INVESTIGATING VARIATION ORDERS OBSERVANCE IN UNRWA CONSTRUCTION CONTRACTS: CASE STUDY

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ABSTRACT

Variation orders (V.O) are considered one of the main challenges that face all stakeholders in construction projects. United Nations Relief and Works Agency (UNRWA) is one of the largest UN sister Organizations that implements hundreds of construction projects in Palestine and especially in the Gaza Strip. Variation orders in UNRWA construction projects usually create negative impact on project sustainability and progress. This study aims to investigate the causes of variation orders in UNRWA construction projects and to introduce how UNRWA contract conditions manage the observance of these variation orders. Three research methodologies were used to achieve these objectives by; reviewing the researches that discussed the causes of V.O and approaches to manage them, introducing how UNRWA contract clauses manage variation orders in construction projects and analyzing three cases (case studies) showing the causes of V.O and how they were managed. The results showed that the majority of the recorded variation orders in UNRWA construction projects were related to client’s (UNRWA) amendments, design changes, non availability of certain types of construction materials due to the siege and closure imposed on Gaza Strip and to the weather conditions which forms one of the reasons for variation orders in UNRWA projects specially in the infrastructure works. Variation orders in construction projects could result from increasing contract value by more than 25%, adding new item that did not exist in the original contract, changing specifications of original contracted items due to unforeseen conditions or the need to change the scope of work. The results also revealed that variation orders were managed through various approaches such as Article 7 (Variations) in UNRWA contract conditions which include seven sub-clauses, considering budget margin as contingencies and direct monitoring, evaluation and review of tender and contract documents.

It can be concluded that in general, variation orders in UNRWA projects are related to the top management requirements/changes (client’s needs) after starting the works. Besides, it can be concluded that more attention should be given and more approaches should be used to control the V.O in UNRWA projects. The study recommends the professionals to exert more efforts and pay more attention in defining the scope of projects, allocating sufficient time for design development and improving design by adding more risk factors during the itemization process. The study introduced valuable recommendations to decision makers in construction industry to hold training programmers in construction variation management and to analyze the potential causes of the previous variations to benefit from the lessons learned in managing any future variations in construction projects.

KEYWORDS: Variation Orders, construction projects, UNRWA, Case studies,
1. INTRODUCTION

Nowadays construction of new projects is becoming a radical demand to improve the conditions of Palestine refugees. The needs to construct new schools, health centers, shelters, housing units and others is becoming a key driver to continue development and enhancement for all parties operating in the construction industry including clients, contractors, subcontractors, and other stakeholders. One of the main clients who contribute to support the construction industry in Palestine especially in the Gaza Strip is the United Nations Relief and Works Agency (UNRWA).

In UNRWA, there are mainly two departments that manage construction and infrastructure projects. These departments are Infrastructure Camps Improvement Program (ICIP) and Field Procurement Department. The first department (program) is responsible of establishing, planning, designing and constructing water supply, sewerage and drainage works in refugee camps and surrounding areas as well as maintains basic environmental health services in the camps, such as refuse removal. Besides, he program is responsible for supervising and preparing all design documents for all UNRWA construction projects such as schools, Health centers, Re housing projects, shelters, etc. while the procurement department is responsible to manage all procurement processes including inviting and selecting the contractors, preparing technical and financial evaluation reports, responding to contractors queries and managing the bidding process for construction, service and goods projects.

In UNRWA, procurement principles are guided by best value for money, fairness, integrity and transparency, Effective competition and the interest of UNRWA and the Palestine refugees. The purpose of these principles is to establish a common framework and common values to be applied throughout the procurement process. In applying these principles in the procurement process, UNRWA supports the activities of the organization by avoiding waste of resources, producing the most appropriate solution at all times, and strengthening the interest of the organization and its clients [1].

One of the main challenges that may face UNRWA as well as other clients who operate in the construction field is the frequent occurrence of the variation orders or as some studies defines it as change orders or amendment to the work. Variation orders (V.O) are considered one of the most significant sources of cost growth and disruptions to field productivity on construction projects. The engineer's review of the design may bring about changes to improve or optimize the design and hence the operations of the project. Furthermore, errors and omissions in engineering or construction may force a change. All these factors and many others necessitate changes that are costly and generally un-welcomed by all parties.

