should pay particular attention to the contract clauses related to the following:

1. Variation: - FIDIC (1999) clause 13,
2. Contractor Notice: - FIDIC (1999) clause 20.1
3. Claims, dispute and arbitration: FIDIC (1999) clauses 20.2-20.8
4. Site evaluation: FIDIC (1999) clause 4.10
5. Unforeseeable physical conditions: FIDIC (1999) clause 4.12
6. Force majeure: FIDIC (1999) clause 19
7. Extension of time for completion: FIDIC (1999) clause 8.4

The second step in effective variations management is to identify the possible variations that might occur in the future activities of the project. Oloo (2015) asserted that the timing is of great importance here, in other words, the earlier

a variation is identified the lower the impacts will be. However, one of the major problems at the project execution stage is the failure of the clients, consultants or the contractors to recognize project variation. Once a potential variation is identified, it will be classified among the different types of the variation provisions that are defined by the contract. As previously mentioned that FIDIC (1999) clause 13, variation may include:

1. Additional work,
2. Omission from work,
3. Change to the quality or other characteristics of any item of the work,
4. Change to the sequence or timing of execution of the work, and
5. Change to the levels, positions and/or dimensions of any part of the work.

The third step of successful variations management is to evaluate the potential VOs. Zakaria et al. (2012) asserted that evaluation all variations and prepare the final account are at post contract stage. The aim of this step is to be able to ascertain the impact of the potential variation on the project's budget and schedule. Using cost analysis and duration analysis techniques, the client and his representative will be able to reach an informed decision whether to adopt or reject the proposed variation in totality or to consider other options. Public Procurement Oversight Authority and Kenya Anti Corruption Commission (PPOA & KACC, 2009) provided a corruption prevention strategies that require all variations to be approved by the clients' tender committee and must adhere to the stipulated limit of 25% of the contract sum for works. Once a decision has been made by the tender committee, it is important to notify the project team members, both internal and external on the approval or rejection of the variation by the client. In order to keep a record of who has been informed, the project team must prepare a list of all the people who are going to be contacted. It is an essential task, as any ignorant in this stage may lead to irreversible damages. Early notification allows both the client and the contractor an opportunity to more effectively control the cost and mitigate schedule impact of variation.

The fourth element in effective variation management is the execution of variation. This entails the issuance of a written VO for implementation by the contractor and thereafter, valuation of the variation.

The fifth and the last step in a successful variation management process is the documentation of variation. This step is important given to avoid a problem with logging variation claims due to lack of records. Al-Dubaisi (2000) asserted that documentation of a variation is a vital element in any change management and the lack of it can jeopardize the right of a contractor to collect fair compensation for a change. Potential VO file should be created for every identified variation in order to track the issue.

Moghaddam (2012) denoted a graphical representation of the VOs management as shown in Figure (2.1).

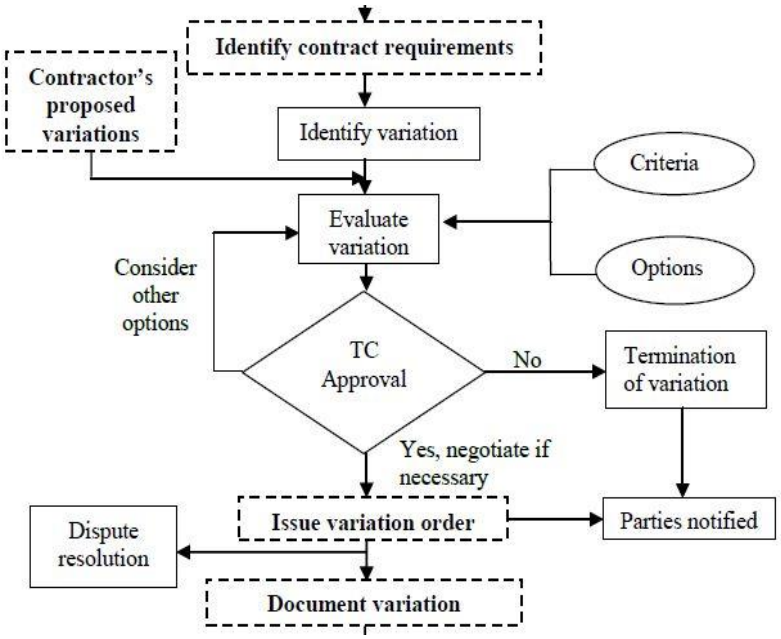

Figure (2.1): VOs management.

Source: Adopted and modified from (Moghaddam, 2012)

2.7 Origin Agents of the VOs

In order to fully understand the resulting problem caused by variations, their source and nature need to be understood, and why they arise (Akinsola, Potts, Ndekugri, & Harris, 1997). Halwatura and Ranasinghe (2013) asserted that although

none can ensure that the VOs can be avoided completely, their occurrence and subsequent waste can be prevented if their origin and causes were clearly known. A VO is a transfer of information from one part to another indicating a needed change (Ndihokubwayo & Haupt, 2008). The identification of the root causer consists into the revelation of the initiator of the VOs so, Arain and Pheng (2006) identified the origin agents of the VOs. These included 'client', 'consultant', and 'contractor'. In addition, in Gaza Strip, there is an additional origin agent called 'Donor'. The Origin Agents of the VOs are depicted in Figure (2.2).

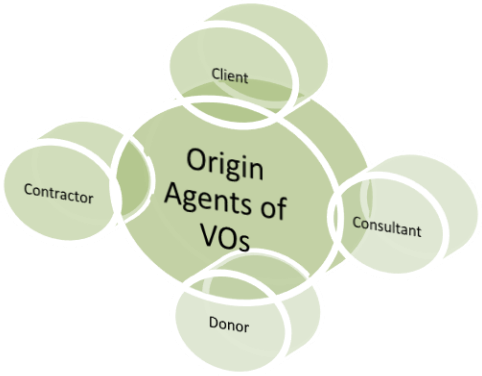

Figure (2.2): Origin Agents of the VOs

2.7.1 Client

A client is a person on behalf of the users and future occupants. Donold (2013) classified clients into two categories: Clients who have the knowledge and experience of the construction industry and those without or with little experience. Clients with experience in construction are involved during the design stage by providing professional guidance to the design team. This participation may contribute to the avoidance of continuous changes during the construction stage. For example, public entity clients and private development companies have their own professional team responsible either for design or supervision of a commissioned designer. The technical input into the design by clients prevents them from fully relying on the designer, minimizing the chance of them changing their mind during the construction stage. Clients without or with little knowledge in construction tend to follow the guidance of the designer without any clear idea that their requirements have been met. Yunus (2007) remarked that it is sometimes very difficult to determine the exact requirements

of the client. As clients are always known for their all demands, they sometimes change their minds by varying the works while in progress. Asamaoh and Offei-Nyako (2013) noted that the client as the project initiator plays a major role in the construction project from the inception to the completion. As a result, clients influence the likelihood of the occurrence of the VOs. Clients anticipate the needs and objectives of projects, establish the scope of works and the required quality standards.

It is an undeniable fact that the bulk of the variations are initiated by the client.

Several researchers

(Jawad, Abdulkader, & Ali, 2009; Ndihokubwayo & Haupt, 2009; Anees, Mohamed, & Razek, 2013; Mohammad et al., 2010; Eigbe, 2016) have reported that the client is the most predominant origin agent of VOs as a result of unclear briefing and changing requirements. Inter alia, problems encountered when dealing with VOs included time and cost determination, which often could be sources of disputes between the contractual parties.

2.7.2 Donor

Today's Palestinian economy is a product of a long and complex existential conflict. Yet history aside, the first time one was able to discuss a pseudo-autonomous Palestinian economy was after the signing of Oslo Accords in 1993, which replaced the direct and full Israeli authority over the two geographically separate regions (the West Bank and Gaza Strip) with the Palestine National Authority. Palestinians were no longer under the civil rule of Israel. However, they were far from having space to grow, develop and move freely; restrictions on movement and trade were imposed, Israeli settlements continued to spread and expand within the Occupied Palestinian Territory, more land was confiscated, farms and trees were destroyed and houses were demolished systematically. The fight over resources continued, and this constrained entity was denied sovereignty; it had no specified borders, no control over crossings, no army or even a national currency (Sarsour, Naser, & Atallah, 2011).Therefore, the donor assistance played an important role in upgrading Palestinian infrastructure facilities and reducing the destructive impact of the Israeli policies and practices.

Gaza Strip depends at most on external funding from Arabian and international donors, that made a high real challenge for the clients, contractors and other parties operating in construction projects, how to manage the VOs which create a non-steady flow of work, and create losses in time, efforts, productivity, and costs. Alimrani (2015) stated that the donor sought to empower the Palestine National Authority to administer the Palestinian areas, implement projects for restoring infrastructure, establish facilities and institutions, and to manage the funding of the comprehensive development process. This leads Enshassi et al. (2010) to argue that the donor does not fund any projects that are not satisfying his guidelines and exceed his financial capability. As the donor allocated the required fund, he plays a regulator and controller role and his interference in project phases is minimal.

2.7.3 Consultant

The consultant team usually consist of an architect, quantity surveyor, structural engineer and services engineer (electrical and mechanical) (Mbamali & Okotiee, 2012). Asamaoh and Offei-Nyako (2013) stated that members of the consultant team have the power to effect VOs upon delegation by the client or on their behalf.

Acharya, LEE, and IM (2006) suggested that the consultants should aim at getting an understanding of the overall scope and goals of the project. However, the feeling of superiority of the consultant over the contractor may prevent the consultant from giving attention to the requests made by the contractor. As cited in (Acharya et al., 2006), most consultants have been working as a businessman in the construction industry. They do not have a deep understanding of the role, responsibilities and a professional requirement of each of these, which are the key to succeeding. Ndihokubwayo (2008) mentioned that during the briefing stage, clients state their requirements and these constitute the basis for formulating contract documents. Unfortunately, a failure by the consultant to interpret the requirements results in the design being different from the perceived one to interpret the requirements and needs of their client, it will results in the difference

in design from the perceived one and this will eventually lead to the VOs; issued to ensure compliance with the client's requirements.

It is impossible to have the knowledge of all new materials and products that are entering the construction market. This shows that the consultant may be unaware of the inexpensive alternatives and when the full information about the materials is available, a VO will be issued to change and give the project a better construction method. Acharya et al. (2006) insisted that when a new technology is applied, at the same time, it must be seen whether skilled people are available to convert the technology into the real work. Otherwise, improper application of the technology may lead to quality degradation or monetary losses.

Besides that, the changes are also in review or reassessment of the design by the designers due to issues such as safety, build ability, and correction of deficiencies or errors. While the contract administrator with the power is then implemented the provision of the contract unless the employer has retained such powers under the contract (Yunus, 2007).

Oloo (2015) explained that in the case of errors, omissions or discrepancies are found in the design or a conflict is discovered between the contract documents, it is the duty of the consultant to provide a remedial solution. A contractor who finds a problem to interpret ambiguous design details and inadequate working drawings notify the concerned consultant as soon as possible. Oloo (2015) also explained that the contractor could not proceed with work where ambiguous situations arise unless the consultant issues an instruction which might at times constitute a VO.

Chapin (2000) states that one of the biggest mistakes professionals make in consultancy business is that they assume they know all the answers and are smarter than their customers, and fail to listen. Consultants should try to be the best but need to realize that there is always going to be someone better or a better way to do things.

2.7.4 Contractor

In traditional construction contracting, the contractor builds according to a design provided by the client and prepared by the client's design professional. However, the designer does not always design the entire project. In every construction project, Sweeney (1998) stated that it is the contractor's responsibility to advise consultant to issue a VO when a technical problem is discovered. All parties involved in the contract should be aware that the information given by the consultant is not always correct. According to Sweeney (1998), the contractor may propose alternative construction methods where his knowledge in the field will work better and fit the desired fitness and function of the design than the method proposed by the client or consultant. Donold (2013) mentioned that the contractors may discover discrepancy, omission, errors, and conflict in the documents and may request consultant opinion regarding the problem arise. VO will then be issued with additional cost to solve the problem.

2.8 Causes of the VOs

Al-Hakim (2005) said that it is rare for a project to perform precisely in line with their original schedule due to reasons such as business condition changes, delivery slips and correction to design. Various authors had identified different causes of the VOs in construction projects both in the private and public projects. Contractual clauses relating to variation allows parties involved in the contract to freely initiate the VOs within the ambit of the scope of the work without alteration of the original contract (Ndihokubwayo & Haupt, 2008). The VOs are common in construction projects so understanding it would require identifying their causes.

The VOs occur due to a number of reasons ranging from finance, design, aesthetic, geological, weather conditions to feasibility of construction, statutory changes, product improvement, discrepancies between contract documents (Hanna, Camlic, Peterson, & Nordheim, 2002). Further, the human behavior of parties to the contract cannot be predicted. The VOs may arise from changes in the minds of parties involved in the contract. Hanna and Swanson (2007) indicated that variations occur due to the uniqueness of each project and the limited resources, time and money available for planning.

The causes of the VOs can be categorized according to the origin agent that initiates the variation. Thus, fifty-seven (57) causes of the VOs were identified from literature review as follows in Table (2.3).

Table (2.3): Causes of VOs

NO	Factors	Sunday (2010)	Memon, Rahman, & Jamil (2014)	Ismail et al. (2012)	Memon, Rahman, & Hasan (2014)	Sun and Meng (2009)	Jadhav & Bhirud (2015)	Aziz (2013)	Mohammad et al. (2010)	Halwatura and Ranasinghe (2013)	Keane et al. (2010)	Al-Dubaisi (2000)	Karthick et al. (2015)	Asamaoh and Offei-Nyako (2013)	Enshassi et al. (2010)
Client related factors															
1.	Change of plans or scope by the client	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.	Change of schedule by the client	✓	✓		✓		✓					✓	✓		✓
3.	Client's financial problems	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓	✓
4.	Inadequate project objectives	✓		✓						✓	✓	✓		✓	✓
5.	Replacement of materials or	✓		✓			✓		✓	✓	✓	✓	✓		✓
6.	Impediment in prompt decision-making process	✓	✓		✓	✓					✓			✓	✓
7.	Obstinate nature of client		✓		✓						✓				✓
8.	Change in specifications by the client.	✓	✓		✓		✓				✓			✓	✓
9.	Inadequate experience of the clients' staff												✓		✓

Continued table (2.3):

NO	Factors	Sunday (2010)	Memon, Rahman, & Jamil (2014)	Ismail et al. (2012)	Memon, Rahman, & Hasan (2014)	Sun and Meng (2009)	Jadhav & Bhirud (2015)	Aziz (2013)	Mohammad et al. (2010)	Halwatura and Ranasinghe (2013)	Keane et al. (2010)	Al-Dubaisi (2000)	Karthick et al. (2015)	Asamaoh and Offei-Nyako (2013)	Enshassi et al. (2010)
10.	Land allocation problems														✓
Donor related factors															
11.	Financial capability of the donor														✓
12.	Budget allocated constraints														✓
13.	Time constraints														✓
14.	Interference of donor in the project requirements														✓
15.	Relation between donor and client														✓
Consultant related factors															
16.	Change in design by the consultant during the construction stage.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓
17.	Inadequate revision and feedback system through design process		✓		✓	✓	✓							✓	✓
18.	Change in specifications by the consultant consultant Change		✓		✓	✓					✓				

Continued table (2.3):

NO	Factors	Sunday (2010)	Memon, Rahman, & Jamil (2014)	Ismail et al. (2012)	Memon, Rahman, & Hasan (2014)	Sun and Meng (2009)	Jadhav & Bhirud (2015)	Aziz (2013)	Mohammad et al. (2010)	Halwatura and Ranasinghe (2013)	Keane et al. (2010)	Al-Dubaisi (2000)	Karthick et al. (2015)	Asamaoh and Offei-Nyako (2013)	Enshassi et al. (2010)
19.	International consultant using the inadequate specification to be followed in the local conditions.														✓
20.	Errors and omissions in design	✓		✓		✓	✓		✓	✓	✓	✓			✓
21.	Discrepancies between contract documents	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
22.	Inadequate scope of work for contractor	✓				✓						✓			
23.	Technology change especially if the time between design and construction is long			✓			✓			✓	✓	✓	✓	✓	✓
24.	Lack of coordination among project parties	✓		✓		✓		✓	✓	✓	✓	✓	✓		
25.	Design complexity		✓		✓	✓		✓			✓		✓		
26.	Value engineering			✓			✓			✓	✓	✓			
27.	Insufficient time for preparation of contract documents					✓									✓

Continued table (2.3):

NO	Factors	Sunday (2010)	Memon, Rahman, & Jamil (2014)	Ismail et al. (2012)	Memon, Rahman, & Hasan (2014)	Sun and Meng (2009)	Jadhav & Bhirud (2015)	Aziz (2013)	Mohammad et al. (2010)	Halwatura and Ranasinghe (2013)	Keane et al. (2010)	Al-Dubaisi (2000)	Karthick et al. (2015)	Asamaoh and Offei-Nyako (2013)	Enshassi et al. (2010)
28.	Design discrepancies	✓			✓			✓				✓			✓
29.	Inadequate working drawing details	✓	✓		✓		✓				✓			✓	
30.	Consultant's lack of judgment and experience	✓								✓				✓	
31.	Lack of consultant's knowledge of available materials and equipment	✓									✓		✓	✓	✓
32.	Consultant's lack of required data	✓				✓					✓				
33.	Ambiguous design details							✓			✓				
34.	Insufficient site investigation prior to design					✓		✓							
Contractor related factors															
35.	Complex design and technology										✓				
36.	Lack of strategic planning		✓		✓	✓	✓	✓			✓				
37.	Contractor's lack of required data	✓				✓									
38.	Lack of contractor's involvement in design										✓			✓	✓

Continued table (2.3):

NO	Factors	Sunday (2010)	Memon, Rahman, & Jamil (2014)	Ismail et al. (2012)	Memon, Rahman, & Hasan (2014)	Sun and Meng (2009)	Jadhav & Bhirud (2015)	Aziz (2013)	Mohammad et al. (2010)	Halwatura and Ranasinghe (2013)	Keane et al. (2010)	Al-Dubaisi (2000)	Karthick et al. (2015)	Asamaoh and Offei-Nyako (2013)	Enshassi et al. (2010)
39.	The required equipment and tools are not available		✓	✓	✓		✓		✓	✓	✓	✓		✓	✓
40.	Lack of a specialized construction manager					✓								✓	
41.	Poor procurement process		✓		✓						✓				
42.	Lack of communication between the contractor and other parties	✓				✓		✓			✓				
43.	Contractor's lack of judgment and Experience.	✓				✓					✓				✓
44.	Shortage of skilled manpower	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
45..	Contractor's financial difficulties	✓	✓	✓	✓				✓	✓	✓	✓			✓
46.	Contractor's desired profitability to improve financial condition	✓							✓	✓	✓	✓	✓	✓	✓
47.	Differing site conditions.	✓		✓					✓	✓	✓	✓	✓	✓	
48.	Defective workmanship.	✓	✓	✓	✓	✓			✓	✓	✓	✓			

NO	Factors	Sunday (2010)	Memon, Rahman, & Jamil (2014)	Ismail et al. (2012)	Memon, Rahman, & Hasan (2014)	Sun and Meng (2009)	Jadhav & Bhirud (2015)	Aziz (2013)	Mohammad et al. (2010)	Halwatura and Ranasinghe (2013)	Keane et al. (2010)	Al-Dubaisi (2000)	Karthick et al. (2015)	Asamaoh and Offei-Nyako (2013)	Enshassi et al. (2010)
49.	Poor site management and supervision					✓	✓	✓							
Environmental factors															
50.	Weather conditions			✓		✓	✓	✓	✓		✓	✓	✓	✓	✓
51.	Safety considerations					✓	✓			✓	✓	✓		✓	✓
52.	Change in government regulations	✓		✓		✓	✓	✓	✓			✓		✓	✓
53.	Change in economical conditions	✓									✓				✓
54.	Unforeseen problems	✓				✓					✓				
55.	Internal political problems					✓									✓
56.	Socio-cultural factors	✓													✓
57.	Lack of construction materials and equipment spare parts due to closure and siege														✓

2.9 Factors influencing the occurrence of VOs

VOs are likely to happen in all different construction projects. Nevertheless, the nature and frequency of variation occurrences vary from one project to another depending on various factors (Kaming, Olomolaiye, Holt, & Harris, 1997). Akinsola et al. (1997) said that it is necessary to identify the factors influencing the occurrence of the VOs. This will lead to better management and control of those items which are controllable and containment of those items which cannot be controlled. Factors influencing the occurrence of the VOs comprise different aspects such as the nature of the project, the complexity of the project, and the project delivery system (Procurement system) used for the project.

2.9.1 Nature of the construction project and its works

The literature provides several main descriptions of the construction project. The main descriptions of the nature of the construction projects are provided in Table (2.4).

Table (2.4): Description of the nature of the construction projects.

No	Description	Author
1	Dynamic nature of the construction project	(Laufer, Shapira, & Telem, 2008); (Mulholland & Christian, 1999); (Bertelsen, 2003)
2	Fragmented nature of the construction project	(Ankrah & Langford, 2005); (Bertelsen, 2003); (Emuze & Smallwood, 2011); (Oyewobi, Jimoh, Ganiyu, & Shittu, 2016)
3	One-off nature of the construction project (unique and novel)	(Westerveld, 2003); (Ahadzie, Proverbs, & Olomolaiye, 2008); (Oyewobi et al., 2016)
4	Highly transient human system (social interaction)	(Bertelsen, 2003)
5	Adversarial culture	(Ankrah & Langford, 2005); (Elbohisi, 2016)

The dynamic nature of the project stems from the uncertainties in the flows feeding the actual tasks and the fragmented nature of the construction project because it is divided into parts that are subcontracted to individual enterprises. Each project is unique because there is always at least one of the following parameters that change: targets, resources, and the environment. This makes project management an

even more complex process. As the project is executed by a temporary production system and the construction site is likewise staffed by a temporary and very transient human system, team building becomes of great importance. Nature of the project can be classified as residential, infrastructure, commercial, office, educational, and health. Ndihokubwayo (2008) mentioned that construction works involve building, civil and/or specialist works. Building works include, for example, the construction of residential houses, commercial premises, and offices. Civil works include, for example, the construction of roads and infrastructural installations. Construction projects that involve extensive unforeseen conditions are likely to generate the VOs. For example, civil works involving bulk earth excavation and building works that include specialist works beyond the expertise of the designer cannot accurately be determined before works commence on site.

Nature of the project also can be classified as new build and renovation/refurbishment.

Love (2002) found that refurbishment and renovation projects are considered prone to higher VOs than new build projects because of the degree of uncertainty and complexity associated with the building work.

2.9.2 Complexity of the project

Research works on the concept of complexity have been conducted for years. The difficulty is that there is actually a lack of consensus on what project complexity really is. Complexity can be understood in different ways, not only in different fields, but has also different connotations within the same field (Morel & Ramanujam, 1999). Several researchers (Baccarini, 1996; Edmonds, 1999; Maylor, Vidgen, & Carver, 2008; Austin, Newton, Steele, & Waskett, 2002; Morel & Ramanujam, 1999; Bosch-rekveldt, Jongkind, Mooi, Bakker, & Verbraeck, 2011) defined a project complexity as the property of a project which makes it difficult to understand, foresee and keep under control its overall behavior, even when given reasonably complete information about the project system.

The Oxford dictionary (2017) defined "complex" as that made up of many parts, complicated or difficult to understand or carry out. Scientists and

mathematicians consider a system "complex" only when it consists of a multitude of interacting elements and Baccarini (1996) and Gidado (1996) described the construction process that always made up of a multitude of interacting parts. Therefore, in simple terms, this may suggest that construction is generally complex in nature. Gidado (1996) asserted that project complexity is attributed to the continuous demand for speed in construction, cost and quality control, health and safety in the workplace and avoidance of disputes, together with technological advances, economic liberalization and globalization, environmental issues and fragmentation of the construction industry. Baccarini (1996) and Ireland (2007) concurred that two types of project complexity are distinguished, namely organizational or management complexity and technological or technical complexity. According to Ireland (2007), Management complexity refers to business aspects of the project, parties involved in a contract and their relationships in terms of communication, allocation of responsibility and authority of decision making and allocation of tasks but technological complexity refers to difficulties and intricacies during the transformation process involving materials, tools, techniques, and skills needed to complete a construction project.

Ireland (2007) also mentioned that the degree of project complexity is classified as low, medium and high complexity. The greater the project complexity, the greater the likelihood of VO occurrence. Alsuliman (2014) noted that the VOs issued due to the complexity of the design might take time for the design team to understand the required change and redesign while works on site are put on hold.

2.9.3 Project delivery system (Procurement system)

The American Institute of Architects and the Associated General Contractors of America (AIA & AGC,2004) published a primer on project delivery and defined the project delivery system as the comprehensive process of assigning the contractual responsibility to an organization or an individual for providing design and construction of services of a project. Furthermore, The Design Build Institution of America (DBIA, 2015) defined the project delivery as a comprehensive process including planning, design, and construction required to

execute and complete a building facility or other type of project. As well, Ling (2014) said that the project delivery system is a method whereby the client searching, finding and contracting a contractor or someone with a professional skill to perform the project. A project delivery system establishes responsibility for how the project is delivered to the client.

Choosing a project delivery method is one of the fundamental decisions clients make while developing their acquisition strategy. Therefore, Ibbs, Kwak, Ng, and Odabasi (2003) stated that every client responsible for the implementation of a construction project must make an early and important decision regarding the method by which the project will be designed and constructed.

There are four main criteria for the success of any project delivery method: cost, quality, time, and safety. However, responsibilities for meeting these criteria vary by method. Each delivery method offers a different level of risk to the client. Ogunsanmi (2013) asserted that because the human behavior of parties to the contracts is unpredictable it may result in VOs arising from changes in minds of parties involved in the contract. So, Luu, Ng, and Chen (2005) stated that an appropriate a project delivery system is a catalyst to the success of a construction project and the least of variation occurrence during construction.

Because of financial, organizational and time constraints, various project delivery methods have evolved to fit a particular project and client needs. Nowadays, there are several types of project delivery systems for a client to choose based on their own needs, which are traditional/conventional design-bid-build (DBB) system, design-build (DB) system and Construction management at risk (CM@R). One type of procurement system may result in more VOs than another. Proponents of particular alternative methods advocate improvements over the traditional system in terms of project schedule and cost control, and the number of disputes (Rojas & Kell, 2008). Therefore, the most popular alternatives to the traditional design-bid-build (DBB) method are construction management at risk method (CM@R) or fast-track/multiple-prime method and design-build (DB).

2.9.3.1 Traditional/conventional delivery system and variations

In the traditional approach, the employer accepts that design work will generally separate from construction, consultants are appointed for design and cost control, and the contractor is responsible for carrying out the works (Davis, Love, & Baccarini, 2008). The complete design can be prepared during the design stage. Thus, client and designer discuss together the final design. As the works commence on site when the design is complete, the occurrence of the VOs in this arrangement is decreased but works were often disrupted when there are too many variations due to unforeseeable problems so, the traditional project method may be preferable for the client who has the time to allow for the project design to be completed before bidding and start of construction. An client, who also desires certainty of the price associated with a completed design and in the case of a public client, is restricted to competitive sealed bidding procedures, would look to use the traditional method.

Rashid et al. (2006) preferred this method because it provides clear accountability and better design and construction control by the client. Since the pre-contract stage of this system is longer, more time is available for the client and the project team to scrutinize and review the design before construction. Alsuliman (2014) viewed that the more time spent on completing the contract documents before commencement of works, the more likely the avoidance of discrepancies between the contract documents, errors, and omissions into the design.

Soares (2012) argued that the VOs could be born depending on the level of integration of design and construction. Accordingly, Love, Gunasekaran, and Li (1998) explained that the traditional method of project delivery has contributed to the so-called ‘‘procurement gap’’ whereby design and construction processes are separated from one another but Love (2002) indicated that traditional project delivery system is subject to lower occurrence of errors, omissions, and changes than other systems.

2.9.3.2 Design and build procurement system and variations

DB is the oldest approach that is regarded as a new and alternative delivery method. During ancient times in Mesopotamia and Egypt, the master builder was responsible for the design and construction of the entire project. This continued to be the most commonly used project delivery method until the late 19th century when advances in science and technology allowed the fields of architecture and engineering to become two different professions (Songer & Molenaar, 1996).

Design- Build (DB) also called “fast-tracking” is one of the best methods of design and construction integration; it recovers the master build concept in construction and changes are viewed as improvements on the project but this integration allows the process of detail design and construction to run almost in parallel and concurrently to each other and construction commencing before the final design is complete. In this system, the client needs to be educated and informed about conveying ideas to the contractor in preparing the design specifications. An integrated process and overlapped design and construction can lead to incomplete or inaccurate designs (Hanna, Russell, Gotzion, & Nordheim, 1999). Owing to the incompleteness of the design, the possibilities of increasing the number of variation works are high.

Another view, Ashworth (1998) argued that the design will be more influenced by the contractor's construction capabilities than the design requirements of the employer. The involvement of contractors into the design is an opportunity for them to use specialized knowledge and methods of construction evolving from their own design and as a result, there is minimize variations. This is in line with Alsuliman (2014) who said that he DB procurement method where the contractor is responsible for both the design and build are deemed to overcome the problem of the VOs occurrence

Ibbs et al. (2003) examined the relationship between impacts on project change as against the DBB and DB project delivery systems and found out that, DBB contracts experienced a higher number of changes and change in cost

against DB contracts. The results obtained were consistent with studies carried out earlier by (Konchar & Sanvido, 1998). Since Contract documents in DBB are typically completed before construction begins, any change occurred in the project need to a VO. In addition, Soares (2012) asserted that the VOs in construction are a consequence of the lack of integration between design and construction and began when construction contracts started to use the two-step project delivery method designated as DBB.

2.9.3.3 Construction management procurement system and variations

Construction management at risk (CM@R) approaches involve a construction manager who takes on the risk of building a project. The architect is hired under a separate contract. The construction manager oversees project management and building technology issues, in which a construction manager typically has particular background and expertise. Such management services may include advice on the time and cost consequences of design and construction decisions, scheduling, cost control, coordination of construction contract negotiations and awards, timely purchasing of critical materials and long-lead-time items, and coordination of construction activities (Rojas & Kell, 2008).

Construction management is a form of “fast- tracking” procurement approach. It gives greater emphasis to the management and integration of the design and construction of projects. As previously mentioned, an integrated process and overlapped design and construction can lead to incomplete designs (Hanna et al., 1999). Incompleteness of contract documents created uncertainty of the scope of the contract. Uncertainty was a clear indication of the likelihood of the occurrence of the VOs. In the other view, Rashid et al. (2006) explained that the contractor has the knowledge, experience, and competency to better manage the design and construction of a project. It is a factor that allows for more efficient and effective coordination of the works, materials, manpower, and plants. These factors have contributed to a better standard and quality of the completed construction products and decreased changes to the quality and other characteristics of any item of works.

Soares (2012) suggested using project delivery systems such as DB and CM@R to minimize the VOs conflicts since VOs are non-existent when construction is delivered under the master builder concept due to the total integration of the project. The master builder serves as both project designer and builder resulting in the completion of very complex projects that come into existence without the use of VOs.

2.10 Impact of the VOs

The impact is defined in Electronic Cambridge English Dictionary as "the force or action of one object hitting another".

Change brings to mind the worst images of a construction project. Cost overruns, mismanaged jobs, low productivity, unexpected subsurface conditions, and litigation are associated with change. Most construction professionals agree that change is an inevitable aspect of the construction process and may even have beneficial effects if handled properly (Ibbs & Ashley, 1987). The main character of the construction projects is complexity where many human and non-human factors and variables play essential roles. So, when the VOs occur all projects performance strongly affected (Al-Hams, 2010). Research on the effects of the VOs was done by many researchers. Thus, Nineteen (19) impacts of the VOs identified from the literature review were tabulated in Table (2.5).

1. **Progress is affected but without any delay.**

The project progress can be affected due to the variations. Yadeta (2016) explained that since variation management passes through different stages, most clients do not approve the VOs on time and the contractor refuses to continue the work. The contractor can also need new materials, new equipment, and specialized work force. These affect the project progress but without any delay, if the activity of variation issue is not on critical path. Arain and Pheng (2005) asserted that only major variations during the project might affect the project completion time. Therefore, the contractor would usually try to accommodate the variations by utilizing the free floats in the construction schedules. Hence, the variations affect the progress but without any delay in the overall project completion. Arain and Pheng (2005) also added that the project progress was

expected to be greatly affected in cases where the new professionals were not readily available.

2. Increase in project cost.

Clients desire to know in advance the total cost of their finished construction project. However, the most construction project will incur cost overruns as a result of the VO (Donold, 2013). Many construction projects incur increased costs because of variation; however, all variations do not increase costs. Deletion in most cases reduces the overall cost of the project, while additions always increase costs (Thomas, Horman, de Souza, & Zavřski). The VOs have both direct and indirect effect on cost. Ssegawa et al. (2002) identified the direct cost associated with VOs, which include price adjustment/escalation, head office overheads, consumable materials, standby time of equipment, time-related costs associated with equipment and manpower and material charges associated with affected tasks.

This direct cost is easier to calculate compared to indirect cost. According to Bower (2000) identified some of the indirect cost associated with VOs, which include lost effort on work already done, time lost in stopping and restarting current tasks in order to make the variation, change in cash flow, financing costs, loss of earnings, etc., loss of productivity due to reprogramming, loss of rhythm, unbalanced gangs and acceleration, revisions to project reports and documents, and loss of float thus increased sensitivity to delay.