1.1 SIGNIFICANCE OF THE STUDY

During the life cycle of construction projects, 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 stages. 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 variation orders that create non steady flow of work,
and create losses in time, efforts and costs. Variations in construction projects can cause substantial adjustment to the contract duration, total direct and indirect cost, or both. Therefore, project management teams must have the ability to respond to variations effectively in order to minimize their adverse impact to the project.

Managing the appearance of (V.O) during construction works (implementation stage) needs special treatment. The number of variations and the amount of it may give negative implication on projects quality and may open the gate for unlimited questions and queries by all construction parties. This research intends to investigate the reasons resulted in variation orders in UNRWA construction projects and the adopted strategies to manage this occurrence. This study will provide a valuable contribution as lessons learned in improving construction industry not only in the Gaza strip but also for both regional and international countries.

1.2 RESEARCH OBJECTIVES

As managing V.O requires a lot of efforts and time, in addition to special treatment to mitigate its negative impact, UNRWA deals with this observable fact precisely and set out a comprehensible tactic to manage and administrate the occurrence of variation orders in construction projects. This study aims to improve the construction industry environment in the Gaza strip throughout managing UNRWA construction projects. The study tries to achieve the following objectives:

1. To investigate the causes of variation order in UNRWA construction projects.
2. To introduce how UNRWA contract conditions manage the observance of variation orders cases.

These objectives will be achieved throughout the following research methodologies:

1. Literature review: by reviewing the researches that discussed the causes of V.O and how it can be managed (theoretical background)
2. Introducing how UNRWA contract clauses in General Conditions (GC) and UNRWA Procurement Manual manage variation order in construction projects.
3. Three case studies showing the causes of VO and how they were managed.

This research started with section one that introduction variation order in construction projects, the significance, objectives and methodologies used in this study. The second section discussed the theoretical background of the V.O including causes and practical steps to manage it, followed by the third section which introduced the methodologies used to achieve research objectives while the fourth section introduced a discussion at three case studies of variation Orders observed in UNRWA construction projects. The last section provided some conclusions and recommendations that were valuable to diminish the negative impact of V.O in construction projects.

2. LITERATURE REVIEW

Change orders have long been identified to have a negative impact on construction productivity, leading to a decline in labor efficiency and, in some cases, sizeable loss of man hours [2]. There are a many definitions of change order such as Hegazy et al. [3]
who defined a change as any modification to the contractual guidance provided to the contractor by the owner, owner's agent or design engineer, Bin Ali [4] defined a variation orders as the alteration or modification of the design, quality of works, as shown upon the contract drawings, bill of quantities, and/or specifications and include the addition omission, or substitution of any works., also Hanna et al. [5a] defined change orders as any event that results in a modification of the original scope, execution time, or cost of work.

Changes 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 [6]. Many researchers studied the variation orders, causes of variation orders and the approaches used to manage it in construction projects such as: Chan and Kumaraswamy [7], Akinsola et al [8], Kaming et al. [9], Yogeswaran et. al [10], Ibbs et al [11], Hegazy et al. [3], Goudreau [12], Hanna al et. [5b], Hsieh et al. [13], Andi and Minato [14], Arain et al [15], Wu et al. [16], Acharya et al. [17], Perkins [18], Isaac and Navon [19], Alnuaimi, et al. [20], and Enshassi et al. [21], the researcher divided these studies into Arabic and International studies in change order or as introduced in many researches variation order.

Arabic studies in change order

Changes in the construction process are seen as almost impossible to be eliminated. Therefore extensive studies have been done by researchers to mitigate the impact of such changes. Enshassi et al. [21] studied 64 factors that caused variation orders in construction project in The Gaza Strip. The study results identified the most important factors cause variation order are lack of materials and equipment spare parts due to closure, change in design by consultant, lack of consultant's knowledge of available materials, errors and omission in design, conflicts between contract documents, owner's financial problems, lack of coordination among project parties, using inadequate specification for local markets by international consultant, internal politics, and change is specification by owners, Al Momani [22] found that user changes are one of the main causes of delay in 130 public projects in Jordan. Hegazy et al. [3] identified causes of change order in the contract documents as change in the regulatory legislations or code after the contract was awarded, changes of scope during construction due to owner, owner’s agent or design engineer new or modified requirements, correction of design errors and omissions, availability of materials and equipments, value Engineering proposals.