Arain and Pheng (2005) revealed that increase in project cost is the first most important effect of variation. Arain and Pheng (2005) further described that every major additions or alteration eventually increase the project cost. Hence, in order to keep overall project cost unchanged; normally in every construction project, a contingency sum is allocated which caters possible variations in the project. However, in most cases, the amount of variation exceeds this sum and results in cost overrun. Furthermore, Al-Dubaisi (2000) added some potential cost items: Time value of capital tied due to a change, shifting of work to a less favorable period, additional bonding and insurance, engineering work for correcting drawings and documents and procurement activities effects. Enshassi,

Kumaraswamy, & Al-Najjar (2010) also asserted that VOs have a very damaging effect on project completion time and invariably lead to cost escalations as well.

3. Hiring new professionals.

Although the frequency of the VOs differs from project to project, they are often described as “frequent” in complex technological projects (Maylor et al., 2008), where there is a need for a new specialized manpower that is one of the major resources required for complex technological projects (Arain, Assaf, & Pheng, 2004). Hence, hiring new experts or replacing existing teams might arise as essential needs for a project entailing varied impacts on the progression of the project.

4. Increase in overhead expenses.

Project variations indicate some minor or major differences to the contractual scope agreed between the client and contractor. In order to make the changes validated and agreed upon mutually by both parties, proper documentation is vital (Hwang & Low, 2012). This is to ensure that the proposed variations are properly communicated and documented to all the parties involved. Hence, it implies that more expenses will be necessary for the legal documentation and paper procedures pertaining to the agreed changes (Arain & Pheng 2005). These expenses are normally not charged to the VO account as they are difficult to define and separate from the different accounts. The charge normally goes on the contractor's overhead account (Al-Dubaisi, 2000). Al-Dubaisi (2000) also added that these overhead charges are provided from the contingency fund allocated for the construction project. Obviously, if the change has an impact on schedule, material or administration level, the project overhead increases proportionally.

5. Delay in payment (cash flow problem)

Construction projects are highly dependent on receiving payments made by the clients. However, these payments may be slow. Delays for a month or more are common. Delay in payment occurred frequently due to variation in construction (Al-Dubaisi, 2000; Arain & Pheng, 2005). Ayalew (2009)

mentioned that variations may hinder the project progress and leads to delay in achieving the targeted milestones during construction work. This eventually affects payment to the contractor which in turn affects his overall cash flow and the payment to be made to the suppliers and subcontractors since the contractor may not pay them unless he gets payment from the client.

6. Quality degradation.

A client who is experiencing financial problems may require the substitution of quality standard expensive materials to sub-standard cheap materials (Ndihokubwayo & Haupt, 2008). Furthermore, Ndihokubwayo and Haupt (2008) asserted that if the VOs are frequent, they may affect the quality of works. Quality may be compromised because contractors tend to compensate for the losses incurred because of the VOs.

7. Productivity degradation.

Variation is one crucial factor in a range of factors influencing labor productivity (Ibbs, Nguyen, & Lee, 2007). The VOs often associated with interruption, delays and modification of work that have a negative impact on the labor productivity (Osman et al., 2009). Thomas & Napolitan (1995) revealed that variations normally led to disruptions and these disruptions were responsible for labor productivity degradation. According to Bolin (2017), If the work related to a change places, the contractor's labor and equipment resources in competition with the original project scope of work, the performance of project work may be adversely affected. Productivity studies cited earlier confirmed that a degradation of productivity in the change package is followed by productivity degradation in subsequent packages. A degradation of productivity was also noted in concurrent activities due to a change (Al-Dubaisi, 2000). The potential productivity losses will give a more realistic picture of the costs and time that are associated with the change (Hanna, Russell, Nordheim, & Bruggink, 1999).

8. Procurement delay.

Frequent procurement delay may occur in the project due to changes that require new materials and specialized equipment (Al-Jishi & Al-Marzoug, 2008; Arain & Pheng, 2005; Al-Dubaisi, 2000). According to Keane et al. (2010), The

contractor may need to accelerate the construction to catch up with the deadline specified in the contract. Procurement delay may cause a need for project activities to be reworked (Arain et al., 2004).

9. Rework and demolition.

Any alteration or addition in the design during execution of the project may results in demolition or rework of any project component (Memon et al., 2014). The main effects when variations occur during the construction phase are rework and delays in project completion. Time and resources are wasted when rework and demolition occurs. However, it depends on the timing of the variations as if variations occur during the design phase, no rework or demolition is required on construction sites as things are not constructed yet (Arain & Pheng, 2005).

10. Logistics delays.

Arain and Pheng (2005) and Ibrahim (2006) believed that variations that require new materials and equipment may result in logistics delay in construction projects. This happens because time is needed for the ordering and transportation of the materials and equipment on site.

11. Damage to firm's reputation.

Variations are referred to as a major source of construction claims and disputes (Yadeta, 2014). In addition, Arain and Pheng (2005) asserted that variations also increase the possibility of professional disputes. Therefore, Ibrahim (2006) mentioned that the claims and disputes may affect the firm's reputation adversely, leading to insolvency in severe cases. Conventionally, variations present problems to all the parties involved in the construction process.

12. Poor safety conditions.

Variations may affect the safety conditions in construction projects (Arain et al., 2004). This is because variations in construction methods, materials and equipment may require additional safety measures during the construction phase (Arain & Pheng, 2005).

13. Poor professional relations

A construction project is not merely brick and mortar brought together. Rather, it creates professional relationships between the parties to the contract. Each project successfully completed constitutes an added experience to participants and their reputation builds up (Shawareb, 2012). Eventually, variations may affect professional relations, leading to disputes (Osman et al., 2009) so, Ibrahim (2006) asserted that frequent communication and strong coordination could improve the relationships between professionals.

14. Additional payments for a contractor.

Arain and Pheng (2005) observed that one of the most common potential effects of the variations in the construction projects is additional payments for the contractor. Due to additional payments, the contractor looks forward to the variations in the construction project. Some contractors even look for ways and excuses to initiate variations during the construction just to obtain additional payments and increase their profit (Osman et al., 2009). Bolin (2017) asserted that the client must have confidence that the contractor's assessment of the costs to complete the extra work for a potential VO is fair and reasonable so the client can avoid being overcharged.

15. Disputes among professionals.

It is advantageous to both the client and the contractor that potential VOs on a project are processed in a fair, equitable, and timely manner. The failure to do so most often results in an increased probability of extended disputes and claims between the client and the contractor (Bolin, 2017). Bolin (2017) mentioned that there are two reasons for a potential VO to be disputed. In the first case, the client and the contractor are unable to come to an agreement that the scope of work, which identified in the potential VO actually represents a variation to the contract scope. In the second case, the client and the contractor both agree that the work scope is a change to the contract scope of work, but are unable to agree on the value or cost of the potential VO and its time impact. For potential the VOs that are disputed, the approval and compensation may be delayed. The issues, if they are ignored or unresolved, can later become claims.

Arain et al. (2004) opined that clear procedures that are presented in the contract and fair allocation of risks could help in resolving disputes through negotiation rather than litigation.

16. Completion schedule delay.

Time has an equivalent money value even if the professional team tries its best to keep the project completion schedule intact (Al-Dubaisi, 2000; Al-Hammadi, 2009). The contract schedule for a project may be impacted or delayed by the work involved in completing a VO. If the extra work is determined to be non-critical as a result of the absorption of the total float on the affected activities, the completion date of the contract schedule will remain unchanged. However, if the changed work is found to extend or delay the completion of activities that are on the critical path of the schedule, the completion date of a project will slip from the planned date (Bolin, 2017). Al-Hams (2010) said that from some interviews which was done with some construction managers in Gaza Strip, VOs were the main cause of increasing in contract value and/or the extension of time. Bower (2000) also mentioned that the time effects translate into a cost because either the contract duration will be extended, which means that overheads and financing are increased, or the work has to be accelerated, leading to the inefficient use of resources.

Smith (2016) found that projects with more VOs have larger cost and schedule overruns than those with less VOs. Additionally, it also found that larger cost and schedule overruns occur when the VOs occur later in the project.

17. Increase in duration of individual activities

A change will have an effect on the sequence and duration of the activities in the contract schedule. If the activities on the schedule's critical or near-critical paths are impacted by scope changes, the contract completion date of a project may be extended unless acceleration of the work is performed (Bolin, 2017). Critical Path Method analysis is a useful method in identifying whether the time needed to finish an activity has affects on finishing time or not, attributing each part to the party responsible for it, and studying the overall impacts on the project schedule (Al-Hams, 2010). Several researcher (Alaryan, Emadelbeltagi,

Elshahat, & Dawood, 2014; Desai, Pitroda, & Bhavasar, 2015; Muhammad et al., 2015) indicated that increase in duration of individual activities are the most important factor that result from a VOs in the construction projects.

18. Hold on work in other areas

According to Meijering (2014), A construction project is a series of interrelated and sometimes interdependent activities or processes where the output of one activity can be the input of other activities. Therefore, a VO can hold on work in the other area. Several researcher (Al-Dubaisi, 2000; Pourrostam, Ismail, & Mansournejad, 2011; Alaryan et al., 2014; Desai et al., 2015; Lokhande & Ahmed, 2015) indicated that work on hold in the other area is important factor that result from a VOs in the construction projects.

19. Impacts on subcontractors

Normally subcontractors have their own plan and schedule assuming that the main contractor will maintain the original conditions that allow start and end of work as scheduled. When a change takes a place, the subcontractor may need to adjust his plans and schedule accordingly. The subcontractor, in turn, may seek price and/or schedule adjustments (Al-Dubaisi, 2000). Ayalew (2009) and Neff (2014) asserted that the VOs have an impact on subcontractors.

Table (2.5): Impact of the VOs.

No	Factors	Al-Dubaisi (2000)	Arain and Pheng (2005)	Osman et al. (2009)	Alnuaimi, Taha, Al Mohsin, & Al-Harthi (2009)	Pourrostam et al. (2011)	Ismail et al. (2012)	Memon et al. (2014).	Alaryan et al. (2014)	Muhammad et al. (2015)	Staiti et al. (2016)	Yadeta (2016)
1	Progress is affected but without any delay	✓	✓	✓	✓					✓		✓
2	Increase in project cost	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3	Hiring new professionals		✓	✓							✓	
4	Increase in overhead expenses	✓	✓	✓					✓	✓		✓

Continued table (2.5):

No	Factors	Al-Dubaisi (2000)	Arain and Pheng (2005)	Osman et al. (2009)	Alnuaimi, Taha, Al Mohsin, & Al-Harthi (2009)	Pourrostam et al. (2011)	Ismail et al. (2012)	Memon et al. (2014).	Alaryan et al. (2014)	Muhammad et al. (2015)	Staiti et al. (2016)	Yadeta (2016)
5	Delay in payment		✓	✓					✓	✓	✓	✓
6	Quality degradation		✓	✓	✓		✓	✓	✓		✓	✓
7	Productivity degradation	✓	✓	✓				✓	✓	✓		✓
8	Procurement delay (materials and equipment)	✓	✓	✓				✓				✓
9	Rework and demolition		✓	✓				✓	✓	✓		✓
10	Logistic delay		✓	✓				✓	✓	✓		✓
11	Damage to firm's reputation		✓	✓						✓	✓	✓
12	Poor safety conditions		✓	✓							✓	✓
13	Poor professional relations		✓	✓							✓	✓
14	Additional payment for contractor		✓	✓	✓	✓	✓		✓	✓		✓
15	Dispute among professionals		✓	✓	✓	✓	✓		✓		✓	✓
16	Completion schedule delay		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
17	Increase in duration of individual activities								✓			
18	Hold work in other activities	✓				✓			✓			
19	Impacts on subcontractors	✓										

2.11 Waste associated with the VOs

2.11.1 Definition of the waste in the construction

Waste is defined as any inefficiency that results in the use of equipment, materials, labor, or capital in larger quantity than those considered as necessary in the production of the building (Formoso, Isatto, & Hirota, 1999). Ohno (1988) identified seven categories of waste: defects, overproduction, waiting, transporting, movement, inappropriate processing, and inventory.

An understanding of waste would require the recognition of what value-adding and non-value-adding activities are. The opinions about what is adding or

not adding value to the process or to the customer vary of course to a great extent dependent on which actor you talk to (Josephson & Saukkoriipi, 2003). Nghona, Crowe, and Ndihokubwayo (2010) said that value-adding and non-value-adding activities could best be realized if the term value can be understood and expressed in what it actually means to those to whom value is to be delivered. Knuf (2000) defined value as everything a customer is willing and satisfied to pay for and Evans (2002) expressed value as the relative amount of the customer's perceived benefit to perceived cost.

Tsai (1998) explained that an activity is value-adding if it is judged to contribute to customer value or satisfy an organizational need. Furthermore, Allen (2000) explained that value-adding is to change the form, fit, or function of a product in order to satisfy the customer. Han, Lee, Fard, & Peña-Mora (2007) defined value-adding activities as operational efforts that realize project requirements defined in the contract data.

According to the non-value-adding activities, several researchers (Alwi, Hampson, & Mohamed, 2002; Josephson & Saukkoriipi, 2003; Han et al., 2007; Han, 2008; Emuze & Smallwood, 2011; Han, Lee, & Peña-Mora, 2012; Wu, Low, & Jin, 2013; Lárusdóttir, Cajander, & Simader, 2014) defined non-value-adding activity as an activity that produce costs, direct or indirect, and take time, resources or require storage but do not add value or progress to the project. Therefore, Buzby, Gerstenfeld, Voss, & Zeng (2002) and Han et al. (2007) described the non-value-adding activity as a wasted effort.

Ohno (1988) identified the following seven wastes, of which the first five refer to the flow of the material, the two last ones to work of the men:

1. Waste of overproduction
2. Waste of correction
3. Waste of material movement
4. Waste of processing
5. Waste of inventory
6. Waste of waiting
7. Waste of motion.

As evident from the waste list of Ohno, there can be a waste also in the utilization of labor and machines. Koskela (1997) mentioned that the main categories of waste during the construction process could be described as reworks/repairs, defects, delays, waiting, poor material allocation, unnecessary material handling and material waste.

2.11.2 Non-value-adding activities associated with the VOs

A perfect understanding of the VOs and subsequent waste occur if they are categorized by their origin and identification of possible waste zones. When a VO is issued, numerous non-value-adding activities/costs are likely to arise. These include unplanned site meetings, travelling, and communication expenses, idle plant, and labor during the waiting time, demolitions, the time took by the designer to understand the required change and redesign, cost and time for litigation in case misunderstanding arise between the contractor and the client or his/her consultant. These represent a waste of resources and are typically paid for by the client (Ndihokubwayo & Haupt, 2008). Nghona et al. (2010) presented some of the non-value adding activities arising during the design process originated from the pre-design stage. These non-value adding activities include redesign and changes in design. These activities absorb time and resources hence, non-value adding costs. Non-value adding activity in a form of the VOs originate from a lack of clear definition and mutual in depth understanding of the client development objectives and the end user services. Nghona et al. (2010) explained that the non-value adding activities arise following alterations demanded by the clients to design drawings.

If the client requirements are inadequately considered concerning the function, the anticipated quality standards, the use of space and the whole working environment of the proposed building, non-value adding activities occur in the form of changes in design drawings and specifications. Thus, poor consideration of the requirements results in unnecessary redesigns (Tzortzopoulos, Chan, Kagioglou, Cooper, & Dyson, 2005).

Ndihokubwayo and Haupt (2009) explained that the waste associated with the VOs was uncovered by identifying those that involved demolition and/or

abortion of work that had already been started and mentioned. An example of the activities that constituted waste included demolitions of portions of works already erected in order to correct errors. Most VOs added value to the project. However, waste was still a consequence of them. Arguably, the VOs may be seen as counter to the principle of waste reduction.

Oyewobi et al. (2016) noted that regardless of how beneficial a VO might be, non-value-adding costs are likely to accrue. For example, a VO to solve the discrepancies between contract documents involves the abortion of works that have already been executed. The cost for aborted works should not have been incurred if discrepancies were not found between contract documents.

Ndihokubwayo and Haupt (2009) found that the examination of site instructions revealed apparently associated waste especially those involving alterations to completed work by having complete designs before work commenced on site, the VOs could be reduced. In addition, Ndihokubwayo and Haupt (2008) argued that the existing estimating and contract valuation techniques do not provide a clear breakdown of losses of materials resulting from the VOs. For example, the cement that hardens in the stores following an instruction to suspend works is not allocated to the VO account. Ndihokubwayo and Haupt (2008) also mentioned that the waste of materials resulting from the VOs might occur in the following circumstances:

- Compensating waste arising when material ordered for one specific purpose is used for another. For example, facing bricks ordered for external wall erection may be used for internal plastered walls when there is a shortage of common bricks.
- Waste due to the uneconomic use of plant arising when the plant lies idle on site as a result of a VO.
- Waste of materials due incorrect decision, indecision or inconsistency inspection of works by the project consultant.
- Waste of materials after a demolition of a portion of work caused by the VO to change a trade. For example, waste for breaking a wall to accommodate a new door.

- Waste due to wrong use of material or waste stemming from materials wrongly specified.

Chan and Yeong (1995) explained that the reducing variations are one of the prerequisites of keeping the cost within budget and completing the project on time. In fact, the concept of non-value-adding activities compels construction project stakeholders to explore waste associated with activities traditionally not perceived as non-value-adding. This knowledge allows for the implementation of improvement measures (Ndihokubwayo, 2008).

2.12 Recommended Strategies to Minimize the VOs

The probable impact of the VOs can be minimized if conceivable strategies are clearly suggested. If strategies are suggested, It would assist professionals in taking proactive measures for reducing the VOs for construction projects. Arain and Pheng (2005) suggested that variations can be reduced with due diligence during the design stages. In order to minimize the VOs, control system should be established for the ultimate benefit of clients. Kudus (2005) concluded that the VOs could be minimized if all the parties involved in projects are aware that preliminary work before tendering must be carried out, for example, detailed site and soil investigations. While design errors and omissions cannot be completely avoided, they can be reduced especially if designers assessed their workloads before committing themselves to new contracts (Ndihokubwayo, 2008). In another way, the designers should ensure enough time and experienced human resources to deliver a sound design within the proposed time frames.

List of strategies that suggested by different researchers (Chan & Yeong, 1995; Sweeney, 1998; Formoso et al., 1999; Bower, 2000; Sun et al., 2004; Kudus, 2005 ; Arain & Pheng, 2005; Ndihokubwayo, 2008; Bin Ali, 2008)are identified as follows These are:

1. Adequate planning is required by all involved parties before works start on site;
2. The consultant should produce a concluding design and contract;
3. Drawings should be complete at tender stage;
4. Adequate time should be spent on pre-tender planning phase;
5. Clients should provide a clear brief of the scope of works;

6. All parties should forecast to overview unforeseen situations;
7. Closer consultant coordination is required at design stage;
8. Enhance communication and all parties should be proactive all times;
9. Works should be supervised with an experienced and dedicated supervisor;
10. Consultant should ensure that the design/specifications fall within the approved budget;
11. Get accurate information and research with regard to procurement procedure, material and plant;
12. Carry out detail site investigation including detail soil investigations and consider it during tendering stage;
13. Have the underground cable route confirm by the local authorities;
14. Have the land application or land purchase completed before awarding contracts;
15. Once the tender is awarded, there should be no changes to the specifications; and
16. Place experienced and knowledgeable executives in the engineering and design department.

2.13 Chapter Summary

This chapter reviewed a literature on the VOs management, their impact on project and strategies to minimize it. The VOs can potentially occur on all construction projects. Types of the VOs were identified according to various classification, reasons for their occurrence and subsequent effect, procedures introducing them, time, necessity, phase, and initiator.

The VOs are issued in the form of a site or contract instructions. However, not all site instructions constitute a VO. From five categories of site instructions that were identified, only two categories constituted the VOs. These included the instruction to vary the design, quality of works and the instruction to resolve discrepancies between contract documents. The instructions to reiterate or enforce contractual provisions, to deal with monetary allowance and to protect the client's interest became VOs only if they were incidental to the first or second types of instructions.

Two stages of Contract General Conditions used in the Palestine, before the year 1994 and after the year 1994. In Palestine. There are several types of general conditions available for inclusion in contract documents used by the different institutions, which are UNRWA, UNDP, PCTD, PECDAR, USAID, World Bank,

EU, and SMDM. Under contractual conditions, a VO is only valid if it is confirmed in writing. The valuation of a VO demands a thorough understanding of contractual provisions, costing principles and fair judgment. The relationship between impacts on project change as against the project delivery systems was examined.

The frequent occurrence of the VOs can affect the overall quality of the works. If not carefully administered, a VO may give rise to disputes between parties to the contract. According to the management of the VOs, five steps were explained which include: identification and understanding of contract requirements and provisions, identification of the possible variations that might occur in the future activities of the project, evaluation the potential VO, issuance of a written VO for implementation and thereafter, valuation and documentation of the VOs. Four origin agents for the VOs were identified. These included client, donor, consultant, and contractor.

A comprehensive list included fifty-seven (57) causes of the VO stemming from the four origin agents was developed. The literature suggested that the nature of the project, complexity of the project and selected procurement methods were factors influencing the occurrence of the VOs in the construction projects. The occurrence of the VOs adversely influences the performance of construction projects. According to their impact, nineteen (19) factors were investigated.

There are direct and indirect non-value-adding costs or waste associated with the VOs. Non-value-adding costs contribute to higher construction delivery costs due to wasted materials and inefficient use of resources**.** Main categories of waste during the construction process can be described as reworks/repairs, defects, material waste, delays, waiting, poor material allocation, unnecessary material handling and material waste. The occurrence of VOs leads to fluctuation of unexpected conditions and uncertain workflow hence the likely expansion of non-value-adding costs. Finally, sixteen (16) recommended strategies to minimize the VOs were summarized.

Chapter 3

Research Methodology

Chapter 3

Research Methodology

This chapter addressed the methodology details used in this research. The methodology describes the practical way in which the whole research project has been organized. It is a plan of action that shows how the problem was investigated, what information was collected using which methods, and how this information was analyzed in order to arrive at conclusions and develop recommendations. The chapter includes information about the research design, Data Sources, population and sample, and pilot study.

3.1 Research Design

This research aims to study the management of the VOs, their impact on the construction projects in Gaza Strip and recommended strategies to minimize it. A desk study was conducted on specific construction projects in Gaza Strip. The desk study on the selected construction projects involved the observation of monthly reports and payment certificates. This research can be both qualitative and quantitative. It is qualitative because the study focused on obtaining the perceptions of projects manager of the selected construction projects relative to the management of the VOs in their projects, their impacts, and strategies to minimize it. Moreover, open-ended questions were adopted in the questionnaire. The study is also quantitative because it focused on measurements of the variables that identified from the literature to get answers for the formulated questions. A quantitative strategy is suitable where there exists variables, measurements, analysis and statistical procedures. It can be used with a large number of cases representing the population and recommend a final course of action. In order to improve the validity of the findings of this research, the triangulation approach was adopted between the desk study, survey and the literature. This approach consists of combinations of qualitative and quantitative methods strengthened with the literature review. The research was designed by eight main steps as described below and shown in Figure (3.1).

- **First Stage: Problem identification**

It was initiated to define the problem, demonstrate the aim, objectives, and hypotheses. In addition, promote a research approach and a suitable technique.

- **Second Stage: Literature Review**

Several studies were reviewed from the literature, reading and taking notes from different sources such as: Academic research journals, Conferences, Dissertations/theses, and Websites.

Fifty-seven (57) causes and nineteen (19) impacts of the VOs were accumulated from the literature. They all were reviewed in the previous chapter in Table (2.3) and Table (2.5) respectively. Some of those causes and impacts have been modified, others have been merged or have been deleted through the process of questionnaire evaluation as well as some items have been added.

- **Third Stage: Desk Study**

In order to have information on the stated problem, six construction projects were selected. Data was extracted from the project payment certificates and monthly progress reports. This helps to understand the relationship between the theories and actual practices in construction projects. The data collected through the desk study was determined the worthiness of the topic for research.

- **Fourth Stage: Interviews**

The semi-structured interviews were conducted with the projects managers of the selected construction projects to understand the causes and impacts of the VOs not seen at their projects documents and gather information about the current practices of the VOs management in their companies as well as look for recommendation and strategies if any to minimize the occurrence of the VOs in construction projects.

- **Fifth Stage: Questionnaire Development**

According to the literature review, all the information that could help in achieving the study objectives were collected, reviewed and formalized to be suitable for the study survey. Therefore, a questionnaire was developed with close-ended and open-ended questions. After that, the pilot study was conducted to include two

stages. The first stage was undertaken by consulting 10 experts (professionals and academics) in construction and two experts in statistics to pre-test the survey and subsequently modified before a final version was produced. After this, the second stage was accomplished by making analysis trial using some of the population for validation before the main survey. The questionnaire was modified based on the results of the pilot study and the final list of questions was adopted to be used for the study.

- **Sixth Stage: The main survey**

In this stage, a quantitative approach was utilized as the main statistical component in the study. In order to obtain reliable and representative quantitative data, the questionnaires were distributed to three categories of the company (i.e. Client, Consultant, and Contractor). Therefore, One hundred and twenty-two (122) paper questionnaire and one hundred and sixty (160) electronically questionnaire distributed among clients, consultants, and contractors who work in construction projects

- **Seventh Stage: Results and discussions**

Data collected was analyzed using both tools descriptive and inferential. Analysis of the data was undertaken using Statistical Package for the Social Sciences (SPSS). The decision-making information can quickly be generated by using powerful statistics, to understand and present the results with tabular and graphical output, and share the results using a variety of reporting methods. By using this software, the following tests were adopted in this study:

A. Descriptive Statistics

1. Frequencies.
2. Measures of central tendency (the mean)
3. Measurement of dispersion based on the mean (standard deviation (SD))
4. Relative Importance Index (RII)
5. Kolmogorov – Smirnov (One- Sample K-S) test of normality.

B. The inferential statistics (bivariate).

1. Pearson product-moment correlation coefficient/ Pearson's correlation coefficient to test the validity of the questionnaire (a parametric test).
2. One-sample T-test for the mean of single samples to check the difference between the paragraph's mean and medium of a hypothesized value 3 (Middle value of Likert scale) (a parametric test).
3. The sample independent t-test to find out whether there is a significant difference in the mean between two groups (a parametric test).
4. Analysis of variance (one-way ANOVA) test to examine if there is a statistically significant difference between several means among the respondents (a parametric test).
5. Cronbach's Coefficient Alpha to test the reliability of questionnaire paragraphs.
6. Spearman-Brown to test the reliability of the questionnaire paragraphs.

- **Eighth Stage: Conclusion and recommendations**

In this stage of the research, conclusions and recommendations were adopted. It includes the results summary with related objectives, identifying problem areas from results and proposing an applicable solution.

- **Ninth Stage: Documentation**

The final phase of the research included formatting, editing the final text, and spelling and grammatical review.

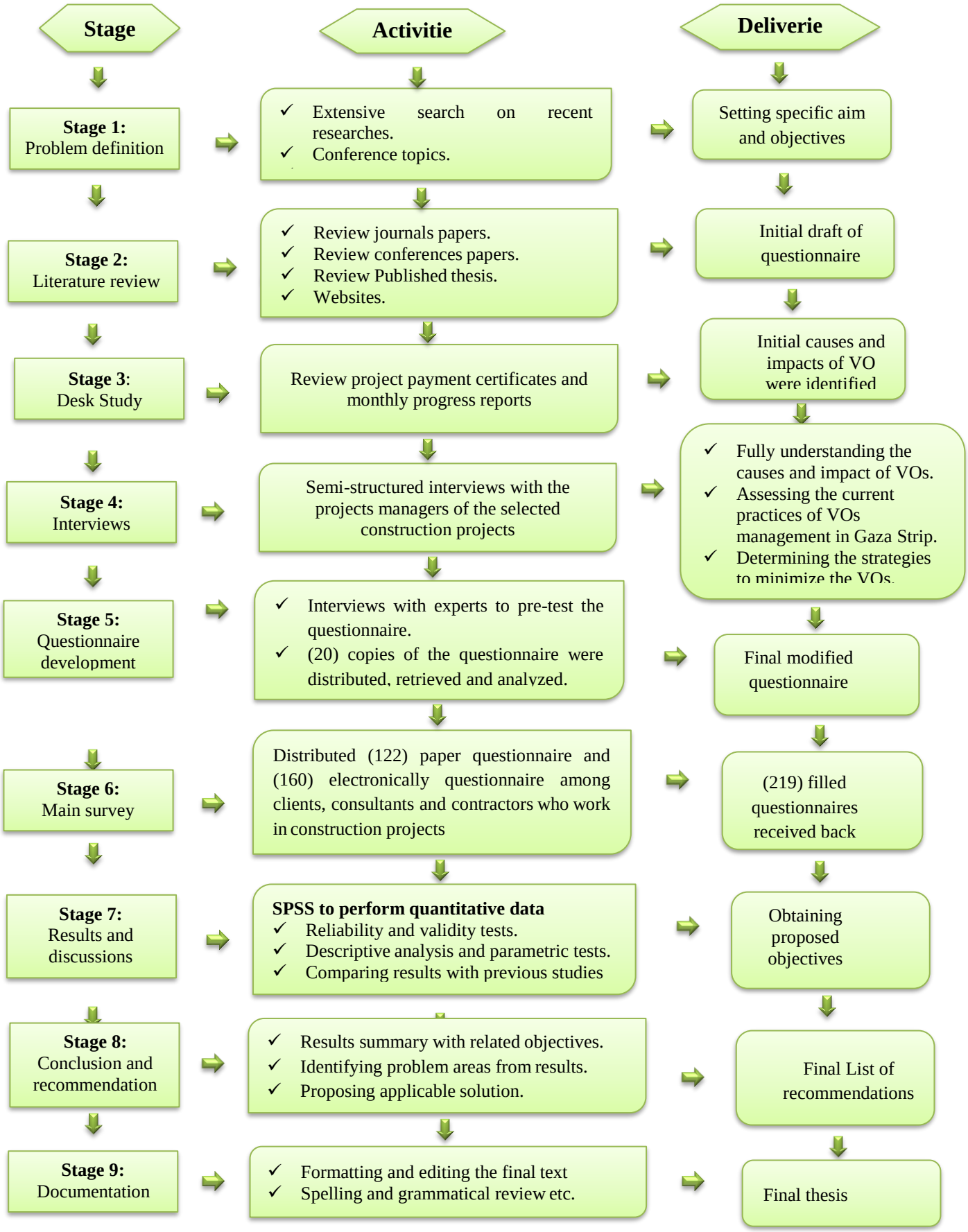

Figure (3.1): Framework of the research methodology

3.2 Data Sources

3.2.1 Secondary data

The secondary data is in the form of literary sources covering relevant topics of the subject matter. Secondary data obtained from different sources, including e-resources (the Internet), past research projects, journals, and books. The Internet provides access to a wide variety of different types of data that can be used to support the research. There are two different literature studies as following (Sey, 2008).

3.2.1.1 Preliminary literature study

A preliminary literature study allowed a feel for the topic to be acquired and the issues involved, and an understanding of how the proposed research would fit into it.

A preliminary literature provided an understanding of the background and key concepts of the research study and the basis upon which the problem statement was formulated.

3.2.1.2 Full literature study

A full literature study is part of the research process itself rather than part of the preparation for research. Such a literature review demonstrates that a researcher is knowledgeable of the area under investigation, shows how previous research studies support the current one and generate new research ideas through discovering what was left behind by others. The literature examined was compiled mainly from websites, textbooks, journals, conference proceedings, theses, and dissertations.

3.2.2 Primary data

3.2.2.1 Desk Study

The design of this research study was informed by the findings of the desk study. It conducted on six selected construction projects in Gaza Strip. Causes and impacts of the VOs of the projects were identified. In order to have

information on the stated problem, data was extracted from the project payment certificates and monthly progress reports.

3.2.2.2 Interviews

Any person-to-person interaction between two or more individuals with a specific purpose in mind is called an interview (Smith, 2012). The interview may be conducted face-to-face or by telephone. It involves questioning or discussing issues with people and it is viewed to be a very useful technique for collecting data which would probably not be accessible using techniques such observations and questionnaires. Because of its flexibility, an interview is a useful method of obtaining information and opinions from experts during the early stages of the research project (Kumar, 2011). Three kinds of interviews are distinguished: structured, unstructured and semi-structured.

3.2.2.2.1 Structured interviews

In structured interviews, the researcher asks a predetermined set of questions, using the same wording and order of questions as specified in the interview schedule. An interview schedule is a written list of questions, open-ended or closed, prepared for use by an interviewer in a person-to-person interaction (this may be face to face, by telephone or by other electronic media). One of the main advantages of the structured interview is that it provides uniform information, which assures the comparability of data. Structured interviewing requires fewer interviewing skills than does unstructured (Kumar, 2011).

3.2.2.2.2 Unstructured Interviews

In unstructured interviews, the almost complete freedom they provide in terms of content and structure represent the strength of it. You are free to order these in whatever sequence you wish. You also have complete freedom in terms of the wording you use and the way you explain questions to your respondents. You may formulate questions and raise issues on the spur of the moment, depending upon what occurs to you in the context of the discussion (Kumar, 2011).

3.2.2.2.3 Semi-structured Interviews

In semi-structured interviews, the interviewer prepares a list of predetermined questions as the structured interview, participants in a semi-structured way have the opportunity to explore issues in as much depth and from as many angles as they please, during answering the open-ended questions. In addition, the interviewer has a greater freedom to probe various areas and to raise specific queries during the semi-structured interview. Conducting semi-structured interview requires background reading, preparing and formulating questions, deciding who to recruit and contacting them to set up appointments, carrying out the interviews, transcribing the script, analyzing the answers and information, and then writing up a coherent text (Longhurst, 2009).

In this research, semi-structured interviews were conducted with the projects managers of the selected construction projects to understand the causes and impacts of the VOs not seen at their projects documents and gather information about the current practices of the VOs management in their companies as well as look for recommendation and strategies if any to minimize the occurrence of the VOs in the construction projects. Interviewees were first informed of the focus of the interview prior to the meeting. This helped the interviewees to prepare for the interview in advance.

3.2.2.3 Questionnaire

A questionnaire is a written list of questions, the answers to which are recorded by respondents. In a questionnaire, respondents read the questions, interpret what is expected and then write down the answers (Kumar, 2011). It is the simplest and time-saving method to collect data effectively from a huge number of respondents. Formulating questions from the identified variables, the questionnaire was designed to gather data from professionals that were involved in the construction projects in Gaza Strip. The questionnaire design was extracted from previous studies directly related to the subject of this research. After a long time of searching, consulting, modifying and reviewing by the supervisor and experts, the questionnaire was established and ready for distribution. The

questionnaire was designed in both English and Arabic languages in order to facilitate the understanding of content for the concerned population sample. Closed-ended and Open-ended questions were formulated.

3.2.2.3.1 Closed-ended questions

Respondents were restricted in the way they answered the questions, as they were required to select one answer from among the given ones. Closed-ended questions, as they provide 'ready made' categories within which respondents reply to the questions asked by the researcher, help to ensure that the information needed by the researcher is obtained (Smith, 2012).

3.2.2.3.2 Open-ended questions

These are the questions that seek to get the opinion of respondents. An open-ended question is a qualitative inquiry aiming at minimizing the imposition of predetermined responses when gathering data whereby people can respond in their own words (Quinn Patton, 2005). Smith (2012) indicated that open-ended questions provide a wealth of information provided respondents feel comfortable about expressing their opinions; provide the respondents an opportunity to express themselves freely resulting in a greater variety of information; virtually eliminate the possibility of the investigator's bias.

The questionnaire was structured in eight sections as follows:

Section 1: General Information.

Section 2: Information about the projects that the respondents managed.

Section 3: The prevalence of the VOs.

Section 4: Assessing the current practices of the VOs management in Gaza Strip.

Section 5: Non-value adding activities associated with the variations during the construction stage.

Section 6: Origin agent of the VOs and factors causing it.

Section 7: Impacts of the VOs.

Section 8: Recommendations to minimize VOs.

The researcher used the five-point Likert scale to measure responses on questionnaire items. In addition, the researcher chose the scale from (1-10) where the answer closer of (10) indicated the high approval of what was mentioned in the concerned paragraph, each scale has a relative weight, as shown in Table (3.1):

Table (3.1): Likert Scale

Agree		**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Severity (Influence)		Not at all influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
Occurrence (frequency)		Never	Rarely	Occasionally	AModerate amount	Agreat amount
Degree of approval	**(1-5)**	1	2	3	4	5
	(1-10)	1+2	3+4	5+6	7+8	9+10
Relative Weight %		20%	40%	60%	80%	100%

3.3 Population and Sample

3.3.1 The Population

The studied population includes clients, contractors, and consultants in Gaza Strip. The contracting companies have a valid registration to December 2017 under classification first and second. The classification of the company depends on every sector the company is working. Therefore, you may find a company has classified as a first degree in building and second degree in roads. The consultant offices have a valid registration to June 2017. According to the Palestinian Contractors Union (PCU) in Gaza strip, there are 190 contractor organizations under classification first and second. According to the Engineers' Association in Gaza strip, there are 62 consultant offices. Moreover, the population of the clients in Gaza Strip cannot be determined so, the researcher used a sample of 32 clients in Gaza strip.

3.3.2 The sample

Kothari (2004) indicated that the sampling is a process of selecting representative units of the whole population for the study. In other words, the study sample is a subset of a population selected to participate in a research study and its size refers to the number of the elements to be included in a study, which

can be individuals, groups or organizations (Zikmund, Babin, Carr, & Griffin, 2013). It is rarely possible to conduct full population surveys so that, a sample can be chosen from the study population. Fellows and Liu (2015) explained that the objective of sampling is to provide a practical means of enabling the data collection and processing components of research to be carried out while ensuring that the sample provides a good representation of the population. Fellows and Liu (2015) also indicated that the sample should be free from bias. Otherwise, the type of selected sample will greatly affect the reliability of subsequent generalization. Sampling strategies are categorized into two main groups, namely probability and non-probability sampling (Tansey, 2007)

A. Probability sampling

Probability sampling is also known as random sampling. In random sampling, all members of the population are listed, and subjects are chosen from that list in random order so, each member has an equal chance of being selected. The advantage of this method is that it is free from bias and it enables generalizations from the sample to the wider population (Tansey, 2007). A random sampling was preferred in the survey so, the samples were selected randomly from contracting companies, consultant offices and clients in Gaza Strip from south to north.

B. Non-probability sampling

Non-probability sampling is also known as non-random sampling. Although non-random sampling is viewed as providing a weak basis of generalization, it is a useful method for certain studies. This method of sampling is preferred when it is difficult to get a response from sample population selected at random (Kumar, 2011). There are no hard and fast rules or guidelines determining the size of non-probabilistic samples (Guest, Bunce, & Johnson, 2006). Given the nature of required data to be gathered from the desk study and the anticipated cooperation of selected participants, a non-random sampling method was judged to be the most suitable so, the purposive sampling method was adopted**.**

Purposive sampling consists of hand-picking supposedly typical or interesting cases. According to Kumar (2011), the purposive sampling technique allows the

researcher to select a respondent who has good knowledge of the subject under discussion. Based on this, six construction projects were selected to represent the desk study. After that, interviews with the managers of the projects were conducted.

3.3.3 Sample Size

Statistical equations were used in order to calculate the sample size for the study population. The following statistical equation was used to determine the sample size (Creative Research System, 2014)

$$\boldsymbol{SS = \frac{Z^2 \times P \times (1-P)}{C^2}} \qquad \textbf{(3.1)}$$

Where:

SS: The sample size

Z: Z value (e.g. 1.96 for 95% confidence interval)

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

C: confidence interval, expressed as decimal (e.g., 0.05 = ±5)

So that:

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

Correction for finite population

$$\boldsymbol{SS_{new} = \frac{SS}{1 + \frac{SS-1}{POP}}} \qquad \textbf{(3.2)}$$

Where: pop is the population;

For the contracting companies (First and Second class), Population = 190 companies.

So that:

$$SS_{new} = \frac{384}{1 + \frac{384 - 1}{190}} = 127$$

For the consulting offices, Population = 62 offices.

So that:

$$SS_{new} = \frac{384}{1 + \frac{384 - 1}{62}} = 54$$

For the clients, the required sample size 30

One hundred and twenty-two paper questionnaires and One hundred and sixty (160) electronic questionnaires were distributed to the potential respondents. 190 questionnaires were distributed to contractors, 62 to consultants, and 32 to clients. Of the two hundred and eighty-two (282) paper and electronic questionnaires distributed, two hundred and nineteen (219) questionnaires were returned that include 128 from contractors (67.4%), 59 from consultants (95%), and 32 from clients (100%) as shown in Table (3.2)

Table (3.2) Population and Sample Size

Target group	Collected Questionnaire			Population	Required Questionnaire
	Collected paper Questionnaire	Collected electronic Questionnaire	All Collected Questionnaire		
Client	24	8	**32**	∞	30
Consultant	29	30	**59**	62	54
Contractor	44	84	**128**	190	127

3.4 Pilot study

In order to test the appropriateness, validity, and reliability of the questionnaire before committing to the complete sample population, a pilot study for the questionnaire was conducted. A pilot study provides a trial run for the questionnaire, which involves testing the wording of questions, identifying any ambiguous questions, testing the technique that used to collect the data, etc. (Naoum, 2007). Hence, any modification of the questionnaire design can be changed. The pilot study was divided mainly into three stages which were:

The first stage: In this stage, the questionnaire was consulted by experts in construction projects and they have an academic background in questionnaires assessment and experts in statistics.

The second stage: In this stage, the questionnaire was conducted to limited group from the targeted population by distributing the questionnaire conveniently to 20 respondents selected randomly.

The third stage: In this stage, the questionnaire analyzed using statistical tests in order to check the questionnaire validity and reliability.

3.4.1 Experts consultation

Pre-testing of the survey can help determine the strengths and weaknesses of the questionnaire concerning question format, wording, and order. For that, the researcher interviewed a sample of ten (10) different experts (professionals and academics) in Gaza Strip to pre-test the survey and subsequently the questions were rephrased, simplified, and modified based on the feedback from the experts, thus questions have become clear to be answered in a way that helps to achieve the target of the study. Another step was consulting two experts in statistics to identify that the instrument used was valid statistically and that the questionnaire was designed well enough to provide relations and tests among variables. Each expert got a copy of the questionnaire for revision, and after that, the researcher discussed the notes with each expert. Each expert developed his own notes for modification and some notes were confirmed by more than one expert. Each note was carefully considered in preparing the final questionnaire. The following items are a summary of the major observations based on the pilot study indicated in Table (3.3).

Table (3.3): Results of pre-testing the questionnaire

Expert #	Outcome
Expert1	✓ Amendment on the scale of answers in the first section. ✓ Suggestion to use five Likert scale in the fourth section. ✓ Wording of some questions in the third, fifth, sixth and seventh section. ✓ Delete "Instructions to deal with the monetary allowance" from the third section because it considered impractical or unrealistic with respect to the unique situation of the construction projects in the Gaza Strip. ✓ Reformulation the factors causing the VOs and impact factors. ✓ Suggestion to a new title for sub-list in the sixth section from "other" to "Environmental factors"

Continued table (3.3):

Expert #	Outcome
Expert 3	✓ Wording of some questions in the second section ✓ Suggestion to use five Likert scale in the third section. ✓ Delete "omission from works" from the third section ✓ Reformulation the activity in the fourth section to be passive. ✓ Reformulation the impact factors "Damage to firm's reputation" to "Image of tech. department (revising of problem statement) then affect the image of the institution". ✓ Re-arrange some factors to give more suitable and consistent meaning.
Expert 4	✓ Add required improvement in question 17 at the sixth section. ✓ Change the scale/range of answers in the first section ✓ Wording of some questions in the first and second section. ✓ Suggestion to use percentage instead of five Likert scale in the second section. ✓ Add paragraph guidelines for the respondent of the questionnaire.
Expert 5	✓ Wording of some questions in the first and second section. ✓ Reformulation the activity in the fourth section to be passive. ✓ Change "Have the land application or land purchase completed before awarding contracts" to "Settling the legal status of land ownership of the project before awarding the tender to the contractor" in the eighth section. ✓ Change "The consultant should produce a concluding design and contract" to "Identification and understanding of contract requirements and provisions by the respective parties before the project starts" in the eighth section. ✓ Add "Required improvements" to question 10 in the third section.
Expert 6	✓ Suggestion to use four types of project "Roads, Building/Residential, Sewerage and water, and Electro-mechanics instead of the two types " infrastructure and Building/residential" ✓ Merge two sentences in the third section from "Additional works, omission from works" to " Additional or omission on regarding coping BOQs with drawings". ✓ Omit "Value engineering", "Design discrepancies", "Inadequate working drawing details" and "Consultant's lack of required data" from the causes related to the consultant in question 17 in the sixth section.
Expert 7	✓ Add an example to question 10 in the third section according to the substitution of works (i.e. Replacing material not available in local market). ✓ Suggestion to change "All clients are fully aware that there could be unnecessary costs that accrue due to the VOs" to "All clients are fully aware that the VOs are based on market surveys and price analysis" at question 12 in the third section. ✓ Add "Required improvements" to question 10 in the third section.
Expert 8	✓ Add "Overhead compensation on a suspension of work" to question 10 in the third section. ✓ Add "The excessive occurrence of the VOs may lead that the designs and quantity take off procedures need to be upgraded" to question 12 in the third section. ✓ Change "Poor procurement process" to "Searching for compensating costs for his low prices if any" in question 17 at the sixth section. ✓ Add "Required improvements" to question 10 in the third section.

Continued table (3.3):

Expert #	Outcome
Expert 9	✓ Add "Compensation for justified delay due to the VOs" to question 10 in the third section. ✓ Add "The excessive occurrence of the VOs may lead that market surveys procedures need to be upgraded" to question 12 in the third section. ✓ Omit "Socio-cultural factors" from the causes related to Environmental factors in question 17 in the sixth section. ✓ Omit "Poor site management and supervision" from question 17 at the sixth section. ✓ Change "Ambiguous design details" to "Inadequate and ambiguous design details and non-clearance of BOQ" in question 17 at the sixth section.
Expert 10	✓ Add "Required improvements" to question 10 in the third section. ✓ Delete "The excessive occurrence of the VOs increases the possibility of unethical practices" from question 12 in the third section. ✓ Change "Excessive VOs result in incurring unnecessary costs" to "Excessive VOs result in incurring additional costs" in question 18 at the seventh section.

3.4.2 Distributing questionnaire to limited group

A small-scale rehearsal of the larger research was conducted before the intended study. Twenty (20) copies of the questionnaire were distributed. The sample selected from the population randomly in order to test the validity and reliability of the questionnaire.

3.4.3 Statistical data analysis using SPSS

After the researcher collected the twenty (20) questionnaire, data analyzed using SPSS in order to test the internal validity and the reliability of the questionnaire. The validity tested using Pearson correlation coefficient for both Internal and structural validity of the questionnaire. The reliability tested using two types of tests the first was Half Split Coefficient and the second was Cronbach's Alpha Coefficient.

3.4.3.1 Questionnaire Validity:

Validity refers to the degree to which an instrument measures what it is supposed to be measured (Pilot and Hungler, 1985). Validity has a number of different aspects and assessment approaches. Statistical validity is used to evaluate instrument validity, which includes external, criterion-related/internal and structural validity**.** Two substantial tests were applied; the

first was criterion-related/internal validity test (Pearson test) which measure the correlation coefficient between each item in the field and the whole field. The second was structure validity test (Pearson 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 field and all the fields of the questionnaire that have the same level of similar scale.

3.4.3.1.1 External Validity:

To ensure a high level of validity, the questionnaire has been handed to a number of concerned experts in construction projects and they have an academic background in questionnaires assessment and experts in statistics. These referees kindly presented their views on the questionnaire in terms of its content, clarity of items' meaning and suitability. They also proposed what they deem necessary to modify the formulation of items in order to avoid any misunderstanding and to assure that the questionnaire meets aims of the study. The final copy of the questionnaire was modified and refined according to the experts' recommendations. (Refer to Appendix A and Appendix B for the final questionnaire design in English and Arabic respectively).

3.4.3.1.2 Criterion-related/Internal Validity:

Internal validity of the questionnaire was the first statistical test used to test the validity of the questionnaire by measuring the correlation coefficients between each item in one field and the whole field.

The correlation coefficient for each domain items was significant at $\alpha = 0.05$, where the probability value of each paragraph was less than 0.05 as shown in Table (C 1) to Table (C 6) in Appendix C. It can be concluded that the paragraphs of the questionnaire were consistent and valid to measure what it was set for.

3.4.3.1.3 Structure Validity:

Structure validity was the second statistical test used to examine the validity of the questionnaire structure by testing the validity of each field and the validity of the entire questionnaire. It measured the correlation coefficient between one field and all the questionnaires' fields that have the same level of the scale. Table (C 7) in Appendix C indicated the correlation

coefficients between the degree of each dimension of the questionnaire and the total degree of the questionnaire. The correlation coefficients were statistically significant at $\alpha \leq 0.05$, while the probability value for all paragraphs is less than 0.05. Therefore, it can be seen that the dimensions were valid to measure what they were set out for so as to achieve the main aim of the research.

3.4.3.2 Questionnaire Reliability:

Reliability is the degree of consistency and precision or accuracy that a measuring instrument demonstrates. Polit and Hungler (1985) defined the reliability as the degree of consistency which measures the attribute it was supposed to be measuring. The less variation an instrument produces in repeated measurements of an attribute, the higher its reliability. Other terms used interchangeably with reliability were stability, dependability, and predictability. If for instance, an instrument elicits similar circumstances, the test is said to be consistent, and therefore, it can be depended upon. Reliability is measured by two methods as follows:

3.4.3.2.1 Split-Half Method:

After the questionnaire is administered, questionnaire paragraphs are fragmented into two parts, namely the odd-number questions, and even-number questions. Then the correlation coefficient between individual questions degrees and degrees of even questions is calculated and corrected by Spearman Brown.

Average correlation coefficient= $\frac{2r}{1+r}$

where r correlation coefficient between degrees of odd-number questions and even-number questions (Kumar, 2011). The normal range of corrected correlation coefficient was between 0.0 and + 1.0 and the significant (α) is less than 0.05 so, all the corrected correlation coefficients were significant at α = 0.05. It can be said that according to the Half Split method, the questionnaire was reliable. Results were indicated in Table (3.4).

Table (3.4) Reliability coefficients by Split-half method

Dimension	Correlation coefficient by Spearman	Reliability coefficient by Brown method
The Prevalence of the VOs	0.35	0.52
Assessing the current practices of the VOs management in Gaza Strip	0.56	0.71
Non-value adding activities associated with the variations during the construction stage	0.39	0.56
Origin agent of the VOs and factors causing it	0.70	0.82
Impacts of the VOs	0.71	0.83
Recommendations to minimize the VOs	0.83	0.91
Total questionnaire paragraphs	**0.74**	**0.85**

3.4.3.2.2 Cronbach's Alpha Method:

It is one of the most commonly used indicators of reliability analysis. Cronbach's Coefficient Alpha was 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 was between 0.0 and + 1.0. Higher values reflect a higher degree of internal consistency (Pallant, 2013). The Cronbach's coefficient alpha was calculated for each field of the questionnaire. The range of 0.74 and 0.96, while the Cronbach's Alpha for the entire questionnaire is 0.97, which indicates an excellent reliability of the entire questionnaire. Thus, the researcher was assured of the questionnaire reliability and validity for responding. Results were indicated in Table (3.5).

Table (3.5): Reliability Cronbach's Alpha method

Dimension	Number of paragraphs	Cronbach's coefficient alpha
The Prevalence of the VOs	16	0.74
Assessing the current practices of the VOs management in Gaza Strip	7	0.81
Non-value adding activities associated with the variations during the construction stage	5	0.76
Origin agent of the VOs and factors causing it	53	0.96
Impacts of the VOs	23	0.92
Recommendations to minimize the VOs	15	0.92
Total questionnaire paragraphs	**119**	**0.97**

3.4.3.3 Test of Normality

Normal distribution approximates many natural phenomena so well. It has been developed into a standard of reference for many probability problems (Field, 2009). Parametric statistical tests often assume the data has a normal distribution because when the data is not normal, it produces unqualified results. Normality was assessed by applying the Central Limit Theorem. The Central Limit Theorem states that when samples are large (above about 30), the sampling distribution will take the shape of a normal distribution regardless of the shape of the population from which the sample was drawn (Field, 2009; Levine, 2008). According to that, the collected data of the research follows the normal distribution, where the sample size is N=219, and so parametric tests must be used. Besides The Central Limit Theorem, normality was assessed by conducting One-Sample Kolmogorov-Smirnov (K-S). The One-Sample Kolmogorov-Smirnov test procedure compares the observed cumulative distribution function for a variable with a specified theoretical distribution, which may be normal, uniform, Poisson, or exponential. The Kolmogorov-Smirnov Z was computed from the largest difference (in absolute value) between the observed and theoretical cumulative distribution functions. This goodness of fit test to examine whether the observations could reasonably have come from the specified distribution. The one-sample Kolmogorov-Smirnov test can be used to test that a variable of interest is normally distributed (Henry & Thode, 2002). Table (3.6) showed the results of Kolmogorov-Smirnov test of normality. From Table 3.6, the probability value **(**p-value) of each variable is greater than 0.05 level of significance, and then the distributions for these variables were normally distributed. Consequently, parametric tests can be used to perform the statistical data analysis.

Table (3.6) One-Sample Kolmogorov-Smirnov Test

Dimension	Z-Value	(P-value)
The Prevalence of the VOs	1.33	0.06
Assessing the current practices of the VOs management in Gaza Strip	1.29	0.07
Non-value adding activities associated with the variations during the construction stage	1.23	0.09
Origin agent of the VOs and factors causing it	1.23	0.09
Impacts of the VOs	0.81	0.52
Recommendations to minimize the VOs	1.32	0.06
Total questionnaire paragraphs	**0.43**	**0.99**

After analysis, the result proved that the questionnaire design (the internal consistency, and the structure of the questionnaire) is valid and that data collected were reliable. Based on that, the 20 successful copies were included in the whole sample.

3.4.3.4 Relative Importance Index (RII)

The RII was used to determine the ranks of all factors and computed as (Sambasivan & Soon, 2007; Field, 2009)

$$\text{Relative importance index method (RII)} = \frac{\sum w}{AN} = \frac{5n_5+4n_4+3n_3+2n_2+1n_1}{5N} \qquad (3.3)$$

Where W is the weighting given to each factor by the respondent, ranging from 1 to 5,(n1 = number of respondents for very low, n2 = number of respondents for low, n3 = number of respondents for medium, n4 = number of respondents for high , n5 = number of respondents for very high). N is the total number of participants in the sample. The RII value had a range of 0 to 1 (0 not inclusive), the higher the value of RII, the more impact of the attribute. However, RII doesn't reflect the relationship between the various attributes. Additional analysis is accompanied by the RII analysis such as the mean and SD (Muhwezi, Acai, & Otim).

3.4.3.5 Parametric tests:

A parametric test is a test that requires data from one of the large catalog of distributions that statisticians have described. Normally this term is used for parametric tests based on the normal distribution, which require four basic assumptions that must be met for the test to be accurate: a normally distributed sampling distribution (researcher can approximate using a normal distribution after invoking the central limit theorem), homogeneity of variance, interval or ratio data, and independence (Field, 2009).

3.4.3.5.1 Pearson product-moment correlation coefficient/ Pearson's correlation coefficient

Pearson product-moment correlation is the most common measure of correlation. It is an index of the relationship between two variables. It reflects the degree of linear relationship between two variables. Pearson correlation is symmetric, i.e. the correlation between x and y is the same between y and x and ranges between +1 and -1, where +1means a perfect positive linear relationship between variables while -1 means a perfect negative linear relationship between variables. In addition, a correlation of 0 means no linear relationship between two variables.

3.4.3.5.2 One sample t-test.

The t-test is a parametric test which used to check the difference between the paragraph's mean and medium of a hypothesized value 3 (Middle value of Likert scale).

3.4.3.5.3 Sample Independent *t*-test

The independent samples *t*-test is probably the most widely used test in statistics. It is used to find out whether there is a significant difference in the mean between two groups. Differences between groups can be explored with independent *t*-test in one condition, that the members of each group are reasonably representative of the population.

3.4.3.5.4 One way ANOVA.

If there are more than two independent groups being compared, the one-way ANOVA is used if the parametric assumptions are satisfied that is, interval scale

variable approximately normally distributed. It used to examine if there is a statistically significant difference between several means among the respondents

3.5 Chapter Summary

This chapter explained the methodology used in this study step by step. The methodology used was considered to achieve the earlier mentioned objective. For better understanding, the methodology simplified into a flow chart diagram as shown in Figure (3.1). The steps from the initial stage of identifying the problem to discussing the method of analyzing were explained. The chapter discussed the primary research framework for the study, population, and sample size. The source of primary and secondary data was outlined and the questionnaire appraisal was detailed through the pilot study. The three fundamental steps were validity, pre-testing the questionnaire and pilot study. These steps were used on the final adjustment on the questionnaire and were described in detail in this chapter. In addition, quantitative data analysis techniques have been used that involved RII, normality, Pearson correlation analysis and other methods using an analytical tool such as SPSS. The results were displayed on tables. To ensure the test validity, reliability used in the analysis.

Chapter 4

Results and discussion

Chapter 4

Results and discussion

This chapter analyses the data collected using desk study, interviews and questionnaire. The method used was discussed in Chapter 3. Interviews with the managers of the selected construction projects are presented, together with observations from desk study. In addition, the collected data from the questionnaires were processed and statistically analyzed using the necessary tests. SPSS was utilized for the analysis of data to furnish the study queries and reach the research result. The objective of this chapter is to identify the highest ranked factors for discussion and to find the correlation with findings from the interviews and desk study.

4.1 Analysis of Data from the Desk Study

Six (6) completed projects in which the VO approved were selected for desk study in order to identify the causes and impacts of the VOs in the construction projects in Gaza Strip. These projects were 100% completed and selected as a representative to the occurrences of the VOs of each of the construction projects. The list of selected projects is as shown in Table (4.1).

Table (4.1): List of selected construction projects

Project Code	Project Name	No. of VOs	Final Expenditure ($)	Actual VO Amount ($)	% of the actual VOs amount to the Final Expenditure
Project A	Re-Construction of a school	5	1,346,581.69	83,971.95	6.24
Project B	Construction of Dwelling Units	4	5,386,907.90	113,304.14	2.10
Project C	Construction of Solid Waste Collection and Transfer Station	3	478,591.95	71,040.80	14.84
Project D	Health Center	3	2,059,203.45	129,182.15	6.27
Project E	Development of Sewerage, Drainage And water systems	2	1,501,107.57	25,324.53	1.69
Project F	Upgrading of Water Well	2	126,089.05	35,825.00	28.41

Source: UNRWA (2017)

4.1.1 Project A

The tender sum for project A was $1,345,971.90 and the original planned works duration was 264 days. There were numerous replacement works due to non-availability of the material at the local market. During the observation of the project, it was observed that some of the material was not available at the local market with the required specification and enough quantities, it was decided that this material should be replaced by another and minor changes were applied. In Gaza Strip, as a special case, there is a restriction in terminals and crossing closure and siege by Israel. Many construction materials and equipment spare parts are prohibited from accessing to Gaza Strip after the Israeli side gave the green light to coordinate entering the construction raw materials to the projects so these materials need to be coordinated from outside special for the project. Other changes occurred due to delay in supply many of raw materials through coordination of material from outside and due to the needs to complete the school before starting the new scholastic year, it was decided to use the raw materials from the local market and paid to the contractor the difference in cost between prices through coordination from outside and prices in the local market. The client added many items due to required improvement. The final expenditure and cost of the project were $1,346,581.69. Due to changes occur during the construction, five VOs were issued at $83,971.95 as per executed cost which was a cost overrun of 6.24% over the planned works cost. The project was delayed 51 days as a result of the VOs, which was a time overrun of 19.32% over the schedule of works. The actual date of the project completion was 14 November 2016.

4.1.2 Project B

The tender sum for project B was $ 5,781,495.00 and the original planned works duration was 336 days. The project was exposed to variation due to essential modifications to some items due to non-availability of the required materials in the local market as a result of prohibition for this items, in addition to inability of materials coordination from the client side from outside during this stage, where the project is reached to a critical period that may hinder its handing over to the beneficiaries. A deduction for the difference in cost was made to

accept the available materials in the local market. Some amendments were added to match the existing architecture drawings, dimensions, and Gaza Electricity Distribution Corporation (GEDCO) specification. Some items were missed during the design stage and were not included in the original BOQ. Furthermore, some essential additional works and improvements were added in order to achieve special needs of some beneficiaries and other were added due to the budget allocated constraints because the donor will withdraw the saving money of the project. The final expenditure and cost of the project were $5,386,907.90. Four VOs were issued at $113,304.14 as per executed cost which was a cost overrun of 2.1% over the planned works cost. The project was delayed 9 days as a result of the VOs, which was a time overrun of 2.68% over the duration of the planned works. The actual date of project completion was 9 March 2016.

4.1.3 Project C

The tender sum for Project C was $493,525.50 and the original planned works duration was 108 days. The work was stopped due to change the location of the project two times due to objection from the surrounding beneficiaries to construct the project at the area required, new approval consumed 6 months for the two times. Consequently, VO is issued as a result of lack coordination between the client and the municipality to reimburse the contractor the costs occurred during the extended time frame. A claim was issued by the contractor to reimburse the overhead cost, renewal of insurance and bank guarantees, mobilization, damage to contractor's equipment and facilities and the cost of cleaning the site and leveling works at two locations. During the observation of the project, it was observed that some of the required material not available at the local market and no coordination for this type of material, so this material substituted to other and need a redesign. Other changes occur due to some of the elements need to be changed to match the new requirements for operating the system in the project. The client added some items due to required improvement. The final expenditure and cost of the project were $478,591.95. Due to changes occur during the construction, three VOs were issued at $71,040.80 as per executed cost which was a cost overrun of 14.84% over the planned works cost. The project was delayed 507 days as a result of the VOs, which was a time

overrun nearly five times of the schedule of the works. The actual date of projects completion was 02 January 2017.

4.1.4 Project D

The tender sum for project B was $1,993,288.00 and the original planned works duration was 312 days. The project was exposed to variation due to the unforeseeable item. It was observed that an existed items underground should be demolished and an existing item in the site should be relocated. This is because of the not adequate site and soil investigation. In addition, It was found that some items were needed and were not included in BOQ. Another variation is due to the supplied material differ from the required item description but technically, the supplied material was accepted as advised by the Design Division. The supplied quantities cannot be returned to the supplier in Israel nor it can be sold in the local market. In this current situation of closure, a new request to supply the required materials cannot be made. A specific amount was deducted from the original unit price. During the observation of the project, it was observed that the designer corrected an error in the description of an item. The client added some items due to required improvement. The final expenditure and cost of the project were $2,059,203.45. Due to these changes, Three VOs were issued at $129,182.15 as per executed cost which was a cost overrun of 6.27% over the planned works cost. The project was delayed 40 days as a result of the VOs, which was a time overrun of 12.82% over the duration of the planned works. The actual date of projects completion was 31 January 2015.

4.1.5 Project E

The tender sum for project E was $1,360,634.00 and the original planned works duration was 312 days. VOs were issued due to a required improvement, insufficient site investigation and unforeseeable works. Other variation issued because of the Israeli side prohibited the access of the coordinated materials from outside so, it was decided to use the required materials from the local market and paid to the contractor the difference in cost of material arising from the not availability of this materials with reasonable prices in the local market. The final expenditure and cost of the project were $1,501,107.57. The project was exposed

to two VOs of $25,324.53 as per executed cost which was a cost overrun of 1.69% over the planned works cost. The project was delayed 68 days as a result of the VOs, which was a time overrun of 21.80% over the duration of the planned works. The actual date of projects completion was 30 November 2016.

4.1.6 Project F

The tender sum for Project F was $ 126,728.00 and the original planned works duration was 24 days. The project was exposed to variation due to an error during design stage because of insufficient site investigation which led to replacing some of the materials to another to be consistent with the circumstances of the area of the project. Other changes occur due to unforeseeable works. The client added some items due to required improvement. The final expenditure and cost of the project were $126,089.05. Two VOs were issued at $35,825.00 as per executed cost which was a cost overrun of 28.41% over the planned works cost. The project was delayed 10 days as a result of the VOs, which was a time overrun of 41.67% over the duration of the planned works. The actual date of projects completion was 16 April 2016.

4.2 Analysis of Data from the Interview

Interviews were made between the projects' managers of the selected construction projects focusing on fully understanding the causes and impacts of the VOs not seen at their projects documents, assessing the current practices of the VOs management in their companies and determining the recommendations or strategies could be taken to minimize the occurrence of the VOs in the construction projects as shown in Table (4.2) below.

Table (4.2): Interviews results

Question	Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F
What are the causes of the VOs on the selected construction projects?	1. Substitution works due to non-availability of the required materials at the local market due to Israeli restriction in terminals and crossing closure and siege. 2. Paying to the contractor the difference in cost between prices through coordination and prices in the local market due to Israeli restriction in terminals and	1. Paying to the contractor the difference in cost between prices through coordination and prices in the local market due to Israeli restriction in terminals and crossing closure and siege. 2. Amendments to match the new requirements and items are missed because of inadequate revision and feedback system through	1. Unforeseeable works 2. Substitution works due to non-availability of the required materials at the local market due to Israeli restriction in terminals and crossing closure and siege. 3. Land allocation problems. 4. Lack coordination between the client and the municipality.	1. Unforeseeable works 2. Insufficient site and soil investigation prior to design. 3. Items are missed because of inadequate revision and feedback system through design process 4. Errors and omissions in design 5. Substitution works due to required improvement.	1. Unforeseeable works 2. Paying to the contractor the difference in materials cost between prices through coordination and prices in the local market due to Israeli restriction in terminals and crossing closure and siege. 3. Insufficient site and soil investigation prior to design.	1. Unforeseeable works 2. Errors and omissions in design. 3. Addition works due to required improvement

Continued Table (4.2):

Question	Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F
	3. crossing closure and siege. 4. Addition works due to required improvement	3. the design process. 4. Addition works due to the budget allocated constraints. 5. Addition works due to required improvement	5. Insufficient site and soil investigation prior to design. 6. Insufficient time for preparation of contract document due to time constraints for budget allocated by the donor 7. Impediment in the prompt decision-making process. 8. Substitution works to achieve the required improvement.		4. Lack of coordination between the client and the municipality in terms of the encroachment of people on the streets 5. Insufficient time for preparation of contract document due to time constraints for budget allocated by the donor. 6. Addition works due to the budget allocated constraints. 7. Impediment in the prompt decision-making process. 8. Required improvement	

Continued Table (4.2):

What are the various impacts of the VOs on the selected construction projects?	1. Increase in project cost 2. Increase in overhead expenses 3. Additional payment for contractor 4. Completion schedule delay (51 Days) 5. Delay in payment. 6. Productivity degradation 7. Procurement delay 8. Poor professional relations Poor safety	1. Increase in project cost 2. Increase in overhead expenses 3. Additional payment for contractor 4. Completion schedule delay (9 days) 5. Delay in payment. 6. Productivity degradation 7. Procurement delay 8. Suspend work in other activities Impacts on	1. Increase in project cost 2. Increase in overhead expenses 3. Additional payment for contractor 4. Completion schedule delay (507 days) 5. Productivity degradation 6. Procurement delay 7. Poor professional relations. 8. Dispute and claims among parties Suspend work	1. Increase in project cost 2. Increase in overhead expenses 3. Additional payment for contractor 4. Completion schedule delay (40 days) 5. Increase in duration of individual activities. 6. Impacts on subcontractors 7. Image of the institution in revising of problem statement	1. Increase in project cost 2. Increase in overhead expenses 3. Additional payment for contractor 4. Completion schedule delay (68 days) 5. Procurement delay 6. Poor professional relations 7. Suspend work in other activities 8. Impacts on subcontractors Increase in	1. Increase in project cost 2. Increase in overhead expenses 3. Additional payment for contractor 4. Completion schedule delay (10 days) 5. Poor professional relations 6. Increase in duration of individual activities.