Alnuaimi, et al. [20] conducted a survey of variations in public construction projects in Oman, they identified the most causes of change order includes owner instructs additional works, owner instructs modification to design, non-availability of construction manuals and procedures for project construction in Oman, Non-availability of engineering licensing for engineers in Oman to maintain the quality of consultancy services, poor communication between relevant governmental units and the owner, non-availability of overall project planning, unrealistic design periods, unrealistic construction schedule, owner fails to make decisions or review documents at the right time low consultancy fee or less experienced designers.
2.5.2 International studies in change order

A critical change may cause consecutive delays in project schedule, re-estimation of work statement, and extra demands of equipment, materials, labor, and overtime. Changes, if not resolved through a formalized change management process, can become the major source of contract disputes, which is a severe risk contributing to project failure [6]. Kaming et al. [9] studied influencing factors on thirty one high-rise projects in Indonesia and found that design changes is one of the most important factors causing time overrun. They stated that design changes inevitably lead to variation in original cost/time programmes. Yogeswaran et al. [10] scrutinised 67 civil engineering projects in Hong Kong and suggested that at least a 15–20% time overrun was due to inclement weather. Based on analysis of 46 completed building projects in the UK During the construction phase, value engineering can be a costly exercise, as variation in any design element would initiate downstream variations to other relevant design components [23].

Awad [24] found that additional works, design revisions and differing sit conditions were the main reasons and significant impacts where, 48 % of variation orders resulted from additional works, 31.9% caused by design revision and 7.8% caused by differing site conditions, Love [25] indicated that non-traditional procurement methods are subject to greater occurrence of errors, omissions and changes than the traditional methods. Andi and Minato [14] find that such change which may be introduced by the client is one of the major problems being faced by the industry. Although these changes are seen as a major setback in executing design task. Memon [26] divided the causes of delay into two broad categories: excusable delays and non-excusable delays. Excusable delays were more oriented to the client or consultant causes, while the non-excusable delays were related to the contractor. Design change was mentioned as a cause in excusable delays. He suggested a list of remedies for the causes of both categories.

lack of coordination between parties may cause major variations that could eventually impact the project adversely and Lack of contractor’s involvement in design may eventually cause variations [15]. Design errors and omissions may lead to loss of productivity and delay in project schedule (Assaf et al., [27] and Hsieh et al. [13] analyzed the causes of change orders for 90 effective metropolitan public works projects in Taipei completed between 1991-2000. They categorized the main causes of variation orders into two main groups namely: i) administrative needs which include; change of work rules/regulation, change of decision making authorities, special need for project commission and ownership transfer, and neighborhoods pleading , ii) construction or technical group which includes; planning and design, underground condition, safety considerations, and natural incidents. They stated that problems incurred in planning and design stages account for the most critical causes of change orders where it represents 23.71% of all causes of change orders. Safety consideration ranked as second in significance among cause of change orders where it contributes about 17.08% of all causes of variation orders.

Wu et al. [16] divided the cause of variation orders in construction highway projects into two parts: external and internal factors. The external factors include the political and economic factor, the natural environmental factor, and the third party factor. He
classified the internal factor into four categories depending on whether they are initiated by the owner, construction design consultant, contractor, or other parties. Arun and Rao [28] reported that changes in design as well as defects and correction in design as factors that resulted in cost and time overruns in India construction project.

Arain and Pheng [29] studied 53 factors that causes variation orders in institutional buildings in Singapore, the result found that there are a strong correlation between lack of consultant's knowledge of available material and consultant's lack of required data, unavailability of equipment unavailability of skills, differing site condition and honest wrong beliefs of contractor, defective workmanship and contractor's lack of judgment and experience, unfamiliarity with local conditions and complex design and technology, and lack of specialized construction manager and lack of strategic planning.

Perkins [18] examined the causes for construction phase changes in 23 private design/build and 20 government design/build construction projects in the United States. He found that changes might arise from: owner-requested additions/deletions to the work; the action of third parties beyond the control of the owner or contractor; delays in owner-supplied access or equipment; differing site conditions; and discrepancies in the original design specifications. He reported that the number of changes due to design error in design/build construction is statistically significantly lower than that of the design-bid-build construction. Lee [30] studied the data of 161 completed transport projects. The results indicated that 95% and 100% of road and rail projects, respectively, had a maximum cost overrun of 50%. The key causes of cost overruns were found to be: changes in scope; delays during construction; unreasonable estimation and adjustment of project costs; and no practical use of earned value management system.