Continued Table (4.2):

Question	Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F
	9. conditions 10. Dispute among professionals 11. Suspend work in other activities 12. Impacts on subcontractors 13. Increase in duration of individual activities 14. Image of the institution in revising of problem statement	9. subcontractors 10. Increase in duration of individual activities 11. Image of the institution in revising of problem statement	9. in other activities. 10. Impacts on subcontractors 11. Increase in duration of individual activities 12. Hiring new professional 13. Logistic delay from municipality 14. Image of the institution in revising of problem statement		9. duration of individual activities 10. Hiring new professionals. 11. Logistic delay from municipality 12. Image of the institution in revising of problem statement	

Continued Table (4.2):

Question	Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F
What are the current practices of the VOs management in your company?	-There is a good contract documentation and all VOs are recorded. -The direct costs of the VOs are calculated. -Existing a specific person with relevant skills to manage the VOs	-There is a good contract documentation and all VOs are recorded. -The direct costs of the VOs are calculated. -A good communication and cooperation among project team members -Identification and understanding of contract requirements and provisions before the project starts -Existing a specific person with relevant skills to manage the VOs	-There is a good contract documentation and all VOs are recorded. -The direct costs of the VOs are calculated. -A good communication and cooperation among project team members -Identification and understanding of contract requirements and provisions before the project starts -The possible variations that might occur in the future activities of the project are identified. -Existing a specific person with relevant skills to manage the VOs	-There is a good contract documentation and all VOs are recorded. -The direct costs of the VOs are calculated. -A good communication and cooperation among project team members -Identification and understanding of contract requirements and provisions before the project starts -The possible variations that might occur in the future activities of the project are identified. -Existing a specific person with relevant skills to manage the VOs	-There is a good contract documentation and all VOs are recorded. -The direct costs of the VOs are calculated. -A good communication and cooperation among project team members -Existing a specific person with relevant skills to manage the VOs	-There is a good contract documentation and all VOs are recorded. -The direct costs of the VOs are calculated. -A good communication and cooperation among project team members -The possible variations that might occur in the future activities of the project are identified. -Existing a specific person with relevant skills to manage VOs

Continued Table (4.2):

Question	Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E	Interviewee F
			-Upgrade market surveys procedures during preparing BOQ -Carry out detailed site investigation including detailed soil investigations and consider it during tendering stage -Quick decision-making process. -Supervise the work with an experienced supervisor with no change of supervision staff during project implementation	Carry out detailed site investigation including detailed soil investigations and consider it during tendering stage -Upgrade market surveys procedures during preparing BOQ	during tendering stage - Quick decision-making process	-Forecast unforeseen situations.

4.3 Findings from the Desk Study and Interviews

The desk study was applied to six selected construction projects. The contract documents were massive with data, information, contract, BOQ and drawings. The studied documents were signed and stamped. From the document study findings, many causes and impacts of the VOs in the construction projects in Gaza Strip were identified. After that, the interviews made to ensure that the causes were documented in the project's documents as it implemented in the project and to ascertain that the researcher understands the project documents correctly. The interviews were made between the project managers of the selected construction projects to emphasize on the causes and impacts of the VOs not seen at their projects documents, assessing the current practices of the VOs management in their companies and determining the recommendations or strategies could be taken to minimize the occurrence of the VOs in the construction projects.

4.3.1 Causes of the VOs

Eleven (11) causes of the VOs were identified to be used in the questionnaire for the verification and validation process to evaluate their degree of importance. But all the eleven causes were already the domain of the variables which identified from the literature review. Below are the desk study and interview finding of summary of causes of the VOs in the construction projects in Gaza Strip from the six projects as shown in Table (4.3)

Table (4.3): Causes of the VOs from the desk study and interviews

SN	Causes of the VOs	% of occurrence
1	Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts).	66.7
2	Required improvement	100
3	Unforeseeable works	66.7
4	Insufficient site and soil investigation prior to design.	50
5	Errors and omissions in design.	16.7
6	Impediment in the prompt decision-making process.	33.3
7	Land allocation problems.	16.7
8	Time constraints for budget allocated by the donor	33.3
9	Budget allocated constraints	33.3
10	Inadequate revision and feedback system through the design process.	33.3
11	Lack of coordination among project parties.	33.3

4.3.2 Impact of the VOs

From the desk study and interviews with the projects' managers of the selected projects, the following are the summary of the impacts of the VOs on the construction projects in Gaza Strip shown in Table (4.4). Sixteen (16) impacts were identified which were being used in the questionnaire for the verification and validation process to evaluate their degree of importance. But all the variables were in the literature review.

Table (4.4): Impacts of the VOs from the desk study and interviews

SN	Impacts of the VOs	% of occurrence
1	Increase in project cost	100
2	Increase in overhead expenses	100
3	Additional payment for contractor	100
4	Completion schedule delay	100
5	Delay in payment.	33.3
6	Productivity degradation	50.0
7	Procurement delay	66.7
8	Poor professional relations	66.7
9	Poor safety conditions	16.7
10	Dispute among professionals	33.3
11	Suspend work in other activities	66.7
12	Impacts on subcontractors	83.3
13	Image of the institution in revising of problem statement	83.3
14	Increase in duration of individual activities.	100
15	Hiring new professionals.	33.3
16	Logistic delay	33.3

4.3.3 The delay in completion schedule due to the VOs

From the desk study and interviews with the projects' managers of selected projects, the following are the summary of the delay in completion schedule due to the VOs as percentage of original schedule as shown in Table (4.5)

Table (4.5): The delay in completion schedule due to the VOs as percentage of original schedule

Project	The delay in completion schedule due to the VOs
Project A	19.32%
Project B	2.68%
Project C	five times of the schedule of the works
Project D	12.82%
Project E	21.80%
Project F	41.67%

4.4 Analysis of Data from the Questionnaires

This section describes results that deduced from a field survey of two hundred and nineteen questionnaires. The questionnaires were analyzed using SPSS. The questionnaire was organized to be completed by the consultants, contractors and clients operating in the construction projects and limited to the last five years. The questionnaire consisted of eight parts, the first part included general information, the second part included information about the projects that the respondents managed, the third part investigated the prevalence of the VOs, the fourth part assessed the current practices of the VOs management in Gaza Strip, the fifth part investigated the non-value adding activities associated with the variations during the construction stage, the sixth part included the origin agent of the VOs and factors causing it, the seventh part investigated the impact of the VOs, and the eighth part included recommended strategies to minimize the VOs. These obtained results will be compared with the relevant literature in addition to the researcher comments. The researcher conducted an analysis of the study dimension by finding the arithmetic mean, SD, and RII. The RII adopted for this study to determine the relative importance of the various causes, impacts and strategies to minimize the VOs based on responses from various groups; contractors, consultants, and clients. In addition, correlation coefficient between parties according to the causes of the VOs, impact of the VOs, and recommended strategies to minimize the VOs was found.

4.4.1 General Information

This part mainly design to provide general information about the respondents in terms of the type of organization, position in the organization, and years of experience.

4.4.1.1 Respondents' type of the organization

The respondents were grouped into three major groups namely clients, consultants and contractors. The returns from the three groups were tabulated in Table (4.6) below which show that 14.6% of the sample was the client, 26.9% was consulting, while 58.4% contracting.

4.4.1.2 Respondents' position in the organization

Among the two hundred and nineteen responses received from clients, consultants, and contractors, the majority of the respondents were working as site/office engineer with 42.9%, a similar result with 25.6% that the respondents were working as organization manager/deputy and project manager/deputy, while 5.9% work on other position as shown in Table (4.6).

4.4.1.3 Respondents' years of experience

Table (4.6) shown that among the respondents, a majority had “more than 15 years” of working experience in the construction industry with 33.3%. The experience for the rest of the respondents was “from 10 years to less than 15 years”, “from 5 years to less than 10 years” and “less than 5 years” with 21%, 29.7% and 16%, respectively.

Table (4.6): Respondent's profile

General information	Frequency	Percent
Type of organization		
Client	32	14.6
Consulting	59	26.9
Contracting	128	58.4
Position in the organization		
Organization manager/Deputy	56	25.6
Project manager/Deputy	56	25.6
Site/Office engineer	94	42.9
Others	13	5.9
Years of experience		
Less than 5 years	35	16
From 5 years to less than 10 years	65	29.7
From 10 years to less than 15 years	46	21
15 years and Over	73	33.3

4.4.2 Information about the projects that the respondents managed

This part mainly designs to provide information about the projects that the respondents managed in the last five years.

4.4.2.1 Type of the project

It's clear from the results in Table (4.7) that 22% of the projects were roads and the same percent for sewerage and water projects, 40.4% were building/residential projects, while 15.5% work at electro-mechanics projects.

Note: Total of the type of project equal 431 because the researcher suggested the respondents choose more than one type.

4.4.2.2 Size of projects that the respondents directed

It's clear from the results in Table (4.7) that 11.4% of the projects directed by the respondents were less than $1 million, 42.5% were “from $1 to less than $5 million”, 17.4% were “from $5 to less than $10 million”, while 28.8% were $10 million and more.

4.4.2.3 Percentage of projects including VOs causing work delay

A majority of the respondents agreed that the percentage of projects included VOs causing work delay were less than 20% with 53.9%. A percentage of 5% indicated “none” and 27.9% indicated “from 20% to 50%”, while 13.2% “more than 50%” as shown in Table (4.7).

4.4.2.4 The delay in completion schedule due to the VOs as a percentage of original schedule

It's clear from the results in Table (4.7) that the majority of the respondents (60.3%) answered that the delay in completion schedule as a percentage of the original schedule due to the VOs was less than 20%. 8.2% of the respondents answered “none”, 25.1% answered “from 20% to 50%”, while 6.4% answered “more than 50%”. These results were nearly in line with the results from the desk study and interviews in this study. As mentioned previously in this chapter in Table (4.5) project A, project B and project D had a delay in completion schedule due to VOs as percentage of original schedule 19.32%, 2.68% and 12.82% respectively which less than 20% as the majority of the respondents answered.

4.4.2.5 Percentage of the projects exceeded the contract's value due to the VOs

It's clear from the results in Table (4.7) that the majority of the respondents (62.1%) answered that the percentage of projects exceeded the contracts' value due to the VOs less than 20%, 12.3% of the respondents answered “none”, 19.2% answered “from 20-50%”, while (6.4%) answered “more than 50%”.

4.4.2.6 Project's progress obstruction caused by VOs

It's clear from the results in Table (4.7) that that the majority of the respondents (54.8%) answered that the percent of VOs caused project's progress obstruction less than 20%, 9.1% of the respondents answered “none”, 26.9% answered “from 20 to 50%”, while 9.1% answered “more than 50%”.

Table (4.7): Information about the projects that the respondents managed

Information about the projects that the respondents managed	Frequency	Percent
Type of project		
Roads	95	22
Building/residential	174	40.4
Sewerage and water	95	22
Electro-mechanics	67	15.5
Size of projects directed		
Less than $1 million	25	11.4
From $1 to less than $5 million	93	42.5
From $5 to less than $10 million	38	17.4
$10 million and more	63	28.8
Percentage of the projects including VOs **causing work delay**		
None	11	5
Less than 20	118	53.9
20-50%	61	27.9
More than the 50%	29	13.2
The delay in completion schedule due to the VOs **as percentage of original schedule**		
None	18	8.2
Less than 20%	132	60.3
20-50%	55	25.1
More than the 50%	14	6.4
Percentage of projects exceeded the contract's value due to the VOs		
None	27	12.3
Less than 20	136	62.1
20-50%	42	19.2

Continued Table (4.7):

Information about the projects that the respondents managed	Frequency	Percent
More than the 50%	14	6.4
The extent of project's progress obstruction caused by VOs		
None	20	9.1
Less than 20%	120	54.8
20-50%	59	26.9
More than the 50%	20	9.1

4.4.3 Analysis of the prevalence of the VOs in the construction projects in Gaza strip

This section investigates the prevalence of the VOs in the construction projects in Gaza strip by studying the works that cause the VOs, site instructions occurring in the construction projects and awareness of the outcome of the VOs. If the dimension had a p-value more than "0.05" then the respondents were neutral regarding this dimension and if the dimension had a p-value less than "0.05", there are two cases: Firstly, a mean less "3" so the respondents were disagree with this dimension. Secondly, a mean more than "3" so the respondents were agreed on this dimension

4.4.3.1 Analysis of the works that cause the VOs

VOs involved substitution works, additional or omission works, required improvements, overhead compensation on a suspension of work and compensation for justified delay due to the VOs, these works were ranked by the mean of responses. A 5 point Likert scale was used where Never = 1; Seldom = 2; Sometimes = 3; Often = 4; and Always = 5 as shown in Table (4.8) and Table (4.9).

37.9% of the respondents agreed that "*Substitution of works*" was the most frequent work caused VOs; others (47%) remained neutral while a little of respondents (15.1%) were disagree. This work was ranked in the first position with a mean of "3.28", RII = 0.656 and p-value equals "0.000" that means the respondents were agree on this work, In Gaza strip, substitution works mainly occurs due to non-availability of the required materials at the local market due to Israeli restriction in terminals and crossing closure and

siege. On the other hand, A little of respondents (13.7%) agreed that "*Overhead compensation on a suspension of work*" was the least frequent work caused the VOs; others (37.9%) remained neutral while nearly a half of respondents (48.4%) were disagree. This work was ranked in the fifth position with a mean of "2.54", RII = 0.509 and p-value equals "0.000" that means the respondents were disagree on this work. In general, the results of all works that cause the VOs showed that the mean equals "2.97", RII = 0.595 and p-value equals "0.547", which means the respondents were neutral with this dimension.

Table (4.8): The works caused the VOs

Works	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Substitution of works (i.e. Replacing material not available in local market).	219	1.4	13.7	47.0	31.5	6.4
Additional or omission on regarding coping BOQs with drawings.	219	1.8	18.7	39.7	34.7	5.0
Required improvements.	219	2.3	26.0	40.2	25.1	6.4
Compensation for justified delay due to the VOs.	219	13.7	24.7	38.4	19.2	4.1
Overhead compensation on a suspension of work.	219	14.6	33.8	37.9	10.0	3.7

Table (4.9): Ranks of the works caused the VOs

Works	Mean	SD	RII	T-Test	P-value	Rank
Substitution of works (i.e. Replacing material not available in local market).	3.28	0.83	0.656	4.969	0.000*	1
Additional or omission on regarding coping BOQs with drawings.	3.22	0.87	0.645	3.794	0.000*	2
Required improvements.	3.07	0.93	0.615	1.168	0.244**	3
Compensation for justified delay due to the VOs.	2.75	1.05	0.551	-3.487	0.001*	4
Overhead compensation on a suspension of work.	2.54	0.98	0.509	-6.879	0.000*	5
Total degree	**2.97**	**0.63**	**0.595**	**-0.603**	**0.547****	

* Arithmetic mean is statistically significant at $\alpha \leq 0.05$

** Arithmetic mean is not statistically significant at $\alpha \leq 0.05$

4.4.3.2 Analysis of site instructions occurring in the construction projects

In practice, the VOs are issued as the site or contract instructions. However, not all instruction vary the contractual arrangements or the way the works are being undertaken. These instructions were ranked by the means of responses. A 5 point Likert scale was used where Never = 1; Seldom = 2; Sometimes = 3; Often = 4; and Always = 5 as shown in Table (4.10) and Table (4.11).

24.2% of the respondents agreed that "*Site instructions to resolve discrepancies in contract documents*" was the most occurred site instruction; others (45.7%) remained neutral while nearly a third of respondents (30.1%) were disagree. This instruction was ranked in the first position with a mean of "2.95", RII = 0.590, and p-value equals "0.396", which means that the respondents were neutral on this instruction. This site instruction considered as a VO when it occurs. Occasionally, contract documents are drawn by different engineers or design personnel during the design phase of the project. In spite of the close coordination between design personnel, discrepancies are sometimes found. Usually, contracts include guidelines in case of conflict so, the more time spent on completing and revising the contract documents with the colleague before the commencement of works, the more likely the avoidance of discrepancies between the contract documents. In contrast, 18.7% of the respondents agreed that "*Site instruction to vary the design, quality or quantity of the works*" was the least occurred site instruction; others (46.6%) remained neutral while nearly a third of respondents (34.7%) were disagree. This instruction was ranked in the fourth position with a mean of "2.84", RII = 0.567, and p-value equals "0.000", which means that the respondents were disagree on this instruction. This site instruction considered as a VO when it occurs. In general, the results of all instructions showed that the mean equals "2.92", RII= 0.583, and p-value equals "0.043" that means the respondents were disagree on this dimension.

Table (4.10): Site instructions occurring in the construction projects

Instructions	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
To resolve discrepancies in contract documents (e.g. rectify errors, omissions)	219	3.2	26.9	45.7	20.1	4.1
To reiterate or enforce contractual provisions (e.g. an instruction to remove from site goods that do not conform to original specifications).	219	4.1	30.1	39.7	19.6	6.4
To protect the client's interest (e.g. an instruction to remove from site camp a worker who constitutes a nuisance.	219	5.0	31.1	34.2	24.2	5.5
To vary the design, quality or quantity of the works.	219	1.8	32.9	46.6	17.4	1.3

Table (4.11): Ranks of site instructions occurring in the construction projects

Instructions	Mean	SD	RII	T-test	P-value	Rank
To resolve discrepancies in contract documents (e.g. rectify errors, omissions)	2.95	0.87	0.590	-0.851	0.396**	1
To reiterate or enforce contractual provisions (e.g. an instruction to remove from site goods that do not conform to original specifications).	2.94	0.96	0.588	-0.917	0.360**	2
To protect the client's interest (e.g. an instruction to remove from site camp a worker who constitutes a nuisance.	2.94	0.99	0.588	-0.890	0.374**	2
To vary the design, quality or quantity of the works.	2.84	0.78	0.567	-3.125	0.002*	4
Total degree	**2.92**	**0.61**	**0.583**	**-2.032**	**0.043***	

* Arithmetic mean is statistically significant at $\alpha \leq 0.05$

**Arithmetic mean is not statistically significant at $\alpha \leq 0.05$

4.4.3.3 Analysis of awareness of the outcome of the VOs

VOs are predictable to occur in the construction projects. A 5 point Likert scale determined to what extent respondents agreed on given statements, namely Strongly disagree = 1; Disagree = 2; Neutral = 3; Agree = 4; and Strongly agree = 5 as shown in Table (4.12) and Table (4.13).

The majority of the respondents (77.6%) agreed that the excessive occurrence of the VOs may lead to know that market surveys procedures need to

be upgraded and ranked it in the first position with a mean of "3.92", RII = 0.784, and p-value equals "0.000", which means that the respondents were agree on this statement. Gaza Strip suffers from Israeli restriction in terminals and crossing closure and siege that leads to non-availability many of the materials at the local market so conducting periodic market surveys leads to avoid many variations.

In addition, 73.1% of respondents reported that the excessive occurrence of the VOs may lead to know that the designs and quantity take off procedures need to be upgraded. Kaming et al. (1997) and Enshassi, Al-Najjar, and Kumaraswamy (2009) asserted that inaccurate quantity take-off is one of the top ten factors that cause cost overruns in the projects so earlier quantity takeoffs and cost estimating during the design stages with continuously updating leads to avoid many variations in the projects. Almost two-thirds of respondents (68.5%) agreed that a clause permitting VOs is an essential feature of any construction contract, and more than a half (57%) of respondents admitted that all clients are fully aware that the VOs are based on market surveys and price analysis.

More than a half of respondents (57.6%) reported that the VO clause is provided because the construction projects involve complex operations, which cannot be accurately determined in advance. This result inline with Ndihokubwayo and Haupt (2009) who concluded in his study " Variation orders on Construction Projects: Value-adding or Waste?" that more than a half of the respondents agreed on this statement.

Less than a half of the respondents (42%) disagreed that the VOs could be avoided; others (27.9%) remained neutral while less than a third of the respondents (30.1%) agreed that the VOs could be avoided and ranked it in the seventh position with mean equals "2.83", RII = 0.566 and p-value equals "0.018", which means that the respondent were disagree on this statement. This result agree with Ndihokubwayo and Haupt (2009) who concluded in his study " Variation orders on Construction Projects: Value-adding or Waste?" that more than several respondents (39.1%) disagreed on this statement.

In general, the results of all statements of awareness of the outcome of the VOs showed that the mean equals "3.47, RII = 0.695 and p-value equals "0.000", which means that the respondent were agree on this dimension.

Table (4.12): awareness of the outcome of the VOs

Statement	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
The excessive occurrence of the VOs may lead to know that market survey procedures need to be upgraded.	219	1.8	9.1	11.4	50.2	27.4
The excessive occurrence of the VOs may lead to know that the designs and quantity take off procedures need to be upgraded.	219	4.1	8.7	14.2	48.4	24.7
A clause permitting the VOs is an essential feature of any construction contract.	219	4.1	12.8	14.6	43.8	24.7
All clients are fully aware that the VOs are based on market surveys and price analysis.	219	3.2	13.2	26.5	43.8	13.2
A VO clause is provided because the construction projects involve complex operations which cannot be accurately determined in advance.	219	3.7	17.8	21.0	45.7	11.9
The existence of a VO clause is an aspect that tends to encourage clients/consultants to change their minds during the course of a contract.	219	7.3	23.3	27.4	37.0	5.0
Most VOs could be avoided.	219	9.1	32.9	27.9	26.0	4.1

Table (4.13): Ranks of awareness of the outcome of the VOs

Statement	Mean	Standard deviation	RII	T test	P-value	Rank
The excessive occurrence of the VOs may lead to know that market survey procedures need to be upgraded	3.92	0.96	0.784	14.262	0.000*	1
The excessive occurrence of the VOs may lead to know that the designs and quantity take off procedures need to be upgraded.	3.81	1.04	0.762	11.546	0.000*	2
A clause permitting the VOs is an essential feature of any construction contract.	3.72	1.10	0.744	9.739	0.000*	3
All clients are fully aware that the VOs are based on market surveys and price analysis.	3.51	0.99	0.701	7.593	0.000*	4
A VO clause is provided because the construction projects involve complex operations which cannot be accurately determined in advance.	3.44	1.03	0.689	6.353	0.000*	5
The existence of a VO clause is an aspect that tends to encourage clients/consultants to change their minds during the course of a contract.	3.09	1.05	0.618	1.293	0.197**	6
Most VOs can be avoided.	2.83	1.05	0.566	-2.389	0.018*	7
Total degree	**3.47**	**0.53**	**0.695**	**13.221**	**0.000***	

*Arithmetic mean is statistically significant at $\alpha \leq 0.05$

**Arithmetic mean is not statistically significant at $\alpha \leq 0.05$

4.4.4 Analysis of the assessing the current practices of the VOs management in Gaza strip

It was imperative to assess the current practices of the VOs management to know whether it needs to be improved or not. A 5 point Likert scale was used where Never = 1; Seldom = 2; Sometimes = 3; Often = 4; and Always = 5. If the dimension had a p-value more than "0.05" then the respondents were neutral regarding this dimension and if the dimension had a p-value less than "0.05", there are two cases: Firstly, a mean less "3" so the respondents were disagree with this dimension. Secondly, a mean more than "3" so the respondents were agreed on this dimension as shown in Table (4.14) and Table (4.15).

It was evident that the majority of respondents (79.4%) calculated the direct costs of the VOs and ranked it in the first position with a mean of "4.19", RII= 0.838, and p-value equals "0.000", which means that the respondents were agree on this activity. Moreover, 74.4% of respondents calculated the indirect costs of the VOs. There are two components to the direct cost of a variation: labor cost and material cost so there is somewhat easy to estimate but it is much more difficult to assess the indirect or consequential cost of the VOs. Generally straightforward enough to assess the direct cost of individual variations.

More than two-thirds of respondents (79%) reported that there is a good contract documentation and all VOs are recorded and 71.3% of respondents admitted that there are a good communication and cooperation among project team members. As Charoenngam et al. (2003) asserted that contract documentation, and good communication and cooperation between construction team members are two of several elements that can be used to manage the VOs.

A little of respondents (13.3%) disagreed that the possible variations that might occur in the future activities of the project are identified; others (42%) remained neutral while more than a third of respondents (44.7%) agreed the possible variations that might occur in the future activities of the project are identified and ranked it in the seventh position with a mean of "3.44", RII = 0.689, and p-value equals "0.000", which means that the respondents were agree on this activity. As Oloo (2015) asserted that an effective variation management require

identifying the possible variations that might occur in the future activities of the project.

In general, the results of all activities of the assessing the current practices of the VOs management show that the mean equals "3.92" more than "3", RII= 0.784, and p-value equals "0.000" which is less than 0.05, which means that the respondents were agree on this dimension.

Table (4.14): Assessing the current practices of the VOs management

Activity	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
The direct costs of the VOs are calculated.	219	0.9	5.5	14.2	32.4	47.0
There are a good contract documentation and all VOs are recorded	219	2.7	3.2	15.1	32.9	46.1
The indirect costs of the VOs are calculated.	219	1.4	5.0	19.2	42.9	31.5
A specific person with relevant skills is employed to manage the VOs.	219	0.5	5.9	21.5	42.0	30.1
There are a good communication and cooperation among project team members.	219	0.5	4.6	23.7	41.6	29.7
There are identification and understanding of contract requirements and provisions by the respective parties before the project starts.	219	1.4	7.8	27.4	42.0	21.5
The possible variations that might occur in the future activities of the project are identified.	219	2.8	10.5	42.0	29.2	15.5

Table (4.15): Ranks of assessing the current practices of the VOs management

Activity	Mean	SD	RII	T-test	P-value	Rank
The direct costs of the VOs are calculated.	4.19	0.94	0.838	18.796	0.000*	1
There are a good contract documentation and all VOs are recorded	4.16	0.98	0.833	17.553	0.000*	2
The indirect costs of the VOs are calculated.	3.98	0.91	0.796	15.904	0.000*	3
A specific person with relevant skills is employed to manage the VOs.	3.95	0.89	0.791	15.829	0.000*	4
There are a good communication and cooperation among project team members.	3.95	0.87	0.791	16.207	0.000*	4
There are identification and understanding of contract requirements and provisions by the respective parties before the project starts.	3.74	0.93	0.749	11.871	0.000*	6
The possible variations that might occur in the future activities of the project are identified.	3.44	0.97	0.689	6.775	0.000*	7
Total degree	**3.92**	**0.64**	**0.784**	**21.339**	**0.000***	

* Arithmetic mean is statistically significant at $\alpha \leq 0.05$

4.4.5 Analysis of the Non-value-adding activities associated with the VOs during the construction stage

Numerous non-value-adding activities are likely to arise when a VO is issued. A 5 point Likert scale was used where Never = 1; Seldom = 2; Sometimes = 3; Often = 4; and Always = 5. If the dimension had a p-value more than "0.05" then the respondents were neutral regarding this dimension and if the dimension had a p-value less than "0.05", there are two cases: Firstly, a mean less "3" so the respondents were disagree with this dimension. Secondly, a mean more than "3" so the respondents were agreed on this dimension as shown in Table (4.16) and Table (4.17).

More than a third of respondents (43.8 %) reported that the waiting time was the most non-value-adding activity associated with the VOs during the construction stage and ranked it in the first position with a mean of "3.35", RII= 0.669 and p-value equals "0.000", which means that the respondents were agree on this activity. Generally, to make a change and process take time. This usually results in placing a hold on the work and waiting for new instructions to come**.**

A little of respondents (28.7%) disagreed that the defects during construction stage were a non-value-adding activity associated with the VOs during the construction stage; nearly a half (43.8%) remained neutral while less than a third of respondents (27.5%) agreed that the defects during construction stage was a non-value-adding activity associated with the VOs during the construction stage and ranked it in the fifth position with a mean of "3", RII= 0.60 and p-value equals "0.938", which means that the respondents were neutral on this activity. Alwi et al. (2002) asserted that quality defects is one of the main categories of waste during the construction process and attributed to variation.

In general, the results of all activities of the non-value-adding activities associated with the VOs during the construction stage show that the mean equals "3.17", RII=0.635 and p-value equals "0.000", which means that the respondents were agree on this dimension.

Table (4.16): Non-value-adding activities associated with the VOs

Activity	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Waiting Time	219	4.6	13.2	38.4	30.6	13.2
Delays	219	1.4	17.4	39.3	30.6	11.4
Reworks/Repairs activities	219	2.3	18.7	45.7	29.2	4.1
Unnecessary material handling and material waste.	219	3.2	21.9	48.4	19.2	7.3
Defects during construction stage	219	2.7	26.0	43.8	23.7	3.7

Table (4.17): Ranks of the non-value-adding activities associated with the VOs

Activity	Mean	SD	RII	T-test	P-value	Rank
Waiting time	3.35	1.02	66.9	5.048	0.000*	1
Delays	3.33	0.94	66.7	5.247	0.000*	2
Reworks/Repairs activities	3.14	0.85	62.8	2.471	0.014*	3
Unnecessary material handling and material waste.	3.05	0.91	61.1	0.889	0.375**	4
Defects	3.00	0.87	60.0	-0.078	0.938**	5
Total degree	**3.17**	**0.66**	**63.5**	**3.921**	**0.000***	

* Arithmetic mean is statistically significant at $\alpha \leq 0.05$

**Arithmetic mean is not statistically significant at $\alpha \leq 0.05$

4.4.6 Analysis of Origin agent of the VOs and factors causing it

This section investigated the origin agent of the VOs, factors influencing the occurrence of the variation and causes of the VOs.

4.4.6.1 Origin agents of the VOs

There are four origin agents of the VOs, namely Clients, consultants, contractors, and donors. The following ranking order was used, namely 1st (most frequent involvement) = 1; 2nd = 2; 3rd = 3; 4th (least frequent involvement) = 4. As shown in Table (4.18), the client was the most frequent origin agent involved followed by consultants followed by contractors then the donor. This ranks in line with several researchers (Ndihokubwayo & Haupt, 2008 and Ndihokubwayo & Haupt, 2009)

The client was ranked by overall respondents in the first position. It reflects the importance of client in the occurrence of the VOs where the clients have the power to decide the needs and the objectives of the project and play a major role in causing variations. Any changes in client's requirements or any financial problems of the client will reflect directly on the project at every phase and may cause the VOs.

The consultant was ranked by all respondents in the second position. This ranking seems to be reliable as the consultant believes that client interference in design affects the scope of work and if the consultant failed to interpret the

requirements and needs of their client, it will results in the difference in design from the perceived one and this will eventually leads to VOs.

It is the contractor's responsibility to advise consultant to issue the VO when a technical problem is discovered. Therefore, the contractor was ranked by all respondents in the third position. This result reflects that the contribution of contractor in causing VOs is minimal as the initiative of any variation is directly related to the approval of the client and mainly caused by variations needed by the client or problems in the design documents.

The donor was ranked by overall respondents in the fourth position. This result reflects that any variations needed by the donor are reflected directly by the client. This rank in line with Enshassi et al. (2010).

Table (4.18): Origin agents of the VOs

Origin agents	Rank
Client	1
Consultant	2
Contractor	3
Donor	4

4.4.6.2 Factors influencing the occurrence of variation

The factors that influencing the occurrence of the VOs were ranked from the most dominant (1) to least dominant (3). The results are shown in Table (4.19). Nature of the project was the most dominant influence with the first rank, followed by the complexity of the project with the second rank and then Project delivery system with the third rank.

Table (4.19) Factors influencing the occurrence of variation

Factors	Rank
Nature of the project. i.e. unforeseen conditions and uniqueness of the project.	1
The complexity of the project. i.e. continuous demand for speed in construction, cost and quality control, health and safety in the work place and avoidance of disputes, together with technological advances.	2
Project delivery system (DBB, DB)	3

4.4.6.3 Causes of the VOs

This part introduces and discusses the obtained results regarding the factors that cause the VOs in the construction projects in the Gaza Strip, the factors were divided into four groups, these groups are; client related factors, donor related factors, consultant related factors, contractor related factors, and environmental factors. Each group contained a number of factors. This section will discuss the comparison between clients, consultants and contractors point view regarding the causes of the VOs. Each of the following subsections will discuss one of the previously mentioned groups. The descriptive statistics, i.e. means, SD, RII, and ranks were established for the all causes of the VOs according to each party of the respondents and to overall respondents and presented in Table (4.20). The numbers in the "rank" column represent the sequential ranking based on the highest mean and RII and the lowest SD. If some factors have similar means and RIIs ranking will depend on the lowest SD. In addition, If the mean of the responses less than 5 then the respondents are disagree, if the mean of the responses more than 6 then the respondents are agree and If the mean of the responses between 5 and 6 then the respondents are neutral.

A- The Top five Most Important Factors

It's shown in Table (4.20) that the top five most important causes of the VOs in the construction projects in Gaza Strip as observed by all respondents and to each party of the respondents included; Israeli restriction in terminals and crossing closure and siege, discrepancies between contract documents, internal political problems, change in specification by the client, and budget allocated constraints.

1. **Israeli restriction in terminals and crossing closure and siege**

   Most construction projects in Gaza Strip are suffering from the VOs due to the unstable political situation in Gaza Strip, concurrent closure borders with Egypt and Israel imposed on Gaza Strip and unjustified siege applied on the Strip in the period 2007 till now.

This factor is the most important cause of the VOs in the construction projects in Gaza Strip. It was ranked, according to overall respondents in the first position with RII = 0.727. Contractor, consultant, and client also ranked it in the first position with RII = 0.695, RII = 0.766, and RII = 0.784 respectively. There is an agreement between all parties that the construction projects are suffering from extraordinary political and economical situation due to closure and siege. Unfortunately, Gaza Strip, in particular, depends fully on the import of raw materials of the construction project (steel, cement, and gravels). It's very hard to enter these materials to Gaza strip. Because of this difficult situation, getting required materials in same specifications and on time is difficult in Gaza Strip so, there are great difficulties to get materials, especially because the borders of Gaza Strip is controlled by the Israeli occupation. The closure of the crossings hindered the entrance of material from outside of Gaza Strip this leads to variations on the construction projects either by omitting some activities that become difficult to execute or by substituting the materials and procedures of construction. Other variations issued when the failure of supplying materials and equipment on time this mean that contractor will lose the efforts of human resources and also lose the time of execution, then the variation will occur. This result inline with several researchers (Enshassi et al., 2010; Al-Hams, 2010; El-Karriri, 2012; Shawareb, 2012; Albhaisi, 2016) whose found that Israeli restriction in terminals and crossing closure and the siege was an important cause of the VOs in the construction projects in Gaza Strip.

2. Discrepancies between contract documents

"*Discrepancies between tender documents*" was ranked in the second position with RII = 0.601 based on overall respondent's feedback. There is an agreement among all parties that this factor is one of the most important causes, it was ranked by contractor and consultant in 4th position with RII = 0.613, 0.600 respectively but client ranked it in the 19th position with RII = 0.556. For successful projects, it is essential that the contract documents should be clear and precise. Discrepancies between contract documents

may result in misunderstanding of the actual requirements of the project. Discrepancies in contract documents frequently occur because of the lack of time required to complete the design phase in an appropriate way and the insufficient feedback cycle in all design stages (schematic, preliminary, detailed and final) and lack of communication among all project parties. In order to solve these discrepancies, the VOs have to be initiated so, continuous coordination and direct communication will not only eliminate design discrepancies and errors as well as omissions in design but also provide an opportunity for professionals to review the contract documents thoroughly that would help in eliminating the variations arising because of discrepancies in contract documents. It is clear that variations are directly attributed to matters not being as stated or as required in the contract documents. This happens either because circumstances actually change or because circumstances upon which the contract documents were based were misconstrued. This result inline with several researchers (Enshassi et al., 2010; Keane et al., 2010; Mohammad et al. 2010; Oloo, 2015; Muhammad et al., 2015; Hanif et al., 2016) whose found that discrepancy between contract documents was one the top ten most important causes of the VOs in the construction projects.

3. Internal political problems

"*Internal political problems*" was ranked in the third position with RII = 0.600 based on overall respondent's feedback. There is a difference between client and contractor who ranked it in 2nd and 3rd position with RII = 0.631 and RII = 0.617 respectively and consultant on the other hand who ranked it in 18th position with RII = 0.544. Internal political problems as rebellion, civil war, or disorder may lead to many of funds for projects were withdrawn because of the political situation. The contractor is the most effected party of internal political problems. If the project in the implementation stage, this may lead to change in scope of work and finally initiate the VOs. This result inline with Enshassi et al., (2010) who found that "*internal political problems*" was one the top ten most important causes of the VOs in the construction projects.

4. Change in specification by the client

"*Change in the specification by the client*" was ranked in the fourth position with RII = 0.597 based on overall respondent's feedback. There is a difference among parties toward the importance of this factor, the contractor and consultant ranked it in 5^{th} position with RII = 0.609 and RII = 0.583 respectively, while client ranked it in 8^{th} position with RII = 0.575. Changes in specifications by the client were common in projects with unclear project objectives. The client who not finalize specifications and design during the initial phase of the project, leading to frequent revisions of specifications during the construction phase that may lead to significant rework also, variations in client's financial ability, variations in client's requirements, design errors and insufficient time for preparation of contract documents lead to change in the specifications by client. Because of change in specifications by the client during the construction phase, a major variation and adjustment in project planning and procurement activities may need.

In addition, the change in specification due to siege and inadequate project objectives is considered as a prime reason to make the client change the requirement. Therefore, the original schedule may severely affected and result not only in giving an extension of time to the contractor, but the work has to vary from the original contract, adjustments in project planning and procurement activities. This result match with several researchers (Oladapo, 2007**;** Enshassi et al., 2010; Shawareb, 2012; Asamaoh & Offei-Nyako, 2013; Yadeta, 2016) whose found that change of specifications by the client was one of the most ten important causes of the VOs.

5. Budget allocated constraints

"*Budget allocated constraints*" was ranked according to overall respondents in the fourth position with RII = 0.597. There is a large a difference among parties toward the importance of this factor, Contractor, consultant, and client ranked it in the 2^{nd}, 30^{th} and 11^{th} position with RII =

0.636, RII = 0.525, and RII = 0.572 respectively. Because of the budget constraints that do not let any additional fund for improvement in scope and compensating the raising of material's prices, the client and consultant may initiate the VOs to omit some activities. This result inline with Enshassi et al., (2010) who found that budget allocated constraints was an important cause of the VOs concerning to the donor related factors and ranked in the 1st position.

B- The least five important factors

It's shown in Table (4.20) that the least five important causes of the VOs in the construction projects in Gaza Strip as observed by all respondents and to each party of the respondents included; change of implementing schedule by the client, inadequate project objectives, change in project purpose and scope by clients, change in governmental regulations and safety considerations.

1. **Change of implementing schedule by the client**

"*Change of implementing schedule by the client*" was ranked in 52nd position as the least important causes of the VOs with RII = 0.455 as per perceptions of all respondents. There is almost an agreement between contractor and client toward this factor, they ranked it in 53rd, and 51st position with RII = 0.439, and 0.447 respectively. However, the consultant ranked it in 42nd position with RII = 0.493. A change of the schedule during the project construction phase may result in a major reallocation of resources. A change in schedule means that the contractor will either be required to provide additional resources or keep some resources idle. In both cases, an additional cost is incurred, time loss and interrupt the performance of work creating the VOs so, improper scheduling of the works leads to a disorganized construction project prone to disputes, claims and considerable losses for all parties involved. It affects the total project duration and the worst effect if the design, bid and build delivery system. This result doesn't match with several researchers (Msallam et al., 2015; Oloo, 2015; Hanif et al., 2016;

Albhaisi, 2016) whose found that the change of implementing schedule by the client is one of the most important factors that cause the VOs.

2. Inadequate project objectives

"*Inadequate project objectives*" was ranked according to overall respondents in the 52nd position as the least important causes of the VOs with RII = 0.455 as per perceptions of all respondents. All project parties agreed that it was one of the five least important causes of the VOs. It was ranked by the contractor, consultant, and client in 52nd, 51st and 53rd position with RII = 0.472, RII = 0.446, and RII = 0.403 respectively. Inadequate project objectives is usually the result of insufficient planning at the project definition stage. This cause of variations affects the project severely during the later phases. In addition, inadequate project objectives can cause variations in construction leading to the designer being restricted in designing a suitable design that may lead to variations at a later stage of the construction process so, professionals should participate from design phase to assist in clarifying the project objectives in terms of building requirements, cost and time budgets and in identifying the noncompliance with their requirements at early stages. This result match with several researchers (Yadeta, 2014**;** Oloo, 2015**;** Yadeta, 2016) whose found that the inadequate project objectives is one the least important causes of the VOs. In contrast, the result doesn't match with several researchers (Keane et al., 2010; Hanif et al., 2016) whose found that the "*inadequate project objectives*" was the most important causes of the VOs.

3. Change in project purpose and scope by the client

"*Change project purpose and scope by the client*" was ranked by overall respondents in 51st position with RII = 0.491as per perceptions of all respondent. There is a difference among parties toward the importance of this factor. It was ranked by the contractor, consultant and client in 51st, 39th and 47th position with RII = 0.488, 0.503 and 0.478 respectively. Change in project purpose and scope by the client can affect the scope of

contractor's involvement directly limiting the potential opportunities for profits for the contractor. This result match with Memon et al. (2014) who found that change in project purpose and scope by the client is one of the least important factors. This result doesn't match with Ismail et al. (2012) and Oloo (2015) whose found that change in project purpose and scope by the client is one of the most important factors and ranked it in the 1st and 3rd position respectively.

4. Change in governmental regulations

"*Change in governmental regulations*" was ranked by overall respondents in 50th position with RII = 0.492 as per perceptions of all respondent, there is a good level of agreement among all parties toward this factor. The contractor, consultant, and client ranked it in 43rd, 52nd and 49th positions with RII = 0.527, 0.434 and 0.459 respectively. The revision of building codes may lead to new governmental regulations. This result match with Yadeta (2016) who found that change in governmental regulations was one of the least important factors.

5. Safety considerations

"*Safety considerations*" was ranked by overall respondents in 49th position with RII = 0.495 as per perceptions of all respondent. There is a significant difference between the perception of the contractor, consultant, and client toward this factor. The contractor, consultant, and client ranked it in 49th, 44th and 38th positions with RII = 0.500, 0.480 and 0.503 respectively. All the people working on a project require safe and secure working conditions and if the safety regulations are not adhered to may result in major accidents and design changes influencing the project schedule and completion so, non-compliance with safety requirements may cause major variations in design. Moreover, in certain construction processes, there are unforeseeable situations where the contractor needs to do whatever it takes to maintain the work schedule by making certain variations without violating safety regulations. Such variations can be either as minor or major lead to re- schedule project activities or even adopt a new

construction method so, a VO will normally be incurred. This result match with several researchers (Ndihokubwayo, 2008; Ismail et al., 2012; Yadeta, 2016) whose found that "*Safety considerations*" was one of the least important causes of the VOs. In contrast, the result doesn't match with several researchers (Hsieh, Lu, & Wu, 2004; Alaryan et al., 2014; Ngwepe, Aigbavboa, & Thwala, n.d.)

Table (4.20): RII and Ranks of the causes of the VOs

Factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts).	0.695	1	0.766	1	0.784	1	0.727	1
Discrepancies between contract documents.	0.613	4	0.600	4	0.556	19	0.601	2
Internal political problems.	0.617	3	0.544	18	0.631	2	0.600	3
Change in specification by the client	0.609	5	0.583	5	0.575	8	0.597	4
Budget allocated constraints.	0.636	2	0.525	30	0.572	11	0.597	4
Time constraints.	0.601	8	0.571	10	0.597	3	0.592	6
Errors and omissions in design.	0.608	6	0.564	13	0.563	16	0.589	7
Required improvement.	0.589	14	0.581	6	0.575	8	0.585	8
Inadequate revision and feedback system through the design process.	0.598	9	0.566	12	0.553	21	0.583	9
Contractor's desired profitability to improve financial condition.	0.576	21	0.614	2	0.556	19	0.583	9
Consultant's lack of judgment and experience.	0.608	6	0.561	14	0.500	39	0.579	11
Change in design by the consultant during the construction stage	0.594	13	0.532	25	0.591	4	0.577	12

Continued table: (4.20)

Factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Contractor's financial difficulties.	0.587	15	0.578	7	0.538	25	0.577	12
Contractor's lack of judgment and experience. i.e. misunderstanding of tender documents during cost estimate stage.	0.555	36	0.612	3	0.584	6	0.574	14
Change in economical conditions.	0.595	12	0.519	34	0.588	5	0.574	14
Differing site conditions. i.e. soil conditions differ from as indicated in the tender document.	0.580	17	0.554	15	0.566	14	0.571	16
Client's financial problems.	0.577	20	0.547	16	0.569	13	0.568	17
Insufficient time for preparation of contract documents.	0.569	28	0.569	11	0.538	25	0.564	18
Failure of the contractor/supplier to provide the required material from outsourcing (shipping obstacles).	0.570	25	0.539	22	0.584	6	0.564	18
Insufficient site investigation prior to design.	0.584	16	0.529	29	0.541	23	0.563	20
Replacement of material or procedure by the client.	0.568	29	0.542	20	0.572	11	0.562	21
Unforeseen problems.	0.573	22	0.532	25	0.575	8	0.562	21
Lack of a specialized construction manager.	0.559	33	0.576	8	0.538	25	0.561	23
Inadequate and ambiguous design details and non-clearance of BOQ.	0.578	19	0.547	16	0.500	39	0.558	24
Relation between donor and client.	0.598	9	0.480	44	0.538	25	0.557	25
Change in specifications by the consultant	0.573	22	0.544	18	0.516	36	0.557	25
Lack of coordination among project parties.	0.550	38	0.573	9	0.550	22	0.556	27

Continued table: (4.20)

Factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Inadequate experience of client's staff.	0.597	11	0.480	44	0.522	33	0.554	28
Lack of consultant's knowledge of available materials and equipment.	0.580	17	0.537	23	0.481	44	0.554	28
International consultant using inadequate specification to be followed in local conditions. i.e. Testing procedure.	0.573	22	0.536	24	0.494	41	0.552	30
Financial capability of donor.	0.570	25	0.514	36	0.541	23	0.551	31
Shortage of skilled manpower	0.556	34	0.531	28	0.563	16	0.550	32
Searching for compensating costs for his low prices if any.	0.563	32	0.541	21	0.509	37	0.549	33
Interference of donor in project requirements.	0.570	25	0.493	42	0.559	18	0.548	34
Contractor's lack of required data.	0.567	30	0.532	25	0.481	44	0.545	35
Lack of communication between contractor and other parties.	0.553	37	0.508	38	0.522	33	0.537	36
Defective workmanship. (Acceptance of defective workmanship due to schedule may force a change in the facility to correct for it).	0.541	42	0.512	37	0.566	14	0.537	36
Technology change especially if the time between design and construction is long.	0.566	31	0.495	41	0.469	48	0.533	38
Obstinate nature of the client.	0.546	39	0.525	30	0.488	42	0.532	39
The required equipment and tools are not available.	0.525	44	0.517	35	0.528	30	0.523	40
Lack of strategic planning.	0.518	46	0.520	33	0.538	25	0.521	41

Continued table: (4.20)

Factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Complex design and technology.	0.512	47	0.522	32	0.528	30	0.517	42
Impediment in prompt decision-making process.	0.556	34	0.478	48	0.425	52	0.516	43
Inadequate scope of work for the contractor.	0.545	40	0.480	44	0.456	50	0.514	44
Lack of contractor's involvement in design.	0.545	40	0.422	53	0.481	44	0.502	45
Weather conditions.	0.519	45	0.449	50	0.525	32	0.501	46
Land allocation problems.	0.509	48	0.463	49	0.522	33	0.499	47
Design complexity.	0.500	49	0.498	40	0.484	43	0.497	48
Safety considerations.	0.500	49	0.480	44	0.503	38	0.495	49
Change in governmental regulations.	0.527	43	0.434	52	0.459	49	0.492	50
Change in project purpose and scope by the client.	0.488	51	0.503	39	0.478	47	0.491	51
Inadequate project objectives.	0.472	52	0.446	51	0.403	53	0.455	52
Change of implementing schedule by the client	0.439	53	0.493	42	0.447	51	0.455	52

4.4.6.3.1 Analysis of Client related factors

In this category, the client related factors have been analyzed. Responses of clients, consultants, and contractors have been sorted and analyzed regarding this group. The findings presented in Table (4.21) and Table (4.22).

Table (4.21) showed RII and the rank of client related factors in terms of the occurrence of the VOs and according to each party and to overall respondents as follows.

"*Change in the specification by the client*" was ranked in the 1st position with RII = 0.597 according to overall respondents. There is a high degree of compatibility between the three parties as they agree on this factor to be the most occurred factor on the VO. The contractor, consultant, and client ranked it in the 1st position with RII = 0.609, 0.583, and 0.575 respectively. Agreement among all parties reflects the importance of this factor as the change in specification by client are frequent in

projects where construction starts before the design is finalized and has direct effects on the project.

"*Required improvement*" was ranked in the 2nd position with RII = 0.585 according to overall respondents. The results show somewhat agreement among all parties on the importance of this cause. The contractor ranked it in the 3rd position with RII = 0.589, while the consultant and the client ranked it in the 1st and 2nd position with RII = 0.581 and RII= 0.575 respectively. Required improvement through project phases results from continuous design reviews, technological advances or constructability reviews.

"*Client's financial problems*" was ranked in the 3rd position with RII = 0.568 according to overall respondents. The contractor and client ranked it in the 4th position with RII = 0.577 and RII= 0.569 respectively, whereas, the consultant ranked it in 3rd position with RII = 0.547. The client who is facing some difficult financial situations may require the substitution of quality standard expensive materials to substandard cheap materials. The financial problems of the client have direct effects on the project. This may lead to initiate some major variations to the project to reduce the cost to make the project feasible.

Table (4.21): Ranks of the occurrence of client related factors on the VOs

Client related factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Change in specification by client	0.609	1	0.583	1	0.575	1	0.597	1
Required improvement.	0.589	3	0.581	2	0.575	1	0.585	2
Client's financial problems.	0.577	4	0.547	3	0.569	4	0.568	3
Replacement of material or procedure by the client.	0.568	5	0.542	4	0.572	3	0.562	4
Inadequate experience of client's staff.	0.597	2	0.480	8	0.522	5	0.554	5
Obstinate nature of the client.	0.546	7	0.525	5	0.488	7	0.532	6
Impediment in prompt decision-making process.	0.556	6	0.478	9	0.425	10	0.516	7

Continued table: (4.21)

Client related factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Land allocation problems.	0.509	8	0.463	10	0.522	5	0.499	8
Change in project purpose and scope by clients.	0.488	9	0.503	6	0.478	8	0.491	9
Change of implementing schedule by client	0.439	11	0.493	7	0.447	9	0.455	10
Inadequate project objectives.	0.472	10	0.446	11	0.403	11	0.455	10

In another hand, the occurrence and the influence of client related factors have been analyzed. Over all responses of contractors, consultants and clients have been sorted and analyzed about this group as shown in Table (4.22). The opinion of respondents regarding this group was as follows.

First: Influence

It's shown from Table (4.22) that *"Replacement of material or procedure by client*" was ranked as the most influential cause on the VOs with mean equals "6.64" and RII = 0.664, that means the respondents were agree this factor. The Israeli restriction in terminals and crossing closure and the siege led to the high shortage in construction materials and substitution of materials occurred due to non-availability of the required materials at the local market then issued VO. In addition, variations in application methods resulted from the substitution of procedures led to issue VO. Hence, an adjustment to the original contract value is required if there is a change in procedures. In contrast, *"Inadequate project objectives*" was ranked as the least influential cause on the VO with mean equals "5.49" and RII = 0.549, that means the respondents were neutral on this factor. *"Inadequate project objectives*" is usually the consequence of insufficient planning at the project definition stage. Inadequate project objectives led to changes in specification then issued VO. This cause of variations affects the project during the later phases. In general, the results of all factors of client related factors showed that the mean equals "6.20" and RII = 0.620, that means the respondents were agree on this dimension.

Second: Occurrence

It's shown from Table (4.22) that *"Change in the specification by the client*" was ranked as the most occurred cause on the VO with mean equals "5.97" and RII = 0.597, that means the respondents were neutral on this factor. In a design stage, change the specification might occurr due to change of mind of the client or the consultant which results in the VOs. This result match with Shawareb (2012) and Ngwepe et al. (n.d.) whose found that the most significant cause of the VOs in client related group is *"change in specification by the client*" and ranked it in the 1st and 2nd position respectively. In contrast, *"Change of implementing schedule by client*" was ranked as the least occurred cause on the VOs with mean equals "4.55" and RII = 0.455, that means the respondents were disagree on this factor. The occurrence of the change of implementing schedule by client affects the whole plan of work and resource allocation, which can result in time and material loss so, inadequate scheduling and coordination of the works lead to a disorganized construction project prone to disputes, claims and considerable losses for all involved. This result agree with Enshassi et al. (2010) who found that this factor was in the 9th position of the occurred factor on the VOs in the related category. In general, the results of all factors of client related factors showed that the mean equals "5.28" and RII = 0.528, that means the respondents were neutral on this dimension.

Table (4.22): The influence and occurrence of client related factors on the VOs

Client related factors	Influence				Occurrence			
	Mean	SD	RII	Rank	Mean	SD	RII	Rank
Change in specification by the client	6.64	2.40	0.664	1	5.97	2.70	0.597	1
Required improvement.	6.29	2.56	0.629	6	5.85	2.63	0.585	2
Client's financial problems.	6.61	2.70	0.661	3	5.68	2.66	0.568	3
Replacement of material or procedure by the client.	6.64	2.32	0.664	1	5.62	2.50	0.562	4
Inadequate experience of client's staff.	6.53	2.54	0.653	4	5.54	2.69	0.554	5
Obstinate nature of the client.	6.33	2.59	0.633	5	5.32	2.59	0.532	6
Impediment in prompt decision-making process.	6.21	2.53	0.621	7	5.16	2.63	0.516	7
Land allocation problems.	5.95	2.53	0.595	9	4.99	2.72	0.499	8

Continued table: (4.21)

Client related factors	Influence				Occurrence			
	Mean	SD		Mean	SD		Mean	SD
Change project purpose and scope by clients.	5.96	2.98	0.596	8	4.91	2.80	0.491	9
Change of implementing schedule by the client	5.50	2.39	0.550	10	4.55	2.33	0.455	10
Inadequate project objectives.	5.49	2.75	0.549	11	4.55	2.72	0.455	10
Total degree	**6.20**	**1.80**	**0.620**		**5.28**	**1.84**	**0.528**	

4.4.6.3.2 Analysis of Donor related factors

In this category, the donor related factors have been analyzed. Responses of clients, consultants, and contractors have been sorted and analyzed regarding this group. The findings presented in Table (4.23) and Table (4.24).

Table (4.23) showed RII and the rank of donor related factors in terms of the occurrence of the VOs and according to each party and to overall respondents as follows.

"Budget allocated constraints" was ranked as the most important factor with RII = 0.597, according to overall respondents. The contractor ranked it in the 1st position with RII = 0.636 and consultant and client ranked it in the 2nd position with RII = 0.525 and 0.572 respectively. Occasionally the client and consultant have to issue VOs by omitting some activities because of the budget constraints that do not allow any additional fund for improvement in scope and covering the rising prices of materials or the donors seek to make some savings.

"Time constraints" was ranked in the 2nd position with RII = 0.592, according to overall respondents. The results show somewhat agreement among all parties on the importance of this cause. The contractor ranked it in the 2nd position with RII = 0.601 and consultant and client ranked it in the 1st position with RII = 0.571 and 0.597 respectively. Sometimes, there is inflexibility of the donor in giving appropriate periods for project implementation. Donor often wants to commit to time schedule otherwise, the fund will be suspended or terminated ongoing projects.

"Relation between donor and client" was ranked in the 3rd position with RII = 0.557 according to overall respondents. The consultant and client ranked it in the 5th position with RII = 0.480 and RII= 0.538 respectively, whereas, the contractor ranked it in 3rd position with RII = 0.598. The relation between client and donor plays an important role in issuing the VOs either by allowing additional fund for execution new activities or by putting constraints on the fund that may lead to omissions.

Table (4.23): Ranks of the occurrence of donor related factors on the VOs

Donor related factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Budget allocated constraints.	0.636	1	0.525	2	0.572	2	0.597	1
Time constraints.	0.601	2	0.571	1	0.597	1	0.592	2
Relation between donor and client.	0.598	3	0.480	5	0.538	5	0.557	3
Financial capability of the donor.	0.570	4	0.514	3	0.541	4	0.551	4
Interference of donor in project requirements.	0.570	4	0.493	4	0.559	3	0.548	5

In another hand, the occurrence and the influence of donor related factors have been analyzed. Over all responses of contractors, consultants and clients have been sorted and analyzed regarding this group as shown in Table (4.24). The opinion of respondents about this group was as follows.

First: Influence

It's shown from Table (4.24) that *"Financial capability of donor*" was ranked as the most influential cause on the VO with mean equals "6.85" and RII = 0.685, that means the respondents were agreement on this factor. The donors' financial capability could change during the project. It could affect or in the extreme even jeopardize the projects' expected outcome. In contrast, *"Interference of donor in project requirements*" was ranked as the least influential cause on the VO with mean equals "6.06" and RII = 0.606, that means the respondents were agree on this factor. The Donors always have the own policy in implementation methods and characteristics of the project. In general, the results of all factors of donor related

factors showed that the mean equals "6.47" and RII = 0.647, that means the respondents were agree on this dimension.

Second: Occurrence

It's shown from Table (4.24) that *"Budget allocated constraints*" was ranked as the most occurred cause on the VO with mean equals "5.97" and RII = 0.597, that means the respondents were neutral on this factor. This result inline with Enshassi et al. (2010) who found that the most significant cause of the VOs in donor related group is budget allocated constraints and ranked it in the 1st position. In contrast, *"Interference of donor in project requirements*" was ranked as the least occurred cause on the VO with mean equals "5.48" and RII = 0.548, that means the respondents were neutral on this factor. This result agree with Enshassi et al. (2010) who found that this factor was the least occurred cause and ranked it in 5th position in the related category. In general, the results of all factors of donor related factors showed that the mean equals "5.69" and RII = 0.569, that means the respondents were neutral on this dimension.

Table (4.24): The Influence and occurrence of donor related factors on the VO

Donor related factors	Influence				Occurrence			
	Mean	SD	RII	Rank	Mean	SD	RII	Rank
Budget allocated constraints.	6.74	2.51	0.674	2	5.97	2.60	0.597	1
Time constraints.	6.53	2.43	0.653	3	5.92	2.52	0.592	2
Relation between donor and client.	6.15	2.46	0.615	4	5.57	2.40	0.557	3
Financial capability of the donor.	6.85	2.78	0.685	1	5.51	2.77	0.551	4
Interference of donor in project requirements.	6.06	2.62	0.606	5	5.48	2.62	0.548	5
Total degree	**6.47**	**2.08**	**0.647**		**5.69**	**2.11**	**0.569**	

4.4.6.3.3 Analysis of Consultant related factors

In this category, the consultant related factors have been analyzed. Responses of clients, consultants, and contractors have been sorted and analyzed regarding this group. The findings presented in Table (4.25) and Table (4.26).

Table (4.25) showed RII and the rank of consultant related factors in terms of the occurrence of the VOs and according to each party and to overall respondents as follows.

"Discrepancies between contract documents" was ranked as the most important factor with RII = 0.601 according to overall respondents. The contractor and consultant ranked it in the 1st position with RII = 0.613 and 0.600 respectively, whereas, the client ranked it in 3rd position with RII = 0.556.

"Errors and omissions in design" was ranked in the 2nd position with RII = 0.589. There is an agreement between consultant, contractor, and client that it is one of the most five important consultant related factors causing the VOs in the construction process. The contractor and client ranked it in the 2nd position with RII = 0.608 and 0.563 respectively, whereas, the consultant ranked it in 5th position with RII = 0.564. A project when designed with inadequate detail or with inappropriate coverage of all the project aspects or with mistakes would affect the work output and the project schedule. Errors if not corrected during the design phase would eventually appear in a construction phase and issue a VO to implement corrective measures.

"Inadequate revision and feedback system through design process" was ranked in the 3rd position with RII = 0.583 according to overall respondents. The results show agreement among all parties on the importance of this cause. The contractor, consultant, and client ranked it in the 4th position with RII = 0.598, RII= 0.566 and RII= 0.553 respectively. To convey a complete concept of the project design, revision and feedback system through design process must be implemented so thorough reviewing of design details would assist in minimizing variations.

Table (4.25) Ranks of the occurrence of consultant related factors on the VOs

Consultant related factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Discrepancies between contract documents.	0.613	1	0.600	1	0.556	3	0.601	1
Errors and omissions in design.	0.608	2	0.564	5	0.563	2	0.589	2
Inadequate revision and feedback system through the design process.	0.598	4	0.566	4	0.553	4	0.583	3
Consultant's lack of judgment and experience.	0.608	2	0.561	6	0.500	9	0.579	4
Change in design by consultant during construction stage.	0.594	5	0.532	11	0.591	1	0.577	5
Insufficient time for preparation of contract documents.	0.569	11	0.569	3	0.538	7	0.564	6
Insufficient site investigation prior to design.	0.584	6	0.529	12	0.541	6	0.563	7

Continued table: (4.25)

Consultant related factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank		RII	Rank	RII
Inadequate and ambiguous design details and non-clearance of BOQ.	0.578	8	0.547	7	0.500	9	0.558	8
Change in specifications by the consultant	0.573	9	0.544	8	0.516	8	0.557	9
Lack of coordination among project parties.	0.550	13	0.573	2	0.550	5	0.556	10
Lack of consultant's knowledge of available materials and equipment.	0.580	7	0.537	9	0.481	13	0.554	11
International consultant using inadequate specification to be followed in local conditions. i.e. Testing procedure.	0.573	9	0.536	10	0.494	11	0.552	12
Technology change especially if the time between design and construction is long.	0.566	12	0.495	14	0.469	14	0.533	13
Inadequate scope of work for the contractor.	0.545	14	0.480	15	0.456	15	0.514	14
Design complexity.	0.500	15	0.498	13	0.484	12	0.497	15

In another hand, the occurrence and the influence of donor related factors have been analyzed. Over all responses of contractors, consultants and clients have been sorted and analyzed regarding this group as shown in Table (4.26). The opinion of respondents about this group was as follows.

First: Influence

It's shown from Table (4.26) that *"Errors and omissions in design*" was ranked as the most influential consultant related factor on the VO with mean equals "6.61" and RII = 0.661, that means the respondents were agree on this factor. Errors if not corrected during the design phase would eventually appear in a construction phase and issue a VO to implement corrective measures. This result doesn't match with Albhaisi (2016) who found that this factor one of the least influential consultant related factor on the VO. In contrast, *"Technology change especially if the time between design and construction is long*" was ranked as the least influential consultant related factor on the VO with mean equals "5.67" and RII = 0.567, that means the respondents were neutral on this factor. The time between the design and construction phase in the Gaza Strip for most projects is not very long. Therefore, technology change in terms of construction materials and equipment is not major. Besides, the nature of the construction projects in Gaza strip does not need a higher

reliance on technology for construction, therefore, the influence of technology change is limited. In general, the results of all factors of consultant related factors show that the mean equals "6.26" and RII = 0.626, that means the respondents were agree on this dimension.

Second: Occurrence

It's shown from Table (4.26) that *"Discrepancies between contract documents*" was ranked as the most occurred consultant related factor on the VO with mean equals "6.01" and RII = 0.601, that means the respondents were agree on this factor. This result inline with Enshassi et al. (2010) who found that this factor was one of the most five important factors in consultant related factors. This result agree with Eigbe (2016) and Sunday (2010) whose found that this factor was one of the most occurred factors on the VO in the related category. In contrast, *"Design complexity*" was ranked as the least occurred consultant related factor on the VO with mean equals "4.97" and RII = 0.497, that means the respondents were disagree on this factor. Design complexity highlights the need of special expertise and construction methods. The nature of the design of the construction projects in Gaza strip does not need a special expertise and construction methods, therefore, the occurrence of Design complexity is limited. This result doesn't match with Albhaisi (2016) who found that this factor was the most occurring factor on the VO in consultant related factors. It was ranked as the first position. In general, the results of all factors of consultant related factors show that the mean equals "5.59" and RII = 0.559, that means the respondents were neutral on this dimension.

Table (4.26): The Influence and occurrence of consultant related factors on the VOs

Consultant related factors	Influence				Occurrence			
	Mean	SD	RII	Rank	Mean	SD	RII	Rank
Discrepancies between contract documents.	6.33	2.58	0.633	10	6.01	2.46	0.601	1
Errors and omissions in design.	6.61	2.61	0.661	1	5.89	2.63	0.589	2
Inadequate revision and feedback system through the design process.	6.27	2.63	0.627	9	5.83	2.44	0.583	3
Consultant's lack of judgment and experience.	6.56	2.56	0.656	2	5.79	2.52	0.579	4
Change in design by consultant during construction stage.	6.37	2.64	0.637	7	5.77	2.55	0.577	5

Continued table: (4.26)

Consultant related factors	Influence			Occurrence				
	Mean	SD		Mean	SD		Mean	SD
Insufficient time for preparation of contract documents.	6.50	2.56	0.650	4	5.64	2.51	0.564	6
Insufficient site investigation prior to design.	6.37	2.61	0.637	8	5.63	2.65	0.563	7
Inadequate and ambiguous design details and non-clearance of BOQ.	6.53	2.52	0.653	3	5.58	2.53	0.558	8
Change in specifications by the consultant	6.23	2.42	0.623	11	5.57	2.50	0.557	9
Lack of coordination among project parties.	6.06	2.42	0.606	12	5.56	2.45	0.556	10
Lack of consultant's knowledge of available materials and equipment.	6.48	2.46	0.648	5	5.54	2.56	0.554	11
International consultant using inadequate specification to be followed in local conditions. i.e. Testing procedure.	6.41	2.53	0.641	6	5.52	2.68	0.552	12
Technology change especially if the time between design and construction is long.	5.67	2.54	0.567	15	5.33	2.54	0.533	13
Inadequate scope of work for the contractor.	5.71	2.51	0.571	14	5.14	2.70	0.514	14
Design complexity.	5.88	2.49	0.588	13	4.97	2.34	0.497	15
Total degree	**6.26**	**1.95**	**0.626**		**5.59**	**1.90**	**0.559**	

4.4.6.3.4 Analysis of contractor related factors

In this category, the contractor related factors have been analyzed. Responses of clients, consultants, and contractors have been sorted and analyzed regarding this group. The findings presented in Table (4.27) and Table (4.28).

Table (4.27) showed RII and the rank of contractor related factors in terms of the occurrence of the VOs and according to each party and to overall respondents as follows.

"Contractor's desired profitability to improve financial condition" was ranked as the most important factor with RII = 0.583, according to overall respondents. The contractor, consultant, and client ranked it in the 3rd, 1st and 6th position with RII = 0.576, 0.614, and 0.556 respectively. Variations are reflected a common source of additional work for the contractor so, variations can be seen as an additional financial reward for the contractor. In Gaza Strip, the contractor may eventually strive to

persuade the client of the project to allow certain variations, leading to additional financial benefits for him. This result doesn't match with Albhaisi (2016) in his study in the construction projects in Gaza Strip. He found that this factor was one of the least occurring contractor related factor on the VO in Gaza strip.