3. Managing occurrence of variation order/Methods used to mitigate change orders impact

Several studies by numerous researchers identified the method to minimize the impact of change orders like Chan. & Yeong [31], Miresco and Pomerol. [32], Cox. [33], Mokhtar et al. [23], Ibbs et al. [34], Arain et al. [15], Al-Jishi, and Al-Marzoug. [35], Alnuaimi, et al. [20]

In order to eliminate or minimize the impact of change orders Assaf et al. [27] found that continuous coordination and direct communication between contractors and consultant and client are the most important method to minimize change order and using a comprehensive site investigations to assist in proper planning for construction activities. Miresco and Pomerol [32] identified that the most important controls for Change Orders are Knowledge-base of previous similar projects: A knowledge-base would facilitate an effective management process, comprehensive analysis and prompt decision making through computerized knowledge-based decision support system. Besides, Cox [33] listed the most important method to control of variation order such as written approvals in construction stage, comprehensive documentation of variation order documentation of variation orders and claims had assisted in tracking the effects of the variation and claim events on time and cost and selection of the appropriate
contract form with the necessary and unambiguous variation clauses in design stage would be helpful in the management of variation orders.

Mokhtar et al [23] identified that the most important methods to control of variation order such as clarity of variation order procedures in construction stage is an integral part of effective management of variation orders, use of project scheduling/management techniques in construction stage, and utilize work breakdown structure, Ibbs et al. (2001) listed the most important methods to control of variation order are clarity of variation order procedures in construction stage would help in reducing the processing time and other mishandling issues, a well defined scope can assist the professional team in recognizing and planning, variation logic and justification for implementation, involvement of the owner during the construction phase, valuation of indirect effects it is essential to acknowledge, and finally knowledge-base of previous similar projects, Arain et al. [15] suggested that, involvement of professionals in design stage, contractor at planning and scheduling , and project manager from an independent firm as the most important methods to control of variation order

Al-Jishi and Al-Marzoug [35] said that contractors have utilized the following controls to minimize the impact of change orders clarity of scope of work of the change order, negotiation of change orders by knowledgeable people, appropriate approval in writing, early setting of change order procedures, and review of design changes for feasibility before approval.

Alnuaimi, et al. [20] identified that the most important remedies for Change Orders are a standard document should be developed to establish the stages/steps from the start of the project until completion and close out, a common learning database system should be shared among all governmental units, a specialized quantity surveyor/cost controller and project manager should be assigned to large construction projects, no design engineer shall be allowed to practice without having a professional license, permanent standards shall cover all construction regulations and permits required for construction projects in Oman, general conditions should be reviewed and updated, construction procedure manual should be established and implemented

4. Research Methodologies

Three research methodologies were used in this study to achieve the research objectives. These methodologies are 1) Literature review that discussed the theoretical background of this researches and studied the factors causing variation orders and how to manage its impact.2) Studying UNRWA contract clause under General Conditions (GC) that deal with the variation orders and the administrative actions in managing such variation order in construction projects 3) while the third method was introducing three case studies in UNRWA construction and infrastructure projects that show the causes of VO and how they were managed. Data analysis was used in these cases to give better understanding and tangible benefits in this research area. While the general framework of this research is a case study, Naoum [36] explained that case studies are used when the researcher intends to support the argument by an in-depth analysis of a person, a group of persons, an organization or a particular project. Moreover, it provides an in-depth analysis of a specific problem. There are three types of case study designs: 1) the
descriptive case study which is similar to the concept of the descriptive survey (i.e. counting), except it is applied on detailed case(s). 2) the analytical case study which is similar to the concept of the analytical survey and 3) the explanatory case study which is the theoretical approach to the problem. It explains causality and tries to show linkages among the objects of the study. It also suggests that a single cause can have a specific effect. In other words, the researcher collects facts and studies the relationship of one set of facts to another, with the hope of finding some causal relationship between them.

5. UNRWA CONTRACT CONDITIONS

At this section an introduction showing how UNRWA contract conditions manages the occurrence of variation order in the construction projects implemented by UNRWA. UNRWA contract conditions were set out since 1968. These general conditions include 25 articles that manage the relationship between the contractor and the client (UNRWA) once signing the contract. Article 7 in UNRWA building contract [37] is the one that deal with the variation order observance and how to manage the relationship with the contractor in case of its occurrence. Article 7 in UNRWA General Conditions states that:

5.1 UNRWA CONTRACT CONDITIONS: ARTICLE 7.VARIATIONS

(a) The total cost of the works as shown in the drawings and Bills of Quantities shall not be deviated from to and extent exceeding twenty-five per centum (25%), except by agreement with the Contractor.