"Contractor's financial difficulties" was ranked in the 2nd position with RII = 0.577. The contractor, consultant, and client ranked it in the 1st, 3rd and 7th position with RII = 0.587, 0.578, and 0.538 respectively. Contractor's financial difficulties were some of the critical factors causing the VOs in the construction projects in Gaza strip. Whether the contractor has been paid or not, the wages of the workers must still be paid. If the contractor is facing financial difficulties, this will affect the availability of workforce and may require variation or extension of time. Contractor's financial difficulties may cause major variations during a project, affecting its quality and progress. Moreover, Contractors during the last five years suffered from financial difficulties due to the siege imposed on Gaza Strip. This result agree with Shawareb (2012) in his study in the construction projects in Gaza Strip. He found that this factor was one of the most occurring factors on the VO in contractor related factors. However, this result doesn't match with Assbeihat and Sweis (2015) who found that this factor was one of the least occurring contractor related factor on the VO.

"Contractor's lack of judgment and experience" was ranked in the 3rd position with RII = 0.574 according to overall respondents. The consultant and client thought that contractor initiated the VOs mainly due to lack of judgment and experience and ranked it in the 2nd and 1st position with RII = 0.612 and RII= 0.584 respectively. In the other hand, the contractor ranked it in 9th position with RII = 0.555. The lack of Contractor's professional experience increases the risk of errors in cost estimate stage as well as during construction. If the contractor is not experienced or competent enough to complete the project. It may lead to the defective workmanship, for instance, rework, schedule delays, productivity degradation, low quality, etc.

However, in most construction projects, the client tends to look at the past experience and the performance of contractors other than the tender pricing before awarding the contract to the contractor to ensure that the contractor is more than competent to handle and complete the project. This result didn't agree with Enshassi

et al. (2010) and Jadhav and Bhirud (2015) whose found that this factor was one of the least occurring factors on the VO in contractor related factors. The researcher point of view agree with Enshassi et al. (2010) and Jadhav and Bhirud (2015) in their result and asserted that lack of experience on the part of the contractor is not a significant cause of the VO. This is unexpected as contractors ordinarily initiate variations because of inexperience in aspects of estimating and construction.

Table (4.27) Ranks of the occurrence of contractor related factor on the VOs

Contractor related factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Contractor's desired profitability to improve the financial condition.	0.576	3	0.614	1	0.556	6	0.583	1
Contractor's financial difficulties.	0.587	1	0.578	3	0.538	7	0.577	2
Contractor's lack of judgment and experience. i.e. misunderstanding of tender documents during cost estimate stage.	0.555	9	0.612	2	0.584	1	0.574	3
Differing site conditions. i.e. soil conditions differ from as indicated in the tender document.	0.580	2	0.554	5	0.566	3	0.571	4
Failure of the contractor/supplier to provide the required material from outsourcing (shipping obstacles).	0.570	4	0.539	7	0.584	1	0.564	5
Lack of a specialized construction manager.	0.559	7	0.576	4	0.538	7	0.561	6
Shortage of skilled manpower	0.556	8	0.531	9	0.563	5	0.550	7
Searching for compensating costs for his low prices if any.	0.563	6	0.541	6	0.509	13	0.549	8
Contractor's lack of required data.	0.567	5	0.532	8	0.481	14	0.545	9
Lack of communication between contractor and other parties.	0.553	10	0.508	14	0.522	12	0.537	10
Defective workmanship. (Acceptance of defective workmanship due to schedule may force a change in the facility to correct for it).	0.541	12	0.512	13	0.566	3	0.537	10
The required equipment and tools are not available.	0.525	13	0.517	12	0.528	10	0.523	12
Lack of strategic planning.	0.518	14	0.520	11	0.538	7	0.521	13
Complex design and technology.	0.512	15	0.522	10	0.528	10	0.517	14
Lack of contractor's involvement in design.	0.545	11	0.422	15	0.481	14	0.502	15

In another hand, the occurrence and the influence of donor related factors have been analyzed. Over all responses of contractors, consultants and clients have been sorted and analyzed regarding this group as shown in Table (4.28). The opinion of respondents about this group was as follows.

First: Influence

It's shown from Table (4.28) that *"Failure of the contractor/supplier to provide the required material from outsourcing (shipping obstacles)* " was ranked as the most influential contractor related factor on the VO with mean equals "6.45" and RII = 0.645, that means the respondents were agree on this factor. In Gaza Strip and according to extraordinary political and economical situation, there are great difficulties to get materials, especially because the borders of Gaza Strip is controlled by the Israeli occupation. The failure of supplying the required materials on time means that contractor will lose the efforts of human resources and lose the time of execution, and then the variation will occur. In contrast, *"Lack of contractor's involvement in design*" was ranked as the least influential contractor related factor on the VO with mean equals "4.92" and RII = 0.492, that means the respondents were disagree on this factor. The majority of project delivery system in Gaza is Design-Bid-Built so, from the practical side, the contractor hasn't been known in design phase yet until the tender is awarded. However, this factor necessarily affects work causing a VO. Including a contractor in the design stage can decrease issues between the contractor and the consultant or the designer. In general, the results of all factors of contractor related factors show that the mean equals "6.06" and RII = 0.606, that means the respondents were agree on this dimension.

Second: Occurrence

It's shown from Table (4.28) that *"Contractor's desired profitability to improve financial condition*" was ranked as the most occurred contractor related factor on the VO with mean equals "5.83" and RII = 0.583, that means the respondents were neutral on this factor. In contrast, *"Lack of contractor's involvement in design*" was ranked as the least occurred contractor related factor on the VO with mean equals "5.02" and RII = 0.502, that means the respondents were neutral on this factor. This result doesn't match with Albhaisi (2016), Jadhav and Bhirud (2015) and Ngwepe et

al. (n.d.) whose found that this factor was one of the most occurring factors on the VO in contractor related factors. In general, the results of all factors of contractor related factors show that the mean equals "5.47" and RII = 0.547, that means the respondents were neutral on this dimension.

Table (4.28): The Influence and occurrence of contractor related factors on the VOs

Contractor related factors	Influence				Occurrence			
	Mean	SD	RII	Rank	Mean	SD	RII	Rank
Contractor's desired profitability to improve the financial condition.	6.31	2.58	0.631	2	5.83	2.59	0.583	1
Contractor's financial difficulties.	6.21	2.76	0.621	7	5.77	2.63	0.577	2
Contractor's lack of judgment and experience. i.e. misunderstanding of tender documents during cost estimate stage.	6.27	2.54	0.627	3	5.74	2.42	0.574	3
Differing site conditions. i.e. soil conditions differ from as indicated in the tender document.	6.21	2.57	0.621	6	5.71	2.34	0.571	4
Failure of the contractor/supplier to provide the required material from outsourcing (shipping obstacles).	6.45	2.38	0.645	1	5.64	2.47	0.564	5
Lack of a specialized construction manager.	6.23	2.61	0.623	5	5.61	2.63	0.561	6
Shortage of skilled manpower	6.27	2.65	0.627	3	5.50	2.59	0.550	7
Searching for compensating costs for his low prices if any.	6.13	2.58	0.613	9	5.49	2.53	0.549	8
Contractor's lack of required data.	6.19	2.41	0.619	8	5.45	2.43	0.545	9
Lack of communication between contractor and other parties.	6.07	2.48	0.607	10	5.37	2.37	0.537	10
Defective workmanship. (Acceptance of defective workmanship due to schedule may force a change in the facility to correct for it).	5.96	2.39	0.596	12	5.37	2.61	0.537	10
The required equipment and tools are not available.	5.94	2.58	0.594	13	5.23	2.48	0.523	12
Lack of strategic planning.	6.03	2.62	0.603	11	5.21	2.41	0.521	13
Complex design and technology.	5.70	2.56	0.570	14	5.17	2.39	0.517	14
Lack of contractor's involvement in design.	4.92	2.95	0.492	15	5.02	2.85	0.502	15
Total degree	**6.06**	**1.84**	**0.606**		**5.47**	**1.80**	**0.547**	

4.4.6.3.5 Analysis of Environmental factors

In this category, the environmental factors have been analyzed. Responses of clients, consultants, and contractors have been sorted and analyzed regarding this group. The findings presented in Table (4.29) and Table (4.30).

Table (4.29) showed RII and the rank of the environmental factors in terms of the occurrence of the VOs and according to each party and to overall respondents as follows.

"Israeli restriction in terminals and crossing closure and siege" was ranked as the most important factor with RII = 0.727 according to overall respondents. The contractor, consultant, and client ranked it in the 1st position with RII = 0.695, 0.766, and 0.784 respectively. The agreement between all parties reflects the severe situation that the construction projects are suffering from because of siege and closure. Unfortunately, Palestine in general and Gaza Strip, in particular, depends fully on the import of raw materials for the construction industry (steel, cement and gravels). During any conflict or disputes between Gaza Strip and Israeli occupation, Israel enforced a siege on the Occupied Territories (Gaza Strip and West Bank) resulting in the lack of construction materials and equipment spare parts so getting required materials in same specifications and on time is difficult in Gaza Strip. This situation leads to variations in a construction project either by omitting some activities that become difficult to execute or by replacing the materials and procedures of construction. This result inline with Enshassi et al. (2010) in his study in the construction projects in Gaza Strip who found that this factor was the most important cause in environmental factors in Gaza strip and ranked it in the 1st position.

"Internal political problems" was ranked in the 2nd position with RII = 0.600. The contractor, consultant, and client ranked it in the 2nd position with RII = 0.617, 0.544, and 0.631 respectively. Agreement among all parties reflects the importance of this factor. Internal political problems; as rebellion, civil war, or disorder may lead to reserve many funds for projects. If the project in the implementation stage, this may lead to change in scope of work and finally initiate the VOs. This result inline with Enshassi et al. (2010) in his study in the construction projects in Gaza Strip who

found that this factor was the most important cause in environmental factors in Gaza strip and ranked it in the 2nd position.

Table (4.29): Ranks of the occurrence of environmental factor on the VOs

Environmental factors	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts).	0.695	1	0.766	1	0.784	1	0.727	1
Internal political problems.	0.617	2	0.544	2	0.631	2	0.600	2
Change in economical conditions.	0.595	3	0.519	4	0.588	3	0.574	3
Unforeseen problems.	0.573	4	0.532	3	0.575	4	0.562	4
Weather conditions.	0.519	6	0.449	6	0.525	5	0.501	5
Safety considerations.	0.500	7	0.480	5	0.503	6	0.495	6
Change in governmental regulations.	0.527	5	0.434	7	0.459	7	0.492	7

In another hand, the occurrence and the influence of environmental factors have been analyzed. Over all responses of contractors, consultants, and clients have been sorted and analyzed regarding this group. As shown in table (4.30), the opinion of respondents regarding this group was as follows:

First: Influence

It's shown from Table (4.30) that *"Israeli restriction in terminals and crossing closure and siege*" was ranked as the most influential environmental factor on the VO with mean equals "7.41" and RII = 0.741, that means the respondents were agree on this factor. In contrast, *"Weather conditions*" was ranked as the least influential environmental factor on the VO with mean equals "5.17" and RII = 0.492, that means the respondents were neutral on this factor. Weather condition such as high temperature or high winds can affect outside activities in the construction projects. This factor may force the contractor to change his work schedule and results in adjustment of contract schedule to compensate the lost time due to weather conditions. Moreover, inclement weather may result in damage and the contractor will be compensated according to contract terms if it mentioned in it. In general, the

results of all factors of environmental factors show that the mean equals "5.96" and RII = 0.596, that means the respondents were neutral on this dimension.

Second: Occurrence

It's shown from Table (4.30) that *"Israeli restriction in terminals and crossing closure and siege* was ranked as the most occurred environmental factor on the VO with mean equals "7.27" and RII = 0.727, that means the respondents were agree on this factor. In contrast, *"Change in governmental regulations*" was ranked as the least occurred environmental factor on the VO with mean equals "4.92" and RII = 0.492, that means the respondents were disagree on this factor. This result inline with Enshassi et al. (2010) who found that this factor was the one of the least occurred cause in environmental factors in Gaza strip and ranked it in the 7th position. In general, the results of all factors of environmental related factors show that the mean equals "5.64" and RII = 0.564, that means the respondents were neutral on this dimension.

Table (4.30): The Influence and occurrence of environmental factors on the VOs

Environmental factors	Influence				Occurrence			
	Mean	SD	RII	Rank	Mean	SD	RII	Rank
Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts).	7.41	2.68	0.741	1	7.27	2.66	0.727	1
Internal political problems.	6.28	2.82	0.628	2	6.00	2.73	0.600	2
Change in economical conditions.	6.10	2.74	0.610	4	5.74	2.71	0.574	3
Unforeseen problems.	6.11	2.45	0.611	3	5.62	2.59	0.562	4
Weather conditions.	5.17	2.65	0.517	7	5.01	2.39	0.501	5
Safety considerations.	5.42	2.59	0.542	5	4.95	2.43	0.495	6
Change in governmental regulations.	5.21	2.71	0.521	6	4.92	2.46	0.492	7
Total degree	**5.96**	**1.95**	**0.596**		**5.64**	**1.83**	**0.564**	

4.4.6.4 Group analysis

RII and ranks for each group of causes of the VOs are presented in the Table (4.31). It's shown from the table that the groups of the factors were ranked as follows: Donor related factors group, Environmental factors group, Consultant related factors group, Contractor related factors group, and Client related factors group. In contrast, by reference to the Table (4.18), the origin agents were ranked as follows: Client, Consultant, Contractor, and Donor.

Firstly, the group analysis indicated that the donor was ranked in the first position. This result reflects that the donor had major effects on the occurrence of the VOs. This may be due to the major interference of donor in the project phases according to the budget allocated constraints and time constraints. This rank doesn't match with Enshassi et al. (2010).

Environmental factors was ranked in the second position. Environmental factors affected on the client to issue the VO while the consultant and contractor were ranked in the third and fourth position respectively. Many factors can affect on the consultant and contractor, who are chosen by the client, to issue the VO. The client was ranked in the fifth position because of the previous group was affected on the client to issue the VOs.

Secondly, the responses regarding the rank of the origin agents indicated that the client was ranked in the first position. This reflects the attempt of the parties to throw responsibility to the client in issuing the VOs.

Table (4.31): RII and Ranks of the group of the causes of the VOs

Group	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Donor related factors	0.595	1	0.517	4	0.561	2	0.569	1
Environmental factors	0.575	3	0.532	3	0.581	1	0.564	2
Consultant related factors	0.576	2	0.542	1	0.519	4	0.558	3
Contractor related factors	0.554	4	0.539	2	0.539	3	0.547	4
Client related factors	0.541	5	0.513	5	0.507	5	0.529	5

4.4.6.5 Correlations among parties according to the causes of the VOs

There is a strong correlation between the rank of consultant and client for the causes of the VOs with a correlation coefficient (0.89). In addition, the correlation between consultant and contractor is strongly correlated with a correlation coefficient (0.86) and the correlation between client and contractor with a correlation coefficient (0.84) as shown in Table (4.32). This result reflects the agreement between all parties on the importance of the causes of the VOs.

Table (4.32): Correlation coefficient between parties according to the causes of the VOs

Respondents	Correlation coefficient	Relation of the Respondents
Client VS Consultant	0.89	Strong
Consultant VS Contractor	0.86	Strong
Client VS Contractor	0.84	Strong

4.4.7 Analysis of the Impact of the VOs

This part introduces and discusses the obtained results regarding the cost implication of the VOs and the factors of the impact of the VO in the construction projects in the Gaza Strip.

4.4.7.1 Cost implication of the VO

VOs have cost implications. Nevertheless, it was imperative to assess the awareness of the construction project actors with regard to the costs that were implied with the VO. The findings are presented in Table (4.33) and Table (4.34). As shown in Table (4.33), respondents were requested to indicate to what extent they agreed with given statements using a 5-point Likert scale of agreement where Strongly disagree = 1; Disagree = 2; Neutral = 3; Agree = 4; and Strongly agree = 5. If the dimension had a p-value more than "0.05" then the respondents were neutral regarding this dimension and if the dimension had a p-value less than "0.05", there are two cases firstly, a mean less "3" so the respondents were disagree with this dimension secondly, a mean more than "3" so the respondents were agreed on this dimension.

The majority of respondents (81.3%) reported that excessive VOs result in incurring additional costs and its rank by all respondents in the first position with a mean of "4", RII = 0.800, and p-value equals "0.000", that means the respondents agree with this statement. Many respondents (63%) reported that the reduction of the occurrence of the VOs could optimally lower construction delivery costs and several respondents (63.5%) agreed that the occurrence of the VOs is the important factor of delay in delivery of the construction projects while 61.2 % of respondents asserted that no matter how carefully a VO is administrated, indirect costs accrue on it.

Less than half of respondents (49.7%) reported that time compression in construction operations could contribute to significant reduction of unnecessary costs; others (26.9%) remained neutral while little of respondents (23.3%) disagreed that time compression in construction operations could contribute to significant reduction of unnecessary costs and its rank by all respondents it in the fifth position with mean equals "3.29", RII = 0.658 and p-value equals "0.000" that means the respondents agree with this statement. In general, the results of all statements of cost implication of the VOs show that the mean equals "3.63", RII= 0.726, and p-value equals "0.000" that means the respondents agree with this dimension.

Table (4.33) Cost implication of the VOs

Statements	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Excessive VOs result in incurring additional costs.	219	0.0	5.9	12.8	57.1	24.2
The reduction of the occurrence of the VOs could optimally lower construction delivery costs.	219	0.9	5.5	30.6	53.0	10.0
The occurrence of the VOs is the important factor of delay in delivery of the construction projects.	219	0.9	13.7	21.9	48.4	15.1
No matter how carefully a VO is administrated, indirect costs accrue on it.	219	0.9	9.6	28.3	53.4	7.8
Time compression in construction operations could contribute to a significant reduction of unnecessary costs.	219	4.6	18.7	26.9	42.9	6.8

Table (4.34): Ranks of cost implication of the VOs

Statements	Mean	SD	RII	T-test	P-value	Rank
Excessive VOs result in incurring additional costs.	4.00	0.78	0.800	18.860	0.000*	1
The reduction of the occurrence of the VOs can optimally lower construction delivery costs.	3.66	0.77	0.732	12.634	0.000*	2
The occurrence of the VOs is the important factor of delay in delivery of the construction projects.	3.63	0.93	0.726	10.014	0.000*	3
No matter how carefully a VO is administrated, indirect costs accrue on it.	3.58	0.81	0.715	10.568	0.000*	4
Time compression in construction operations can contribute to a significant reduction of unnecessary costs.	3.29	1.00	0.658	4.268	0.000*	5
Total degree	**3.63**	**0.54**	**0.726**	**17.276**	**0.000***	

*Arithmetic mean is statistically significant at $\alpha \leq 0.05$

4.4.7.2 Analysis of the impact of the VOs

In this section, the impact of the VOs has been analyzed. Responses of clients, consultants, and contractors have been sorted and analyzed about the impact of the VO. The descriptive statistics, i.e. means, SD, RII, and ranks were established for the all factors impact of the VOs according to each party of the respondents and to overall respondents and presented in Table (4.35) and Table (4.36). The numbers in the "rank" column represent the sequential ranking based on the highest mean and RII and the lowest SD. If some factors have similar means and RIIs ranking will depend on the lowest SD. In addition, If the mean of the responses less than 5 then the respondents disagree, if the mean of the responses more than 6 then the respondents agree and If the mean of the responses between 5 and 6 then the respondents are neutral.

Table (4.35) showed the RII and the rank of factors impact of the VOs in terms of the occurrence of the VOs and according to each party and to overall respondents as follows.

The most important factors

"*Delay in payment*" was the most commonly occurred factor and ranked in the 1st position with RII = 0.605 according to overall respondents. There is a low degree of compatibility between the three parties. The contractor ranked it in the 1st position with RII = 0.639, while the consultant and the client ranked it in the 5th and 8th position with RII = 0.544 and RII= 0.581 respectively. VOs have an impact on the payment to the contractor. Besides, delay in payment gives bad impacts to contractors, particularly contractors with small capital. Besides, it also creates a negative chain effect in term of overall cash flow and the payment to be made within the players in the construction projects such as to suppliers, sub-contractors as well as end users for example; the main contractors may not be able to pay the subcontractors unless they get paid by the client first. This result inline with Ibrahim (2006) who mentioned that delay in payment was the common impact of the VO and ranked it 2nd position while (Alaryan et al., 2014) reported that delay in payment was one of the most five impact of the VO. On the other hand, this result doesn't match with Karthick et al. (2015) who ranked this factor in the last position.

"*Increase in duration of individual activities*" was ranked in the 2nd position with RII = 0.581 according to overall respondents. The results show somewhat agreement among all parties on the importance of this cause. The client highlighted this factor as the most significant by placing it at 1st rank with RII = 0.678, while the contractor and consultant ranked it in the 2nd and 3rd position with RII = 0.566 and RII= 0.561 respectively. VOs have an impact on the sequence and duration of the activities in the contract schedule so, Bolin (2017) said "*if the activities on the schedule's critical or near-critical paths are impacted by scope changes, the contract completion date of a project may be extended unless acceleration of the work is performed*". This result agrees with Alaryan et al. (2014) and Desai et al. (2015) whose found that increase in duration of individual activities was one of the top five impacts of the VO.

"*Completion schedule delay*" was ranked in the 3rd position with RII = 0.575 according to overall respondents. The contractor and client ranked it in the 2nd position with RII = 0.566 and RII= 0.659 respectively, whereas, the consultant

ranked it in 4th position with RII = 0.547. Variations often impede the project progress, leading to delay in achieving the targeted milestones during construction. The completion schedule for the project will delay by the work involved in completing the VO. Major variations may impact the project adversely, leading to delays in the project completion. Besides, frequent minor variations can also impact the project adversely depending on the timing of the occurrence of the variations, for example, the impact of a variation in design during the construction phase can be more severe than in the design phase. This result agrees with several researchers (Osman et al., 2009; Ismail et al., 2012; Alaryan et al., 2014; Memon et al., 2014; Pourrostam et al., 2011; Desai et al., 2015; Yadeta, 2016) whose reported that completion schedule delay was one of the top five impacts of the VOs.

The two least important factors

"*Rework and demolition*" was ranked according to overall respondents in the 17th position with RII = 0.515 according to overall respondents. There is a difference among parties toward the importance of this factor, Contractor, consultant, and client ranked it in the 15th, 11th and 16th position with RII = 0.513, RII = 0.519, and RII = 0.519 respectively. This was because any alteration or addition in the design during execution of the project quite often cause some parts of the work done to be demolished and done again. It depends on the timing of the variations. If variations occur during the design phase, no rework or demolition is required on construction sites, as things are not constructed yet. Therefore, the impact of a change in design during the construction phase is more serious than in the design phase. This result nearly agrees with Msallam et al. (2015) and Yadeta (2016) whose found that this factor was one of the least important impact addressed.

"*Increase in overhead expenses*" was ranked in 18th position as the least important impact of the VOs with RII = 0.502 as per perception of all respondents. There is a difference among parties toward the importance of this factor, Contractor, consultant, and client ranked it in the 16th, 18th and 13th position with RII = 0.509, RII = 0.469, and RII = 0.534 respectively. This was because the VOs require processing procedures, paper work, and reviews before they even proceed but these expenses are normally minor and not charged to the VO account as they are difficult

to define and separate from the different accounts. The charge normally goes on the overhead account and these overhead charges are provided from the contingency fund allocated for the construction project. This result nearly agrees with Karthick et al. (2015) whose found that this factor was one of the least important impacts of the VO.

Table (4.35): Ranks of the occurrence of impact of the VOs

Paragraph	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Delay in payment.	0.639	1	0.544	5	0.581	8	0.605	1
Increase in duration of individual activities.	0.566	2	0.561	3	0.678	1	0.581	2
Completion schedule delay.	0.566	2	0.547	4	0.659	2	0.575	3
Increase in project cost.	0.551	4	0.563	2	0.613	4	0.563	4
Dispute among professionals.	0.547	5	0.541	6	0.609	5	0.554	5
Procurement delay (materials and equipment).	0.544	6	0.571	1	0.556	11	0.553	6
Suspend work in other activities.	0.543	7	0.515	13	0.619	3	0.547	7
Impacts on subcontractors.	0.532	9	0.527	9	0.572	9	0.537	8
Additional payment for contractor.	0.537	8	0.514	14	0.556	11	0.533	9
Quality degradation.	0.530	10	0.519	11	0.513	17	0.525	10
Productivity degradation.	0.520	13	0.520	10	0.528	15	0.521	11
Poor safety conditions.	0.498	18	0.534	7	0.584	7	0.521	11
Poor professional relations.	0.522	12	0.486	16	0.572	9	0.520	13
Image of technical department (revising of problem statement) then affect the image of the institution.	0.519	14	0.486	16	0.588	6	0.520	13
Hiring new professionals.	0.524	11	0.514	14	0.488	18	0.516	15
Logistic delay.	0.506	17	0.529	8	0.534	13	0.516	15
Rework and demolition.	0.513	15	0.519	11	0.519	16	0.515	17
Increase in overhead expenses.	0.509	16	0.469	18	0.534	13	0.502	18

In another hand, the occurrence and the influence of factors impact of the VO have been analyzed. Over all responses of contractors, consultants, and clients have been sorted and analyzed as shown in Table (4.36). The opinion of respondents regarding this group was as follows.

First: Influence

It's shown from Table (4.36) that *"Completion schedule delay*" was ranked as the most influential impact on the VO with mean equals "6.77" and RII = 0.677, that means the respondents were agree on this factor. Variations often result in time extension according to the work involved in completing the VO. if the changed work is found to extend or delay the completion of activities that are on the critical path of the schedule, the completion date of a project will slip from the planned date. In contrast, *"Quality degradation*" was ranked as the least influential impact factor on the VO with mean equals "5.77" and RII = 0.577, that means the respondents were neutral on this factor. If the VOs are frequent, they may potentially affect the quality of works. Quality may be compromised as contractors try to compensate for losses they are not optimistic about recovering. In general, the results of all factors of the impact of the VOs show that the mean equals "6.07" and RII = 0.607, that means the respondents were agree on this dimension.

Second: Occurrence

It's shown from Table (4.36) that *"Delay in payment*" was ranked as the most occurred impact on the VO with mean equals "6.05" and RII = 0.505, that means the respondents were agree on this factor. In contrast, *"Increase in overhead expenses*" was ranked as the least occurred impact on the VO with mean equals "5.02" and RII = 0.502, that means the respondents were neutral on this factor. In general, the results of all factors of the impact of the VOs show that the mean equals "5.39" and RII = 0.539, that means the respondents were neutral on this dimension.

Table (4.36): The Influence and occurrence of the impact of the VOs

Paragraph	Influence				Occurrence			
	Mean	SD	RII	Rank	Mean	SD	RII	Rank
Delay in payment.	6.36	2.52	0.636	3	6.05	2.48	0.605	1
Increase in duration of individual activities.	6.61	2.30	0.661	2	5.81	2.33	0.581	2
Completion schedule delay.	6.77	2.26	0.677	1	5.75	2.45	0.575	3
Increase in project cost.	6.18	2.42	0.618	9	5.63	2.29	0.563	4
Dispute among professionals.	6.26	2.44	0.626	5	5.54	2.46	0.554	5

Paragraph	Influence				Occurrence			
	Mean	SD	RII	Rank	Mean	SD	RII	Rank
Procurement delay (materials and equipment).	6.25	2.32	0.625	6	5.53	2.46	0.553	6
Suspend work in other activities.	6.27	2.45	0.627	4	5.47	2.48	0.547	7
Impacts on subcontractors.	6.19	2.50	0.619	8	5.37	2.52	0.537	8
Additional payment for contractor.	5.84	2.41	0.584	12	5.33	2.46	0.533	9
Quality degradation.	5.66	2.55	0.566	18	5.25	2.43	0.525	10
Productivity degradation.	5.83	2.28	0.583	13	5.21	2.38	0.521	11
Poor safety conditions.	5.75	2.57	0.575	16	5.21	2.61	0.521	11
Poor professional relations.	5.86	2.55	0.586	11	5.20	2.43	0.520	13
Image of technical department (revising of problem statement) then affect the image of the institution.	6.21	2.42	0.621	7	5.20	2.51	0.520	13
Logistic delay.	5.79	2.35	0.579	14	5.16	2.37	0.516	15
Hiring new professionals.	5.72	2.46	0.572	17	5.16	2.50	0.516	15
Rework and demolition.	5.97	2.41	0.597	10	5.15	2.39	0.515	17
Increase in overhead expenses.	5.77	2.34	0.577	15	5.02	2.33	0.502	18
Total degree	**6.07**	**1.64**	**0.607**		**5.39**	**1.78**	**0.539**	

4.4.7.3 Correlations among parties according to impact of the VOs

There is a highly strong correlation between the rank of consultant and client for the impact of the VOs with a correlation coefficient (0.91). In addition, the correlation between client and contractor is strongly correlated with a correlation coefficient (0.88) and the correlation between consultant and contractor with a correlation coefficient (0.87) as shown in Table (4.37). These results imply that most of the respondents have the same perception about the impact of the VOs.

Table (4.37): Correlation coefficient between parties according to impact of the VOs

Respondents	Correlation coefficient	Relation of the Respondents
Client VS Consultant	0.91	Strong
Client VS Contractor	0.88	Strong
Consultant VS Contractor	0.87	Strong

4.4.8 Analysis of the Recommended Strategies to Minimize the VOs

In this part of the questionnaire, the respondents were asked to rate the degree of importance of the recommended strategies to minimize the VOs in the construction projects by using a 5-point Likert scale of agreement where unimportant = 1; less important = 2; important = 3; very important = 4; and very high important = 5. Responses of clients, consultants, contractors and overall responses have been sorted and analyzed regarding this group. The RII and ranks were established and presented in Table (4.38)

4.4.8.1 Contractor responses relative to the Recommended Strategies to Minimize the *VOs*

It's shown in Table (4.38) below that the most important recommended strategies to minimize the VOs according to the contractor's point of view was *"Supervise the works with an experienced and dedicated supervisor*" with RII=0.844 followed by *"Enhance communication and cooperation among project team members*" with RII=0.817 and then *"Place experienced and knowledgeable executives in the design department*" and *"Consultants should ensure that the design/specifications fall within the approved budget*" with RII=0.816. According to these respondents, *"All parties should forecast unforeseen situations*" with RII=0.673 was the least important recommended strategies to minimize the VOs**.**

4.4.8.2 Consultant responses relative to the Recommended Strategies to Minimize the *VOs*

From Table (4.38) below, the most important recommended strategies to minimize the VOs according to the consultant's point of view was *"Place*

experienced and knowledgeable executives in the design department" with RII= 0.817 followed by *"Supervise the works with an experienced and dedicated supervisor*" with RII=0.810 and then *"Carry out detail site investigation including detail soil investigations and consider it during tendering stage*" with RII= 0.803. According to these respondents, *"All parties should forecast unforeseen situations*" with RII=0.647 was the least important recommended strategies to minimize the VOs**.**

4.4.8.3 Client responses relative to the Recommended Strategies to Minimize the ***VOs***

It's shown in Table (4.38) below that the most important recommended strategies to minimize the VOs according to the client's point of view was *"Place experienced and knowledgeable executives in the design department*" with RII= 0.813 followed by *"Consultants should ensure that the design/specifications fall within the approved budget*" with RII=0.800. The next strategies were *"All involved parties should plan adequately before works start on site*", *"Spend adequate time on pre-tender planning phase*" and *"Once the tender is awarded, make no changes to the specifications*" with RII = 0.775. The recommended strategy *"All parties should forecast unforeseen situations*" with RII=0.688 was the least important recommended strategies to minimize the VOs**.**

4.4.8.4 Overall responses relative to the Recommended Strategies to Minimize the ***VOs***

It's shown in Table (4.38) below that the most important recommended strategies to minimize the VOs according to all the respondents was *"Supervise the works with an experienced and dedicated supervisor"* with RII= 0.823 followed by "Place experienced and knowledgeable executives in the design department" with RII=0.816 and then *"Consultants should ensure that the design/specifications fall within the approved budget*" with RII= 0.805. The least important recommended strategies to minimize the VOs was *"All parties should forecast unforeseen situations*" with RII=0.688

Table (4.38): Ranks of the Recommended Strategies to Minimize the VOs

Paragraph	Contractor		Consultant		Client		Over all	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Supervise the works with an experienced and dedicated supervisor.	0.844	1	0.810	2	0.763	6	0.823	1
Place experienced and knowledgeable executives in the design department	0.816	3	0.817	1	0.813	1	0.816	2
Consultants should ensure that the design/specifications fall within the approved budget.	0.816	3	0.783	7	0.800	2	0.805	3
All involved parties should plan adequately before works start on site.	0.811	6	0.800	4	0.775	3	0.803	4
Identification and understanding of contract requirements and provisions by the respective parties before the project starts	0.814	5	0.800	4	0.756	9	0.802	5
Complete the drawings at tender stage.	0.802	7	0.780	8	0.763	6	0.790	6
Enhance communication and cooperation among project team members.	0.817	2	0.746	13	0.731	10	0.785	7
Spend adequate time on pre-tender planning phase.	0.783	10	0.790	6	0.775	3	0.784	8
Settling the legal status of land ownership of the project before awarding the tender to the contractor.	0.795	8	0.776	10	0.725	11	0.780	9
Carry out detail site investigation including detail soil investigations and consider it during tendering stage	0.766	13	0.803	3	0.763	6	0.775	10
Once the tender is awarded, make no changes to the specifications	0.783	10	0.759	12	0.775	3	0.775	10
The consultant should coordinate closely at the design stage.	0.784	9	0.780	8	0.713	14	0.773	12
Get accurate information and research with regard to procurement procedure, material, and plant.	0.773	12	0.776	10	0.719	12	0.766	13
Clients should provide a clear brief of the scope of works.	0.728	14	0.708	14	0.719	12	0.721	14
All parties should forecast unforeseen situations.	0.673	15	0.647	15	0.688	15	0.668	15

4.4.8.5 Correlations among parties according to the Recommended Strategies to Minimize *the VOs*

There is a highly strong correlation between the rank of consultant and client for recommended Strategies to minimize the *VOs* with a correlation coefficient (0.92). In addition, the correlation between consultant and contractor is strongly correlated with a correlation coefficient (0.88) and the correlation between client and

contractor with a correlation coefficient (0.81) as shown in Table (4.39). These results imply that most of the respondents have the same perception about the recommended strategies to minimize the *VOs*.

Table (4.39) Correlation coefficient between parties according to Strategies to Minimize the VOs

Respondents	Correlation coefficient	Relation of the Respondents
Client VS Consultant	0.92	Strong
Consultant VS Contractor	0.88	Strong
Client VS Contractor	0.81	Strong

4.5 Research Hypotheses Testing:

Five hypotheses were tested through applying One-Way ANOVA as follow.

4.5.1 Difference among the respondents due to general information and the information of the project that the respondents' managed.

H_1: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza Strip due to the general information and the information of the project that the respondents' managed.

The sub-hypotheses included are as follows:

4.5.1.1 Difference among the respondents due to type of the organization

H_{1A}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza strip due to the type of the organization.

Table (4.40) indicates that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about the impact and minimization of the VOs in Gaza strip due to the respondent's type of organization.

Table (4.40): Results of ANOVA due to the respondent's type of organization

Section	Source of variation	Sum of Squares	Degree of Freedom (DF)	Mean Square	F	p-value
Impacts of the VOs	Between groups	10.862	2	5.431	3.156	0.056*
	Within groups	371.735	216	1.721		
	Total	382.597	218			
Minimization of the VOs	Between groups	0.870	2	0.435	0.960	0.384*
	Within groups	97.825	216	0.453		
	Total	98.695	218			

*P-value not statistically significant

4.5.1.2 Difference among the respondents due to position in the organization

H_{1B}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza strip due to the position in the organization.

Table (4.41) indicates that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about the impact and minimization of the VOs in Gaza strip due to the respondent's position in the organization.

Table (4.41): Results of ANOVA due to the respondent's position in the organization

Section	Source of variation	Sum of Squares	DF	Mean Square	F	p-value
Impacts of the VOs	Between groups	13.005	3	4.335	2.522	0.059*
	Within groups	369.592	215	1.719		
	Total	382.597	218			
Minimization of the VOs	Between groups	0.684	3	0.228	0.500	0.683*
	Within groups	98.011	215	0.456		
	Total	98.695	218			

*P-value not statistically significant

4.5.1.3 Difference among the respondents due to years of experience

H_{1c}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza strip due to years of experience.

Results, as shown in Table (4.42), indicate that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about the impact and minimization of the VOs in Gaza strip due to the respondent's years of experience.

Table (4.42): Results of ANOVA due to the respondent's years of experience

Section	Source of variation	Sum of Squares	DF	Mean Square	F	p-value
Impacts of the VOs	Between groups	7.438	3	2.479	1.421	0.238*
	Within groups	375.159	215	1.745		
	Total	382.597	218			
Minimization of the VOs	Between groups	2.494	3	0.831	1.858	0.138*
	Within groups	96.201	215	0.447		
	Total	98.695	218			

*P-value not statistically significant

4.5.1.4 Difference among the respondents due to size of projects

H_{1D}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza Strip due to Size of projects directed in the last five years.

Results, as shown in Table (4.43), indicate that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about impact and minimization of the VOs in Gaza strip due to the size of projects directed.

Table (4.423): Results of ANOVA due to size of projects

Section	Source of variation	Sum of Squares	DF	Mean Square	F	p-value
Impacts of the VOs	Between groups	4.260	3	1.420	0.807	0.491*
	Within groups	378.337	215	1.760		
	Total	382.597	218			
Minimization of the VOs	Between groups	1.144	3	0.381	0.840	0.473*
	Within groups	97.551	215	0.454		
	Total	98.695	218			

*p-value not statistically significant

4.5.1.5 Difference among the respondents due to percentage of projects including the VOs

H_{1E}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza strip due to the percentage of projects including the VOs causing work delay in the last five years.

Results, as shown in table (4.44), indicate that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about impact and minimization of the VOs in Gaza strip due to percentage of projects including the VOs causing work delay.

Table (4.44): Results of ANOVA due to percentage of projects including the VOs

Section	Source of variation	Sum of Squares	DF	Mean Square	F	p-value
Impacts of the VOs	Between groups	7.338	3	2.446	1.401	0.243*
	Within groups	375.259	215	1.745		
	Total	382.597	218			
Minimization of the VOs	Between groups	4.958	3	1.653	1.790	0.118*
	Within groups	93.737	215	0.436		
	Total	98.695	218			

*P-value not statistically significant

4.5.1.6 Difference among the respondents due to the delay in completion schedule due to the VOs

H_{1F}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza strip due to the delay in completion schedule due to the VOs in the last five years.

Results, as shown in table (4.45), indicate that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about impact and minimization of the VOs in Gaza strip due to the delay in completion schedule due to the VOs.

Table (4.45): Results of ANOVA due to the delay in completion schedule due to the VOs

Section	Source of variation	Sum of Squares	DF	Mean Square	F	p-value
Impacts of the VOs	Between groups	8.282	3	2.761	1.586	0.194*
	Within groups	374.315	215	1.741		
	Total	382.597	218			
Minimization of the VOs	Between groups	0.164	3	0.055	0.120	0.949*
	Within groups	98.530	215	0.458		
	Total	98.695	218			

*P-value not statistically significant

4.5.1.7 Difference among the respondents due to percentage of projects exceeded the contract's value due to the VOs

H_{1G}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza strip due to the percentage of projects exceeded the contract's value due to the VOs in the last five years.

Results, as shown in table (4.46), indicate that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about impact and minimization of the VOs in Gaza strip due to the percentage of projects exceeded the contract's value due to the VOs.

Table (4.46): Results of ANOVA due to percentage of projects exceeded the contract's value due to the VOs

Section	Source of variation	Sum of Squares	DF	Mean Square	F	p-value
Impacts of the VOs	Between groups	3.459	3	1.153	0.654	0.581*
	Within groups	379.137	215	1.763		
	Total	382.597	218			
Minimization of the VOs	Between groups	1.682	3	0.561	1.242	0.295*
	Within groups	97.013	215	0.451		
	Total	98.695	218			

*p-value not statistically significant

4.5.1.8 Difference among the respondents due to the VOs cause project's progress obstruction

H_{1H}: There is a significant difference among the respondents, statistically at $\alpha \leq 0.05$, toward impact and minimization of the VOs in Gaza Strip due to the VOs cause project's progress obstruction.

Results, as shown in table (4.47), indicate that the p-value more than the significance level ($\alpha \leq 0.05$), thus it can be concluded that there are no differences in the averages of the research responses about impact and minimization of the VOs in Gaza Strip due to the VOs cause project's progress obstruction

Table (4.47): Results of ANOVA due to the VOs cause project's progress obstruction

Section	Source of variation	Sum of Squares	DF	Mean Square	F	p-value
Impacts of the VOs	Between groups	12.020	3	4.007	2.325	0.076*
	Within groups	370.577	215	1.724		
	Total	382.597	218			
Minimization of the VOs	Between groups	0.898	3	0.299	0.658	0.579*
	Within groups	97.796	215	0.455		
	Total	98.695	218			

*P-value not statistically significant

4.5.2 Effect of the prevalence of the VOs on impact and minimization of the VOs

H_2: There is significant effect of the prevalence of the VOs, statistically at $\alpha \leq 0.05$ on impact and minimization of the VOs in Gaza Strip.

To answer this hypothesis, Pearson correlation coefficient was found to study the relation between the prevalence of the VOs and impact and minimization of the VOs in Gaza Strip.

The results in the Table (4.48) indicate that there is a positive correlation with statistical significance between the prevalence of the VOs and impact and minimization of the VOs in Gaza Strip, which the p-value of the correlation coefficient is less than 0.05.

Table (4.48): Results of Pearson correlation coefficient studying effect of the prevalence of the VOs

Section	Correlation coefficient	p-value
Impacts of the VOs	0.30	0.000*
Minimization of the VOs	0.20	0.002*

* Correlation is statistically significant at $\alpha \leq 0.05$

4.5.3 Effect of the current practices of the VOs management on impact and minimization of the VOs

H_3: There is a significant effect of the current practices of the VOs management, statistically at $\alpha \leq 0.05$, on impact and minimization of the VOs in Gaza Strip.

To answer this hypothesis, Pearson correlation coefficient was found to study the relation between the current practices of the VOs management and impact and minimization of the VOs in Gaza Strip.

The results in the Table (4.49) indicated that there is a positive correlation with statistical significance between current practices of the VOs management and minimization of the VOs in Gaza Strip, where the p-value of the correlation coefficient is less than 0.05.

In addition, there is no correlation with statistical significance between current practices of the VOs management and impact of the VOs in Gaza strip where the p-value of the correlation coefficient is more than 0.05.

Table (4.49): Results of Pearson correlation coefficient studying effect of the current practices of the VOs management

Section	Correlation coefficient	p-value
Impacts of the VOs	0.06	0.374**
Minimization of the VOs	0.36	0.000*

* Correlation is statistically significant at $\alpha \leq 0.05$

**Correlation is not statistically significant at $\alpha \leq 0.05$

4.5.4 Effect of the non-value adding activities associated with the variations on impact and minimization of the VOs

H_4: There is a significant effect of the non-value adding activities associated with the variations during the construction stage, statistically at $\alpha \leq 0.05$, on impact and minimization of the VOs in Gaza Strip.

To answer this hypothesis, Pearson correlation coefficient was found to study the relation between non-value adding activities associated with the variations during the construction stage and impact and minimization of the VOs in Gaza Strip.

The results in the Table (4.50) indicated that there is a positive correlation with statistical significance between the non-value adding activities associated with the variations during the construction stage and impact and minimization of the VOs in Gaza Strip where the p-value of the correlation coefficient is less than 0.05.

Table (4.50): Results of Pearson correlation coefficient studying effect of the non-value adding activities associated with the variations

Section	Correlation coefficient	p-value
Impacts of the VOs	0.21	0.001*
Minimization of the VOs	0.20	0.002*

* Correlation is statistically significant at $\alpha \leq 0.05$

4.5.5 Effect of the origin agent of the VOs and factors causing it on impact and minimization of the VOs

H_5: There is a significant effect of the origin agent of the VOs and factors causing it, statistically at $\alpha \leq 0.05$, on impact and minimization of the VOs in Gaza Strip.

To answer this hypothesis, Pearson correlation coefficient was found to study the relation between effects of the origin agent of the VOs and factors causing it and impact and minimization of the VOs in Gaza Strip.

The results in the Table (4.51) indicated that there is a positive correlation with statistical significance between effects of the origin agent of the VOs and factors

causing it and impact and minimization of the VOs in Gaza Strip, which the p-value of the correlation coefficient is less than 0.05.

Table (4.51): Results of Pearson correlation coefficient studying effect of the origin agent of the VOs and factors causing it

Section	Correlation coefficient	p-value
Impacts of the VOs	0.69	0.000*
Minimization of the VOs	0.35	0.000*

* Correlation is statistically significant at $\alpha \leq 0.05$

4.6 Chapter Summary

This chapter included an analysis of the desk study, interviews and questionnaire. Causes and impact of the VOs of the projects were identified from the desk study also causes and impacts of the VOs not seen at the project's documents in the desk study were identified from the interviews with the project's managers. In addition, information about the current practices of the VOs management in their companies and recommended strategies to minimize the occurrence of the VOs in the construction projects were investigated. Finally, the results extracted from the questionnaires were discussed. Similarities and differences between the desk study and interviews and questionnaire have been shown and a reasonable explanation for these differences have been provided.

Chapter 5

Conclusions and Recommendations

Chapter 5

Conclusions and Recommendations

This chapter summarizes the study and aims to provide recommendations and conclusions for the management of the VOs in Gaza Strip: Impacts and Minimization. By revisiting the research objectives and key findings, an overview discussed to assess the extent to which the research objectives were met.

5.1 Summary of the research

An investigation into the management of the VOs, their impact on the construction projects in Gaza Strip and the recommended strategies to minimize it was conducted. An extensive review of the literature was carried out to achieve the aim of the study. The purpose of the research was to develop a clear understanding of causes and impact of the VOs and recommended strategies to minimize it. A desk study was conducted on specific construction projects in Gaza Strip and interviews with their project's managers for obtaining their perceptions relative to the management of the VOs. In addition, the results of 219 collected questionnaires were analyzed quantitatively and then presented by using an “interpretive-descriptive” method for qualitative data analysis. Finally, recommendations for the issue of the VOs in the construction projects in Gaza Strip were outlined.

5.2 Conclusions of the research objectives, questions, and hypotheses

In achieving the aim of the research, six primary objectives have been outlined and made through the findings of the analyzed collected questionnaires. These objectives are related to the research questions that were developed to increase one's knowledge and familiarity with the subject. The outcomes were found as follows:

5.2.1 Outcomes related to objective one

The objective was: To investigate the prevalence of the VOs in the construction projects. This objective is related to the following research question:

The first research question: Do VOs prevail in the construction project?

The prevalence of the VOs in the construction projects in Gaza strip investigated by studying the works that cause the VOs, site instructions occurring

in the construction projects and awareness of the outcome of the VOs. The study findings of RII test indicated that substitution of works (i.e. replacing material not available in local market) and additional or omission on regarding coping BOQs with drawings were the most frequent work caused VOs while overhead compensation on a suspension of work was the least frequent work caused VOs. When the respondents were asked about the site instructions occurring in the construction projects, the respondents agreed that site instructions to resolve discrepancies in contract documents was the most occurred site instructions and this site instruction lead to issue a VO.

Furthermore, according to awareness of the outcome of the VOs, the majority of the respondents (77.6%) agreed that the excessive occurrence of the VOs may lead to know that market surveys procedures need to be upgraded and 73.1% of respondents reported that the excessive occurrence of the VOs may lead to know that the designs and quantity take off procedures need to be upgraded whereas less than a third of the respondents (30.1%) agreed that the VOs could be avoided.

5.2.2 Outcomes related to objective two

The objective was: To assess the current practices of the VOs management in Gaza Strip. This objective is related to the following research question:

The second research question: What are the current practices of the VOs management in Gaza Strip?

The study findings of RII test indicated that the majority of respondents (79.4%) calculated the direct costs of the VOs and 74.4% of respondents calculated the indirect costs of the VOs whereas more than two-thirds of respondents (79%) reported that there are a good contract documentation and all VOs are recorded and 71.3% of respondents admitted that there are a good communication and cooperation among project team members. On the other hand, A little of respondents (13.3%) disagreed that the possible variations that might occur in the future activities of the project are identified; others (42%) remained neutral while more than a third of respondents (44.7%) agreed the possible variations that might occur in the future activities of the project are identified.

5.2.3 Outcomes related to objective three

The objective was: To investigate the non-value adding activities associated with the variations during the construction stage. This objective is related to the following research question:

The third research question: What are the non-value adding activities associated with the variations during the construction stage?

The study findings of RII test demonstrated that more than a third of respondents (43.8 %) reported that the waiting time was the most non-value-adding activity associated with the VOs during the construction stage. On the other hand, a little of respondents (28.7%) disagreed that the defects during construction stage was a non-value-adding activity associated with the VOs during the construction stage; nearly a half (43.8%) remained neutral while less than a third of respondents (27.5%) agreed that the defects during construction stage was a non-value-adding activity associated with the VOs during the construction stage.

5.2.4 Outcomes related to objective four

The objective was: To identify the predominant origin agent as well as the direct causes of the VOs. This objective is related to the following research question:

The fourth research question: Who is the predominant origin agent and what are the causes of the VOs?

The study findings indicated that the predominant origin agent was the client followed by the consultant followed by the contractor and finally the donor.

In addition, the study findings investigated the multi-source factors responsible for the VOs. **The most occurred important factors according to client's point of view were:**

1. Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts);
2. Internal political problems;

3. Time constraints;
4. Change in design by the consultant during construction stage;
5. Change in economical conditions;
6. Failure of the contractor/supplier to provide the required material from outsourcing (shipping obstacles);
7. Contractor's lack of judgment and experience. i.e. misunderstanding of tender documents during cost estimate stage;
8. Change in specification by the client;
9. Required improvement;
10. Unforeseen problems.

The most important factors according to consultant's point of view were:

1. Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts);
2. Contractor's desired profitability to improve financial condition;
3. Contractor's lack of judgment and experience. i.e. misunderstanding of tender documents during cost estimate stage;
4. Discrepancies between contract documents;
5. Change in specification by the client;
6. Required improvement;
7. Contractor's financial difficulties;
8. Lack of a specialized construction manager;
9. Lack of coordination among project parties;
10. Time constraints.

The most important factors according to contractor's point of view from the desk study and the questionnaire were:

1. Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts);
2. Budget allocated constraints;
3. Internal political problems;
4. Discrepancies between contract documents;
5. Change in specification by client;

6. Errors and omissions in design;
7. Consultant's lack of judgment and experience;
8. Required improvement;
9. Unforeseeable works;
10. Insufficient site and soil investigation prior to design.

5.2.5 Outcomes related to objective five

The objective was: To identify the impact of the VOs on overall project performance. This objective is related to the following research question:

The fifth research question: What is the impact of the VOs on overall project performance?

The study findings investigated the impact of the VOs. **The most occurred impact of** the **VOs according to client's point of view were:**

1. Increase in duration of individual activities;
2. Completion schedule delay;
3. Suspend work in other activities;
4. Increase in project cost;
5. Dispute among professionals;
6. Image of technical department (revising of problem statement) then affect the image of the institution;
7. Poor safety conditions;
8. Delay in payment;
9. Impacts on subcontractors;
10. Poor professional relations.

The most occurred impact of the **VOs according to consultant's point of view were:**

1. Procurement delay (materials and equipment);
2. Increase in project cost;
3. Increase in duration of individual activities;
4. Completion schedule delay;
5. Delay in payment;

6. Dispute among professionals;
7. Poor safety conditions;
8. Logistic delay;
9. Impacts on subcontractors;
10. Productivity degradation.

The most occurred impact of the **VOs according to contractor's point of view from the desk study and the questionnaire were:**

1. Delay in payment;
2. Increase in duration of individual activities;
3. Completion schedule delay;
4. Increase in project cost;
5. Dispute among professionals;
6. Procurement delay (materials and equipment);
7. Suspend work in other activities;
8. Additional payment for contractor;
9. Impacts on subcontractors;
10. Increase in overhead expenses

5.2.6 Outcomes related to objective six

The objective was: To recommend strategies to minimize the VOs. This objective is related to the following research question:

The sixth research question: How can we reduce the level of changes in the construction projects?

The study findings investigated the recommended strategies to minimize the VOs. **The most recommended strategies to minimize** the **VOs according to client's point of view were:**

1. Place experienced and knowledgeable executives in the design department;
2. Consultants should ensure that the design/specifications fall within the approved budget;
3. All involved parties should plan adequately before works start on site
4. Spend adequate time on pre-tender planning phase;

5. Once the tender is awarded, make no changes to the specifications;
6. Supervise the works with an experienced and dedicated supervisor;
7. Complete the drawings at tender stage;
8. Carry out detail site investigation including detail soil investigations and consider it during tendering stage;
9. Identification and understanding of contract requirements and provisions. by the respective parties before the project starts;
10. Enhance communication and cooperation among project team members.

The most recommended strategies to minimize the **VOs according to consultant's point of view were:**

1. Place experienced and knowledgeable executives in the design department;
2. Supervise the works with an experienced and dedicated supervisor;
3. Carry out detail site investigation including detail soil investigations and consider it during tendering stage;
4. All involved parties should plan adequately before works start on site;
5. Identification and understanding of contract requirements and provisions by the respective parties before the project starts;
6. Spend adequate time on pre-tender planning phase;
7. Consultants should ensure that the design/specifications fall within the approved budget;
8. Complete the drawings at tender stage;
9. The consultant should coordinate closely at design stage;
10. Settling the legal status of land ownership of the project before awarding the tender to the contractor;
11. Get accurate information and research with regard to procurement procedure, material and plant;

The most recommended strategies to minimize the **VOs according to contractor's point of view were:**

1. Supervise the works with an experienced and dedicated supervisor;
2. Enhance communication and cooperation among project team members;
3. Place experienced and knowledgeable executives in the design department;

4. Consultants should ensure that the design/specifications fall within the approved budget;
5. Identification and understanding of contract requirements and provisions by the respective parties before the project starts;
6. All involved parties should plan adequately before works start on site;
7. Complete the drawings at tender stage;
8. Settling the legal status of land owner
9. ship of the project before awarding the tender to the contractor;
10. The consultant should coordinate closely at design stage;
11. Spend adequate time on pre-tender planning phase;
12. Once the tender is awarded, make no changes to the specifications.

5.3 Recommendations

Based on the achieved objectives of this research as stated earlier, the recommendations below were drawn as a result of the research findings discussed in chapter four. The following recommendations are hereby made with the view of minimizing the occurrence and mitigating the impact of the VOs in the construction projects in Gaza Strip. The recommendations presented in Table (5.1).

Table (5.1): Recommendation for the VOs Management

No.	Finding	Section	Recommendation
1	Substitution of works (i.e. Replacing material not available in local market) and additional or omission on regarding coping BOQs with drawings were the most frequent aspect of variation in the construction projects in Gaza Strip	**Section 4.4.3.1**	- Clients should rush in the adoption of alternative materials when some of the required materials described in the contract are not available due to Israeli restriction in terminals and crossing closure and siege. -Market survey procedures need to be upgraded. - It's recommended that the engineer specifies the material for the constructing in a detailed manner to eliminate the possibility of variations later in terms of substitution of materials or procedures. -Review and finalize the design during the design phase by the consultant to assert that BOQs coping with drawings.
3	Identification and understanding of contract requirements and provisions by the respective parties before the project starts and the possible variations that might occur in the future activities of the project are identified were the least practices of the VOs management	**Section 4.4.4**	-The client should prepare a well-defined brief, clear and concise document about his/her needs devoid of ambiguities before entering the design stage and involve him during different project phases especially in the planning and design phases. This would assist in identifying noncompliance with their requirements early on. -Frequent coordination and direct communication should be between the professionals during the design and construction phases to consider the possible variations that might occur in the future activities.

Continued table: (5.1)

No.	Finding	Section	Recommendation
4	Waiting time and delays were the most non-value-adding activity associated with the VOs during the construction stage	**Section 4.4.5**	-Speeding up the decision-making process this would assist in preventing a hold on the work and waiting for new instructions to come. -The client should hire well-experienced technical staff members that can advise and

			help the top authority in decision making in a timely manner.
5	Client was the most predominant origin agent of the VOs in the construction projects in Gaza Strip	**Section 4.4.6.1**	During pre-construction phase the client should provide a well-defined brief, clear and concise document about his/her needs devoid of ambiguities. This can be done either by carrying out a feasibility study or circulating a questionnaire to the end users of the project and also conduct enough deliberation about the project's final intended use.
6	According to the desk study and the questionnaire, the study showed that the most important causes of the VOs in the construction projects in Gaza Strip were: 1. Israeli restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts) 2. Discrepancies between contract documents 3. Internal political problems 4. Change in specification by the client 5. Budget allocated constraints 6. Required improvement 7. Unforeseeable works 8. Insufficient site and soil investigation prior to design 9. Errors and omissions in design.	**Section 4.4.6.3**	-A comprehensive database included unit price, supplier, and specifications should establish by the Ministry of Housing and Public Works. The database should be updated periodically. This would enhance the consciousness of the consultant regarding the available materials in local and markets. -Sufficient time should be given for planning and design phase, this will assist in minimizing errors in design, conflicts between contract documents. - Communicate with donors to separate political conditions from the construction projects to prevent many of funds for projects from withdrawal because of the political situation. - Clients should make adequate financial planning during the planning stage and involve him during different project phases especially in the planning and design phases. This would assist in preventing the change in specifications by the client during the construction phase. -The client normally lacks the ability to read design documents prepared by the engineer, in many instances, the client gets surprised that what is being constructed is not what they have anticipated or envisioned so a three-dimension model is very helpful in this regard and should be used to help clients see their project before construction starts. - Frequent coordination and direct communication should be between the professionals during the design and construction phases to consider unforeseen conditions. - A national database system about soil, underground services, and weather conditions should be developed and made available for all concerned parties.

Continued table: (5.1)

No.	Finding	Section	Recommendation
7	According to the desk study and the questionnaire, the study revealed that the most important impact of the VOs in the construction projects in Gaza Strip	**Section 4.4.7**	- The registration of consulting companies and contractors should be reviewed from time to time to ensure the competence of their present technical and financial capabilities. -Get the approval of all stakeholders or

	were: 1. Delay in payment. 2. Increase in duration of individual activities 3. Completion schedule delay 4. Increase in project cost. 5. Dispute among professionals 6. Increase in overhead expenses 7. Additional payment for contractor		specialized departments before the execution. Also, keep in touch with other parties (such as water, electricity, communication, etc.) to avoid conflicts. -Clients should make adequate financial planning during the planning stage and speed up the decision-making process to avoid delay in payment. -Contractors should consider using a Work Breakdown Structure or other tracking systems for the construction activities. This may lead to trace the effects of the VOs on the rest of the project. -Contractors should expend more effort prior to contract award to review contract document for both legal and contractual conditions as well as technical details to spot unclear areas where conflict over its interpretation may arise. These matters should be closed and resolved prior to the start of construction. -Provision of contingencies in the contract sum of about 2.5-5% of the value of works. - The client should hire well-experienced technical staff members that can advise and help the top authority in decision making in a timely manner. - It is advantageous to both the client and the contractor that potential VOs on a project are processed in a fair, equitable, and timely manner to avoid disputes and claims between the client and the contractor.
8	The study showed that the most important recommended strategies to minimize the VOs in the construction projects in Gaza Strip were: 1. Supervise the works with an experienced and dedicated supervisor. 2. Place experienced and knowledgeable executives in the design department 3. Consultants should ensure that the design/specifications fall within the approved budget 4. All involved parties should plan adequately before works start on site 5. Identification and understanding of contract requirements and provisions by the respective parties before the project starts	**Section 4.4.8**	It's recommended concentrating on achieving this recommended strategies to minimize the VOs.

5.4 Limitations and recommendation for future studies

Although the research was carefully prepared and has reached its aim, there were some certain limitations.

- First of all, the study was conducted only on a population who is living in Gaza strip in Palestine. Because of the geographical limit, it was hard to think about a sample from the same population in West Bank.
- Second, the research survey was limited to Gaza strip contracting companies that are classified under a first and second class. Because of the time limit, it was hard to think about using all classification of the contracting companies.
- Finally, the study was limited to the construction industry practitioners in Gaza Strip in the last five years.

Therefore, there are many recommendations for future studies as follows:

- It is recommended to extend this research to include all of the contracting companies under all classification (first, Second, third, fourth and fifth)
- The survey was conducted in the Gaza Strip in a period where the construction business was deteriorated or even paralyzed, which in turn was reflected on the results of the research. It is recommended to conduct another survey when the construction industry recovers and make a comparative analysis of the results.
- Conducting workshops, including clients and consultants to make them aware of the repeated causes for the Variation orders and make them suggest a recommended strategies to minimize them.

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Appendices

Appendix A: Questionnaire (English)

Islamic University of Gaza

Dean of Graduate Studies

College of Engineering - Master's program

Engineering project management

Questionnaire about

Management of variation orders in Gaza Strip: Impacts and Minimization

To start, I would like to present my appreciation and thanks to you for taking part of your time and effort to complete this questionnaire, which considered as a basic requirement for the completion of my research in order to award the master of science degree in engineering project management at Islamic university of Gaza.

This questionnaire aims to study the impact of variation orders (VOs) on construction projects in Gaza Strip and recommend strategies to minimize it, and is part of a supplementary research required for a master's degree in engineering project management of the Islamic University of Gaza.

Please kindly we request your assistance in mobilizing the required data with level of accuracy and honesty as usual in your work, knowing that all responses and facts will remain fully confidential, and will be used for the research purposes only.

All appreciations and thanks for your contribution to support scientific research.

Researcher:

Samia Nassar

tick √ versus the convenient option for you.

Section 1: General Information

1. Type of your organization/company:		
☐ Client	☐ Consulting	☐ Contracting
2. Position in the organization/company:		
☐ Organization manager/Deputy	☐ Project manager/Deputy	
☐ Site/Office engineer	☐ Others (Please Specify)……..…	
3. Years of experience:		
☐ Less than 5 year	☐ From 5 years to less than 10 years	
☐ From 10 years to less than 15 years	☐ 15 years and Over	

Section 2: Information about the projects that you managed

4. Type of project (You can choose more than one)			
☐ Roads	☐ Building/residential	☐ Sewerage and water	☐ Electro-mechanics
5. Size of projects directed in the last five years:			
☐ Less than $1 million		☐ From $1 to less than $5 million	
☐ From $5 to less than $10 million		☐ $10 million and more	
6. % of projects including VOs causing work delay in the last five years:			
☐ None	☐ Less than 20%	☐ 20-50%	☐ More than the 50%
7. The delay in completion schedule due to VOs as a percentage of original schedule in the last five years:			
☐ None	☐ Less than 20%	☐ 20-50%	☐ More than the 50%
8. % of projects exceeded the contract's value due to the VOs in the last five years:			
☐ None	☐ Less than 20%	☐ 20-50%	☐ More than the 50%
9. To which extent VOs cause project's progress obstruction:			
☐ None	☐ Less than 20%	☐ 20-50%	☐ More than the 50%

Section 3: The prevalence of VOs

10. Please indicate how frequently are the following works cause variation

No.	Works	Never	Seldom	Sometimes	Often	Always
10.1	Additional or omission on regarding coping BOQs with drawings.					
10.2	Substitution of works (i.e. Replacing material not available in local market).					
10.3	Overhead compensation on a suspension of work.					
10.4	Compensation for justified delay due to VOs.					
10.5	Required improvements.					

11. From your own experience, how frequently are the following types of site instructions occurring on construction projects in Gaza Strip?

No.	Instructions	Never	Seldom	Sometimes	Often	Always
11.1	To vary the design, quality or quantity of the works.					
11.2	To resolve discrepancies in contract documents (e.g. rectify errors, omissions)					
11.3	To reiterate or enforce contractual provisions (e.g. instruction to remove from site goods that do not conform to original specifications).					
11.4	To protect the client's interest (e.g. instruction to remove from site camp a worker who constitutes a nuisance.					

12. To which extent do you agree with the following statements?

No.	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
12.1	A clause permitting VOs is an essential feature of any construction contract.					
12.2	Most VOs could be avoided.					
12.3	A VO clause is provided because construction projects involve complex operations which cannot be accurately determined in advance.					
12.4	The existence of a VO clause is an aspect that tends to encourage clients/consultants to change their minds during the course of a contract.					
12.5	All clients are fully aware that VOs are based on market surveys and price analysis.					
12.6	The excessive occurrence of VOs may lead to know that the designs and quantity take off procedures need to be upgraded					
12.7	The excessive occurrence of VOs may lead to know that market survey procedures need to be upgraded.					

Section 4: Assessing the current practices of VOs management in Gaza Strip

13. Indicate which of the following is true of your organization.

No.	Activity	Never	Seldom	Sometimes	Often	Always
13.1	There are a good contract documentation and all VOs are recorded					
13.2	The direct costs of VOs are calculated.					
13.3	The indirect costs of VOs are calculated.					
13.4	A specific person with relevant skills is employed to manage VOs.					
13.5	There are a good communication and cooperation among project team members.					
13.6	There are identification and understanding of contract requirements and provisions by the respective parties before the project starts.					
13.7	The possible variations that might occur in the future activities of the project are identified.					

Section 5: Non-value adding activities associated with the VOs during the construction stage.

14. From your own experience, how frequently are the following categories of the waste during the construction stage occur as a result of VO?

No.	Waste categories	Never	Seldom	Sometimes	Often	Always
14.1	Reworks/Repairs activities					
14.2	Defects during construction stage					
14.3	Unnecessary material handling and material waste.					
14.4	Delays					
14.5	Waiting Time					

Section 6: Origin agent of the VOs and factors causing it

15. Please rank each of the origin agents of VO (from 1 most to 4 least)

No.	Origin agent	Give an order from 1 to 4
15.1	Client	
15.2	Donor	
15.3	Consultant	
15.4	Contractor	

16. Please rank each of the factors influencing the occurrence of variation (from 1 most to 3 least)

No.	Factors	Give an order from 1 to 3
16.1	Nature of the project. i.e. unforeseen conditions and uniqueness of project.	
16.2	Complexity of the project. i.e. continuous demand for speed in construction, cost and quality control, health and safety in the work place and avoidance of disputes, together with technological advances.	
16.3	Project delivery system (design-bid-build, design-build)	

17. From your point of view, Please indicate the degree of influence and occurrence that lead to the presence of VOs in the project on a scale 1 to 10

No Influence ——————————————— Very high

1 2 3 4 5 6 7 8 9 10

Never occur ——————————————— Great amount

1 2 3 4 5 6 7 8 9 10

No.	Factors	Influence	Occurrence
		Very high—No Influence (1) (10)	Great amount—Never occur (1) (10)
First: Client related factors			
1	Change project purpose and scope by clients.		
2	Change of implementing schedule by client		
3	Client's financial problems.		
4	Inadequate project objectives.		
5	Impediment in prompt decision-making process.		
6	Obstinate nature of client.		
7	Change in specification by client		
8	Inadequate experience of client's staff.		
9	Replacement of material or procedure by client.		
10	Land allocation problems.		
11	Required improvement.		
Second: Donor related factors			
1	Financial capability of donor.		
2	Budget allocated constraints.		
3	Time constraints.		
4	Interference of donor in project requirements.		
5	Relation between donor and client.		
Third: Consultant related factors			
1	Change in design by the consultant during the construction stage.		
2	Inadequate revision and feedback system through design process.		
3	Change in specifications by the consultant.		
4	International consultant using inadequate specification to be followed in local conditions. i.e. Testing procedure.		
5	Errors and omissions in design.		
6	Discrepancies between contract documents.		
7	Inadequate scope of work for contractor.		
8	Technology change especially if the time between design and construction is long.		
9	Lack of coordination among project parties.		
10	Design complexity.		
11	Insufficient time for preparation of contract documents.		

No.	Factors	Influence Very high——No Influence (1) (10)	Occurrence Great amount—Never occur (1) (10)
12	Inadequate and ambiguous design details and non-clearance of BOQ.		
13	Consultant's lack of judgment and experience.		
14	Lack of consultant's knowledge of available materials and equipment.		
15	Insufficient site investigation prior to design.		
Fourth: Contractor related factors			
1	Complex design and technology.		
2	Lack of strategic planning.		
3	Contractor's lack of required data.		
4	Lack of contractor's involvement in design.		
5	The required equipment and tools are not available.		
6	Lack of a specialized construction manager.		
7	Searching for compensating costs for his low prices if any.		
8	Lack of communication between contractor and other parties.		
9	Contractor's lack of judgment and experience. i.e. misunderstanding of tender documents during cost estimate stage.		
10	Shortage of skilled manpower		
11	Contractor's financial difficulties.		
12	Contractor's desired profitability to improve financial condition.		
13	Differing site conditions. i.e. soil conditions differ from as indicated in the tender document.		
14	Defective workmanship. (Acceptance of defective workmanship due to schedule may force a change in the facility to correct for it).		
15	Failure of the contractor/supplier to provide the required material from outsourcing (shipping obstacles).		
Fifth: Environmental factors			
1	Weather conditions.		
2	Safety considerations.		
3	Change in government regulations.		
4	Change in economical conditions.		
5	Unforeseeable works		
6	Internal political problems.		
7	Israel restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts).		

Section 7: Impacts of VOs

18. Cost implication of VOs: To which extent do you agree with the following statements?

No.	Statement	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
18.1	Excessive VOs result in incurring additional costs.					
18.2	The reduction of the occurrence of VOs could optimally lower construction delivery costs.					
18.3	Time compression in construction operations could contribute to significant reduction of unnecessary costs.					
18.4	No matter how carefully a VO is administrated, indirect costs accrue on it.					
18.5	The occurrence of VOs is the important factor of delay in delivery of construction projects.					

19. From your point of view select the degree of influence and occurrence that lead to impact the construction project due to VOs on a scale 1 to 10.

No Influence high ——————————————— **Very**

1 2 3 4 5 6 7 8 9 10

Never occur amount ——————————————— **Great**

1 2 3 4 5 6 7 8 9 10

No.	Factors	Influence	Occurrence
		Very —No Influence high	**Great —Never occur amount**
1	Increase in project cost.		
2	Hiring new professionals.		
3	Increase in overhead expenses.		
4	Delay in payment.		
5	Quality degradation.		
6	Productivity degradation.		
7	Procurement delay (materials and equipment).		
8	Rework and demolition.		
9	Logistic delay.		
10	Poor safety conditions.		
11	Poor professional relations.		
12	Additional payment for contractor.		
13	Dispute among professionals.		
14	Completion schedule delay.		
15	Increase in duration of individual activities.		
16	Suspend work in other activities.		
17	Impacts on subcontractors.		
18	Image of technical department (revising of problem statement) then affect the image of the institution.		

Section 8: Recommended Strategies to minimize VOs

20. To which extent do you agree with the following recommendations?

No.	Recommended Strategies to minimize VOs	Unimportan	Less important	Important	Very important	Very High important
1	All involved parties should plan adequately before works start on site.					
2	Identification and understanding of contract requirements and provisions by the respective parties before the project starts					
3	Complete the drawings at tender stage.					
4	Spend adequate time on pre-tender planning phase.					
5	Clients should provide a clear brief of the scope of works.					
6	All parties should forecast unforeseen situations.					
7	The consultant should co-ordinate closely at design stage.					
8	Enhance communication and cooperation among project team members.					
9	Supervise the works with an experienced and dedicated supervisor.					
10	Consultants should ensure that the design/specifications fall within the approved budget.					
11	Get accurate information and research with regard to procurement procedure, material and plant.					
12	Carry out detail site investigation including detail soil investigations and consider it during tendering stage					
13	Settling the legal status of land ownership of the project before awarding the tender to the contractor.					
14	Once the tender is awarded, make no changes to the specifications					
15	Place experienced and knowledgeable executives in the design department					

21. Do you have any further comments or suggestions relative to VOs?

……

Appendix B: Questionnaire (Arabic)

الجامعة الإسلامية – غزة

عمادة الدراسات العليا

كلية الهندسة – برنامج الماجستير

إدارة المشروعات الهندسية

استبانة حول:

إدارة الأوامر التغييرية في قطاع غزة: تأثيرها وتقليلها

بداية أتقدم لكم بالشكر والامتنان على إعطاء جزء من وقتكم الثمين لتعبئة هذه الاستبانة التي تعد جزءاً أساسياً من الدراسة البحثية المطلوبة لنيل درجة الماجستير في إدارة المشروعات الهندسية بالجامعة الإسلامية.

تهدف هذه الدراسة إلى دراسة تأثير الأوامر التغييرية على المشاريع الانشائية في قطاع غزة ووضع الاستراتيجيات اللازمة لتقليلها.

يرجى التكرم بالمساعدة في تعبئة البيانات المطلوبة بمستوى الدقة والأمانة المعهودة في عملكم مع العلم أنه سيتم استخدام البيانات التي ستجمع لأغراض البحث العلمي فقط.

ولكم كل الشكر والتقدير على مساهمتكم في دعم البحث العلمي

الباحثة:

ساميه نصار

إشراف:

د. خالد الحلاق

يرجى وضع علامة √ مقابل الخيار الذي ترونه مناسباً.

القسم الأول: معلومات عامة

22.نوع المؤسسة / الشركة:		
☐ مالك/صاحب عمل	☐ استشاري	☐ مقاول
23.المسمى الوظيفي:		
☐ مدير المؤسسة / نائب	☐ مدير المشروع / نائب	
☐ مهندس موقع/ مكتب	☐ أخرى (يرجى التحديد)	
24.سنوات الخبرة		
☐ أقل من 5 سنوات	☐ من 5 إلى أقل من 10 سنوات	
☐ من 10 إلى أقل من 15 سنة	☐ 15 سنة فأكثر	

القسم الثاني: معلومات عن المشاريع التي قمت بإدارتها

25.نوع المشروع (يمكنك اختيار أكثر من نوع)			
☐ طرق	☐ مباني	☐ الصرف الصحي والمياه	☐ كهروميكانيك
26.حجم المشاريع التي قمت بإدارتها في السنوات الخمس الماضية:			
☐ أقل من مليون دولار	☐ من 1 إلى أقل من 5 ملايين دولار		
☐ من 5 إلى أقل من 10 ملايين دولار	☐ 10 ملايين دولار فأكثر		
27.نسبة المشاريع التي تحتوي على أوامر تغييرية وتسببت في تأخير العمل في السنوات الخمس الماضية:			
☐ لا يوجد	☐أقل من 20٪	☐ 20-50٪	☐ أكثر من 50٪
28.التأخير في الجدول الزمني بسبب الأوامر التغييرية كنسبة مئوية من الجدول الزمني الأصلي في السنوات الخمس الماضية:			
☐ لا يوجد	☐ أقل من 20٪	☐ 20-50٪	☐ أكثر من 50٪
29.نسبة المشاريع التي تجاوزت قيمة العقد بسبب الأوامر التغييرية في السنوات الخمس الماضية:			
☐ لا يوجد	☐ أقل من 20٪	☐ 20-50٪	☐ أكثر من 50٪
30.إلى أي مدى الأوامر التغييرية تسببت في عرقلة تقدم المشروع:			
☐ لا يوجد	☐ أقل من 20٪	☐ 20-50٪	☐ أكثر من 50٪

القسم الثالث: انتشار الأوامر التغييرية

31.يرجى الإشارة إلى مدى تكرار ما يلي من الأعمال التي تسبب أوامر تغييرية في المشاريع الإنشائية في قطاع غزة.

الرقم	الأعمال	مطلقاً	نادراً	أحياناً	غالباً	دائماً
10.1	أعمال إضافية أو حذف بسبب عدم تطابق جدول الكميات مع المخططات.					
10.2	أعمال مستبدلة بسبب عدم توفر المواد في السوق المحلية.					
10.3	تعويضات بسبب التكاليف الإدارية خلال فترة تعليق العمل الناتجة عن الأوامر التغييرية.					
10.4	تعويضات عن التأخير المبرر بسبب الأوامر التغييرية.					
10.5	إضافة تحسينات مطلوبة.					

32.من تجربتك الخاصة، ما مدى تكرار ما يلي من تعليمات الموقع في المشاريع الإنشائية في قطاع غزة؟

الرقم	تعليمات الموقع	مطلقاً	نادراً	أحياناً	غالباً	دائماً
11.1	تعليمات الموقع لتغيير التصميم أو الجودة أو كمية من الأعمال.					
11.2	تعليمات الموقع لحل التناقضات في وثائق العقد (مثال: تصحيح الأخطاء والسهو).					
11.3	تعليمات الموقع لإنفاذ الأحكام التعاقدية (مثال: تعليمات بإزالة البضائع من الموقع التي لا تتفق مع المواصفات المطلوبة).					
11.4	تعليمات الموقع لحماية مصلحة المالك (مثال: تعليمات لإزالة عامل من الموقع الذي يشكل مصدر إزعاج)					

33. إلى أي مدى توافق على العبارات التالية؟

الرقم	العبارة	أعارض بشده	أعارض	محايد	أوافق	أوافق بشدة
12.1	يعتبر وجود بند يسمح بالأوامر التغييرية هو سمة أساسية من سمات أي عقد إنشاء.					
12.2	يمكن تجنب معظم الأوامر التغييرية.					
12.3	يوجد بند الأوامر التغييرية لأن المشاريع الإنشائية تحتوي على عمليات لا يمكن تحديدها بدقة مقدما.					
12.4	يوجد بند الأوامر التغييرية ليشجع المالك والاستشاري على تغيير تفكيرهم أثناء العمل.					
12.5	يدرك مالك المشروع أن الأوامر التغييرية تستند على استطلاعات السوق وتحليل الأسعار.					
12.6	يؤدي تكرار حدوث الأوامر التغييرية إلى ضرورة تحسين إجراءات حصر الكميات والمخططات.					
12.7	يؤدي تكرار حدوث الأوامر التغييرية إلى ضرورة تحسين إجراءات دراسة السوق.					

القسم الرابع: تقييم الممارسات الحالية لإدارة أوامر التغيير في قطاع غزة

34.حدد مما يلي الذي ينطبق على مؤسستك.

الرقم	الأعمال	مطلقاً	نادراً	أحياناً	غالباً	دائماً
13.1	يوجد توثيق جيد لوثائق العقد ويتم تسجيل جميع الأوامر التغييرية.					
13.2	يتم حساب التكاليف المباشرة للأوامر التغييرية.					
13.3	يتم حساب التكاليف الغير المباشرة للأوامر التغييرية.					
13.4	وجود شخص ذو مهارات لإدارة الأوامر التغييرية.					
13.5	يوجد تعاون وتواصل فعال بين أعضاء فريق المشروع.					
13.6	يوجد فهم وتحديد لمتطلبات العقد ونصوصه من قبل أطراف العقد قبل بداية المشروع.					
13.7	يتم تحديد التغييرات المحتملة على أنشطة المشروع.					

القسم الخامس: الأنشطة غير ذات القيمة المضافة المرتبطة بالتغييرات خلال مرحلة الإنشاء:

35.من خبراتك الخاصة، كم مرة تحدث الفئات التالية من الفاقد أثناء مرحلة الإنشاء نتيجة للأوامر التغييرية؟

الرقم	الفئات	مطلقاً	نادراً	أحياناً	غالباً	دائماً
14.1	إعادة أعمال/إصلاحات.					
14.2	عيوب أثناء مرحلة التنفيذ.					
14.3	حدوث تبديد أو فقدان للمواد نتيجة الأوامر التغييرية.					
14.4	تأخير.					
14.5	فترة انتظار.					

القسم السادس: العامل المنشأ للأوامر التغييرية والعوامل المسببة لها

36.يرجى ترتيب كل من العامل المسبب للأوامر التغييرية من خلال إعطاء كل عامل رقم من 1 إلى 4 (1 أكثر تسبباً إلى 4 أقل تسبباً)

الرقم	العامل المسبب للأوامر التغييرية	ترتيبهم من رقم 1 إلى 4
15.1	المالك/ صاحب العمل	
15.2	ممول المشروع	
15.3	الاستشاري	
15.4	المقاول	

37. يرجى ترتيب كل من العوامل التي تؤثر على حدوث الأوامر التغييرية عن طريق إعطاء كل عامل رقم من 1 إلى 3 (1 أكثر حدوثاً إلى 3 أقل حدوثاً)

الرقم	العوامل	ترتيبهم من رقم 1 إلى 3
16.1	طبيعة المشروع مثل الظروف الغير المتوقعة وكون المشروع فريد من نوعه.	
16.2	تعقيد المشروع مثل الطلب المستمر على السرعة في البناء، التكلفة ومراقبة الجودة، الصحة والسلامة في مكان العمل وتجنب النزاعات، جنبا إلى جنب مع التقدم التكنولوجي.	
16.3	نظام التعاقد المشروع (design-bid-build, design-build)	

38.من وجهة نظرك، يرجى بيان درجة التأثير والحدوث التي تؤدي إلى وجود أوامر تغييرية في المشروع باختيار رقم من 1 إلى 10

لا تأثير 1 2 3 4 5 6 7 8 9 10 تأثير عالي جداً

لا تحدث عالي جداً 1 2 3 4 5 6 7 8 9 10 تحدث بشكل

الرقم	العوامل المؤثرة	تأثيرها لا تأثير (1) ـــــ تأثير عالي جدا (10)	حدوثها لا تحدث (1) ـــــ تحدث بشكل عالي جدا (10)
	أولاً: العوامل المتعلقة بصاحب العمل أو مالك المشروع		
1	تغيير هدف العمل ومجاله من قبل المالك.		
2	تغيير جدولة العمل من قبل المالك.		
3	المشاكل المالية لصاحب العمل.		
4	عدم وضوح أهداف العمل لدى المالك.		
5	ضعف قدرة المالك على اتخاذ القرارات.		
6	طبيعة المالك واصراره على رأيه رغم تناقض رأيه مع رأي الاستشاري.		
7	تغيير في المواصفات من قبل المالك.		
8	عدم الخبرة الكافية لطاقم العمل لدى المالك.		

الرقم	العوامل المؤثرة	تأثيرها لا تأثير ـــــــ تأثير عالي جدا (1) (10)	حدوثها لا تحدث ـــــــ تحدث بشكل عالي جدا (1) (10)
9	تغيير نوم المواد المستخدمة أو طرق التنفيذ أثناء العمل من قبل المالك او حسب رغبة المالك.		
10	مشاكل في تعيين الموقع.		
11	تحسينات مطلوبة من صاحب العمل.		
ثانيا: العوامل المتعلقة بممول المشروع			
1	القدرة المالية لممول المشروع.		
2	قيود على الميزانية المخصصة.		
3	قيود على وقت المنحة.		
4	تدخل الممول في متطلبات المشروع.		
5	العلاقة بين ممول المشروع وصاحب العمل.		
ثالثا: العوامل المتعلقة باستشاري المشروع			
1	تغيير أو تعديل التصميم من قبل الاستشاري في		
2	عدم كفاءة نظام مراجعة وتغذية راجعة خلال		
3	تغيير في المواصفات من قبل الاستشاري.		
4	استخدام مواصفات غير ملائمة للظروف المحلية من قبل استشاري دولي مثل (Testing		
5	وجود نقص أو أخطاء في التصميم.		
6	تعارض وتضارب بين وثائق العقد.		
7	عدم وضوح هدف ومجال العمل للمقاول.		
8	تغير تقنيات التنفيذ عندما يكون الوقت بين		
9	ضعف التعاون بين أطراف المشروع.		
10	تعقيد التصميم وصعوبة فهمه.		
11	ضيق وقت تحضير وثائق العطاء.		
12	تفاصيل التصميم غير كافية وغامضة وعدم		
13	ضعف خبرة الاستشاري.		
14	ضعف متابعة الاستشاري للمواد والمعدات		
15	عدم الاهتمام بزيارة وفحص الموقع قبل التصميم.		
رابعا: العوامل المتعلقة بمقاول المشروع			
1	تعقيد التصميم والتقنيات المستخدمة للمشروع.		
2	عدم وجود خطة واضحة ومفصلة للعمل لدى		
3	عدم توفر البيانات اللازمة للعمل لدى المقاول.		
4	عدم مشاركة المقاول في أعمال التصميم.		
5	عدم توفر المعدات المطلوبة للعمل لدى المقاول.		
6	عدم وجود مدير مشروع متخصص وذو كفاءة.		
7	البحث عن تعويض انخفاض أسعار المقاول إن		
8	ضعف التواصل بين المقاول وباقي أطراف		
9	قلة خبرة المقاول (عدم فهم المقاول لوثائق العقد خلال مرحلة تقدير		
10	عجز أو نقص في العمال المهرة لدى المقاول.		
11	ضعف القدرة المالية للمقاول.		
12	رغبة المقاول في الربح لتحسين وضعه المالي.		

الرقم	العوامل المؤثرة	تأثيرها	حدوثها
		لا تأثير ـــــــ تأثير عالي جدا (1) (10)	لا تحدث ـــــــ تحدث بشكل عالي جدا (1) (10)
13	اختلاف ظروف الموقع (ظروف التربة تختلف كما موجود في وثائق العطاء).		
14	خلل في المصنعية والأعمال المنجزة (قبول المصنعية التي بها عيوب بسبب الجدول الزمني قد تؤدي إلى التغيير في المشروع لإصلاح		
15	عدم قيام المقاول / المورد بتوفير المواد المطلوبة من المصادر الخارجية (عقبات الشحن		
خامسا: عوامل بيئية			
1	سوء الأحوال الجوية.		
2	اعتبارات السلامة والأمان في الموقع.		
3	تغيير في اللوائح والقوانين الحكومية.		
4	سوء الوضع الاقتصادى.		
5	مشاكل غير متوقعة.		
6	مشاكل سياسية داخلية.		
7	إغلاق المعابر والحصار (عدم توفر مواد البناء وقطع الغيار للمعدات)		

القسم السابع: آثار الأوامر التغييرية

39. التكلفة المترتبة على أوامر التغيير: إلى أي مدى تتفق مع العبارات الآتية؟

الرقم	العبارة	أعارض بشده	أعارض	محايد	أوافق	أوافق بشدة
18.1	تؤدي كثرة الأوامر التغييرية إلى تكاليف إضافية للمشروع.					
18.2	تقليل الأوامر التغييرية يمكن أن يقلل على النحو الأمثل من تكاليف المشروع.					
18.3	يسهم ضغط الوقت في عمليات التشييد في خفض كبير للتكاليف غير الضرورية.					
18.4	تنتج التكاليف غير المباشرة عن الأوامر التغييرية بغض النظر عن إدارتها بشكل جيد.					
18.5	يتأخر تسليم المشروع بسبب حدوث الأوامر التغييرية.					

40.من وجهة نظرك حدد درجة التأثير والحدوث التي تؤدي إلى التأثير على المشروع بسبب الأوامر التغييرية باختيار رقم من 1 إلى 10

لا تأثير ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا تأثير عالي جداً
1 2 3 4 5 6 7 8 9 10

لا تحدث عالي جداً ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا ـــــ ا تحدث بشكل
1 2 3 4 5 6 7 8 9 10

الرقم	العوامل المؤثرة	تأثيرها لا تأثير ـــــ تأثير عالي جدا (1) (10)	حدوثها لا تحدث ـــ تحدث بشكل عالي جدا (1) (10)
1	زيادة تكلفة المشروع.		
2	توظيف اختصاصيين مهنيين جدد.		
3	زيادة الانفاق على التكاليف الإدارية.		
4	تأخير دفعات للمقاول.		
5	انخفاض جودة العمل.		
6	انخفاض الإنتاجية.		
7	تأخير في عملية الشراء (المواد والمعدات).		
8	إعادة العمل والإزالة.		
9	التأخير اللوجستي.		
10	سوء الأمن والسلامة في الموقع.		
11	العلاقات المهنية السيئة.		
12	دفعات إضافية للمقاول.		
13	نزاعات بين أطراف العمل.		
14	تأخير في الجدول الزمني.		
15	زيادة مدة أنشطة أعمال المشروع.		
16	تعليق الأعمال في أنشطة أخرى للمشروع.		
17	الأوامر التغييرية تؤثر على مقاول الباطن.		
18	تؤثر على صورة المؤسسة (صورة القسم الفني في مراجعته للمشاكل التي تواجه المشروع).		

القسم الثامن: استراتيجيات وتوصيات لتقليل الأوامر التغييرية

41. إلى أي مدى تتفق مع الاستراتيجيات والتوصيات الآتية لتقليل الأوامر التغييرية

الرقم	*استراتيجيات وتوصيات لتقليل الأوامر التغييرية*	غير مهمة	أقل أهمية	مهمة	مهمة بشكل كبير	مهمة بشكل كبير جدا
1	يجب على جميع الأطراف المعنية التخطيط بشكل كاف قبل بدء العمل في الموقع.					
2	تحديد وفهم متطلبات العقد والأحكام من قبل الأطراف المعنية قبل بدء المشروع.					
3	استكمال المخططات والوثائق العقد في مرحلة العطاء.					
4	قضاء وقت كاف في مرحلة التخطيط قبل العطاء.					
5	يجب على صاحب المشروع تقديم ملخص واضح لمجال الأعمال.					
6	يجب على جميع الأطراف التنبؤ بالحالات الغير متوقعة.					
7	ينبغي أن يقوم الاستشاري بالتنسيق الوثيق في مرحلة التصميم.					
8	تعزيز التواصل والتعاون بين أعضاء فريق المشروع.					
9	الإشراف على أعمال المشروع من قبل مشرف ذو خبرة.					
10	يجب على الاستشاري التأكد من أن التصميم/المواصفات ضمن الميزانية المخصصة					
11	الحصول على معلومات دقيقة فيما يتعلق بإجراءات الشراء والمواد والمصانع.					
12	العمل على زيارة وفحص الموقع بما في ذلك فحص التربة وأخذها بعين الاعتبار في					
13	العمل على تسوية الأوضاع القانونية لملكية الأرض التي سيقام عليها المشروع قبل ترسية العطاء على المقاول.					
14	عدم تغيير المواصفات بعد ترسية العطاء.					
15	تعيين أشخاص ذوي خبرة ومعرفة جيدة في قسم التصميم.					

42. هل يوجد لديكم أي تعليقات أو اقتراحات بخصوص الأوامر التغييرية؟

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Appendix C: Correlation coefficient

Table (C1): Internal validity for the prevalence of VOs

No	Paragraph	Relation Coefficient	P-value
VOs on construction projects in Gaza Strip			
1	Additional or omission on regarding coping BOQs with drawings.	0.58	0.000*
2	Substitution of works (i.e. Replacing material not available in local market).	0.61	0.000*
3	Overhead compensation on a suspension of work.	0.81	0.000*
4	Compensation for justified delay due to VOs.	0.73	0.000*
5	Required improvements.	0.59	0.000*
site instructions occurring on construction projects in Gaza Strip			
1	To vary the design, quality or quantity of the works.	0.51	0.000*
2	To resolve discrepancies in contract documents (e.g. rectify errors, omissions)	0.65	0.000*
3	To reiterate or enforce contractual provisions (e.g. instruction to remove from site goods that do not conform to original specifications).	0.81	0.000*
4	To protect the client's interest (e.g. instruction to remove from site camp a worker who constitutes a nuisance.	0.68	0.000*
Items VOs			
1	A clause permitting VOs is an essential feature of any construction contract.	0.60	0.000*
2	Most VOs can be avoided.	0.40	0.000*
3	A VO clause is provided because construction projects involve complex operations which cannot be accurately determined in advance.	0.54	0.000*
4	The existence of a VO clause is an aspect that tends to encourage clients/consultants to change their minds during the course of a contract.	0.53	0.000*
5	All clients are fully aware that VOs are based on market surveys and price analysis.	0.56	0.000*
6	The excessive occurrence of VOs may lead that the designs and quantity take off procedures need to be upgraded.	0.60	0.000*
7	The excessive occurrence of VOs may lead that market surveys procedures need to be upgraded.	0.57	0.000*

* Correlation is statistical significant at $\alpha \leq 0.05$

Table (C2): Internal validity for assessing the current practices of VOs management

No	Paragraph	Relation Coefficient	P-value
1	There are a good contract documentation and all VOs are recorded	0.71	0.000*
2	The direct costs of VOs are calculated.	0.73	0.000*
3	The indirect costs of VOs are calculated.	0.66	0.000*
4	A specific person with relevant skills is employed to manage VOs.	0.69	0.000*
5	There are a good communication and cooperation among project team members.	0.73	0.000*
6	There are identification and understanding of contract requirements and provisions by the respective parties before the project starts.	0.69	0.000*
7	The possible variations that might occur in the future activities of the project are identified.	0.57	0.000*

* Correlation is statistical significant at $\alpha \leq 0.05$

Table (C3): Internal validity for the non-value adding activities associated with the VOs during the construction stage

No	Paragraph	Relation Coefficient	P-value
1	Reworks/Repairs activities	0.69	0.000*
2	Defects	0.69	0.000*
3	Unnecessary material handling and material waste.	0.74	0.000*
4	Delays	0.75	0.000*
5	Waiting	0.70	0.000*

* Correlation is statistical significant at $\alpha \leq 0.05$

Table (C4): Internal validity for the origin agent of the VOs and factors causing it

No	Paragraph	Relation Coefficient	P-value
First: Client related factors			
1	Change project purpose and scope by clients.	0.74	0.000*
2	Change of implementing schedule by client	0.67	0.000*
3	Client's financial problems.	0.65	0.000*
4	Inadequate project objectives.	0.74	0.000*
5	Impediment in prompt decision-making process.	0.71	0.000*
6	Obstinate nature of client.	0.70	0.000*
7	Change in specification by client	0.74	0.000*
8	Inadequate experience of client's staff.	0.70	0.000*
9	Replacement of material or procedure by client.	0.69	0.000*
10	Land allocation problems.	0.70	0.000*
11	Required improvement.	0.58	0.000*
Second: Donor related factors			
1	Financial capability of donor.	0.83	0.000*
2	Budget allocated constraints.	0.81	0.000*
3	Time constraints.	0.81	0.000*

No	Paragraph	Relation Coefficient	P-value
4	Interference of donor in project requirements.	0.79	0.000*
5	Relation between donor and client.	0.78	0.000*
Third: Consultant related factors			
1	Change in design by consultant during construction stage.	0.84	0.000*
2	Inadequate revision and feedback system through design process.	0.82	0.000*
3	Change in specifications by the consultant	0.81	0.000*
4	International consultant using inadequate specification to be followed in local conditions. i.e. Testing procedure.	0.74	0.000*
5	Errors and omissions in design.	0.82	0.000*
6	Discrepancies between contract documents.	0.75	0.000*
7	Inadequate scope of work for contractor.	0.76	0.000*
8	Technology change especially if the time between design and construction is long.	0.72	0.000*
9	Lack of coordination among project parties.	0.76	0.000*
10	Design complexity.	0.71	0.000*
11	Insufficient time for preparation of contract documents.	0.75	0.000*
12	Inadequate and ambiguous design details and non-clearance of BOQ.	0.71	0.000*
13	Consultant's lack of judgment and experience.	0.81	0.000*
14	Lack of consultant's knowledge of available materials and equipment.	0.73	0.000*
15	Insufficient site investigation prior to design.	0.86	0.000*
Fourth: Contractor related factors			
1	Complex design and technology.	0.70	0.000*
2	Lack of strategic planning.	0.81	0.000*
3	Contractor's lack of required data.	0.73	0.000*
4	Lack of contractor's involvement in design.	0.52	0.000*
5	The required equipment and tools are not available.	0.81	0.000*
6	Lack of a specialized construction manager.	0.77	0.000*
7	Searching for compensating costs for his low prices if any.	0.72	0.000*
8	Lack of communication between contractor and other parties.	0.69	0.000*
9	Contractor's lack of judgment and experience. i.e. misunderstanding of tender documents during cost estimate stage.	0.79	0.000*
10	Shortage of skilled manpower	0.78	0.000*
11	Contractor's financial difficulties.	0.78	0.000*
12	Contractor's desired profitability to improve financial condition.	0.62	0.000*
13	Differing site conditions. i.e. soil conditions differ from as indicated in the tender document.	0.60	0.000*
14	Defective workmanship. (Acceptance of defective workmanship due to schedule may force a change in the facility to correct for it).	0.75	0.000*
15	Failure of the contractor/supplier to provide the required	0.62	0.000*

No	Paragraph	Relation Coefficient	P-value
	material from outsourcing (shipping obstacles).		
Fifth: Environmental factors			
1	Weather conditions.	0.73	0.000*
2	Safety considerations.	0.74	0.000*
3	Change in government regulations.	0.75	0.000*
4	Change in economic conditions.	0.71	0.000*
5	Unforeseen problems.	0.71	0.000*
6	Internal political problems.	0.83	0.000*
7	Israel restriction in terminals and crossing closure and siege (Lack of construction materials and equipment spare parts).	0.62	0.000*

* Correlation is statistical significant at $\alpha \leq 0.05$

Table (C5): Internal validity for the impact of VOs

No	Paragraph	Relation Coefficient	P-value
Impacts of VOs			
1	Excessive VOs result in incurring additional costs.	0.63	0.000*
2	The reduction of the occurrence of VOs can optimally lower construction delivery costs.	0.68	0.000*
3	Time compression in construction operations can contribute to significant reduction of unnecessary costs.	0.58	0.000*
4	No matter how carefully a VO is administrated, indirect costs accrue on it.	0.56	0.000*
5	The occurrence of VOs is the important factor of delay in delivery of construction projects.	0.68	0.000*
The degree of influence and occurrence that lead to impact the construction project due to VOs			
1	Increase in project cost.	0.60	0.000*
2	Hiring new professionals.	0.60	0.000*
3	Increase in overhead expenses.	0.71	0.000*
4	Delay in payment.	0.70	0.000*
5	Quality degradation.	0.72	0.000*
6	Productivity degradation.	0.70	0.000*
7	Procurement delay (materials and equipment).	0.67	0.000*
8	Rework and demolition.	0.71	0.000*
9	Logistic delay.	0.69	0.000*
10	Poor safety conditions.	0.68	0.000*
11	Poor professional relations.	0.71	0.000*
12	Additional payment for contractor.	0.66	0.000*
13	Dispute among professionals.	0.73	0.000*
14	Completion schedule delay.	0.69	0.000*

No	Paragraph	Relation Coefficient	P-value
15	Increase in duration of individual activities.	0.73	0.000*
16	Suspend work in other activities.	0.69	0.000*
17	Impacts on subcontractors.	0.64	0.000*
18	Image of tech. department (revising of problem statement) then affect the image of the institution.	0.50	0.000*

* Correlation is statistical significant at $\alpha \leq 0.05$

Table (C6): Internal validity for the recommended strategies to minimize VOs

No	Paragraph	Relation Coefficient	P-value
1	All involved parties should plan adequately before works start on site.	0.71	0.000*
2	Identification and understanding of contract requirements and provisions. by the respective parties before the project starts	0.71	0.000*
3	Complete the drawings at tender stage.	0.70	0.000*
4	Spend adequate time on pre-tender planning phase.	0.76	0.000*
5	Clients should provide a clear brief of the scope of works.	0.71	0.000*
6	All parties should forecast unforeseen situations.	0.59	0.000*
7	The consultant should co-ordinate closely at design stage.	0.64	0.000*
8	Enhance communication and cooperation among project team members.	0.71	0.000*
9	Supervise the works with an experienced and dedicated supervisor.	0.71	0.000*
10	Consultants should ensure that the design/specifications fall within the approved budget.	0.78	0.000*
11	Get accurate information and research with regard to procurement procedure, material and plant.	0.77	0.000*
12	Carry out detail site investigation including detail soil investigations and consider it during tendering stage	0.73	0.000*
13	Settling the legal status of land ownership of the project before awarding the tender to the contractor.	0.72	0.000*
14	Once the tender is awarded, make no changes to the specifications	0.64	0.000*
15	Place experienced and knowledgeable executives in the design department	0.71	0.000*

* Correlation is statistical significant at $\alpha \leq 0.05$

Table (C7): Correlations coefficient between each dimension and the total degree of the questionnaire

Dimension	Relation Coefficient	P-value
The Prevalence Of VOs		
The occurrence of VOs on construction projects in Gaza Strip	0.80	0.000*
Site instructions occurring on construction projects in Gaza Strip	0.72	0.000*
The awareness of the outcome of VOs	0.74	0.000*
Assessing the current practices of VOs management in Gaza Strip	0.40	0.000*
Non-value adding activities associated with the variations during the construction stage	0.41	0.000*
Origin agent of the VOs and factors causing it		
First: Client related factors	0.81	0.000*
Second: Donor related factors	0.82	0.000*
Third: Consultant related factors	0.89	0.000*
Fourth: Contractor related factors	0.82	0.000*
Fifth: Environmental factors	0.67	0.000*
Impacts of VOs		
Impacts of VOs	0.40	0.000*
The degree of influence and occurrence that lead to impact the construction project due to VOs	0.97	0.000*
Recommendations to minimize VOs	0.53	0.000*

* Correlation is statistical significant at $\alpha \leq 0.05$