(b) No variations shall be made by the Contractor until and unless he is so authorized by the Director or works in writing, and no claims for such varieties shall be considered as valid unless the said authorization is produced by the Contractor.

(c) Variations made by the AGENCY to the Drawings and Bills of Quantities requiring additional work or reducing the amount of work shall be governed by the provisions of this Contract just as if they were embodied in the original Drawings and Bills of Quantities.

(d) 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 Bills of Quantities shall not be considered variations.

(e) 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 Bills of Quantities and be mutually agreed between the contractor and the director of dorks and shall be confirmed in writing before the work is commenced. In the event these parties fail to agree upon a rate the AGENCY reserves the right to order the work to be carried out in any way it shall deem fit.

(f) In the event the AGENCY 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.

(g) 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.

6. CASE STUDIES: HOW VARIATION ORDER BE MANAGED

Three cases will be presented as cases showing the occurrence of variation order in UNRWA construction projects and it were managed and documented. These cases were compared with the previous researches and UNRWA contract conditions to illustrate at which level these cases were managed.

CASE1: Removal of debris from residential buildings in the Gaza Strip

This case was issued in December 2009 to remove debris from residential buildings in Gaza Strip damaged by the bombardments of December 2008/January 2009 and from previous military incursions within Gaza Strip Camps. The original contract had the same scope of works with the same requirements. This VO was issued by the technical department which is Special Environment Health Program (SEHP). The purpose of this VO was to save time, costs and efforts required in the tendering process as the contractors may add new costs of transportation of machinery and equipment needed for rubble removal. Table 1 summarizes the main information of the original contract and the current variation Order.

Table1: comparison between the original contract and the current variation Order

<table>
<thead>
<tr>
<th>I. Original Construction Contract: Background</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Original Project/Contract</td>
<td>Removal of debris from residential buildings in the Gaza Strip ( Kh-Younis and Rafah Camps)</td>
</tr>
<tr>
<td>Original Contract Amount (excluding contingency)</td>
<td>$ 327,701.0</td>
</tr>
<tr>
<td>Contingencies ($) in the Original Contract Proposal</td>
<td>0.0</td>
</tr>
<tr>
<td>Issuing date of the VO</td>
<td>22 December 2009</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Variation Orders: Background</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of V.O before this one</td>
<td>No</td>
</tr>
<tr>
<td>Number of this VO (Amendment no.)</td>
<td>1/2009</td>
</tr>
<tr>
<td>Purpose of this VO</td>
<td>This V.O is intended to remove debris from additional residential buildings damaged by bombardment of December 2008/January 2009</td>
</tr>
<tr>
<td>Amount of this V.O</td>
<td>$ 148,363.00</td>
</tr>
<tr>
<td>Percentage of the V.O to the original Contractual amount %</td>
<td>45.27%</td>
</tr>
</tbody>
</table>

This variation order brought the aggregated percentage of the value in the varied works relative to the original contract amount to + 45.27% which is greater than the 25% limit of variation beyond which an agreement with the contractor is needed (as stated in UNRWA contract condition clause, Article 7)[37]. At this variation order, a new
agreement was signed with the contractor with new prices to implement this work although it is relevant to the original contract. The reason because of the additional amount was more than 25% of the contract as stated in Para. (a) in Article 7 Which indicates that “The total cost of the works as shown in the Drawings and Bills of Quantities shall not be deviated from to and extent exceeding twenty-five per centum (25%), except by agreement with the Contractor”.

CASE 2: Maintenance of drainage system at beach Camp, Phase II

This VO was issued in March 2010 to rehabilitate asphalt road that was damaged because of the heavy rains which made collapse of soil underneath the existing asphalt road. Table 2 summarizes the main information of the original contract and the current variation Order.

Table2: comparison between the original contract and the current variation Order

<table>
<thead>
<tr>
<th>I. Original Construction Contract: Background</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of Original Project/Contract</td>
<td>Maintenance of drainage system at beach Camp, Phase II</td>
</tr>
<tr>
<td>Original Contract Amount (excluding contingency)</td>
<td>$ 50,336.00</td>
</tr>
<tr>
<td>Contingencies ($) in the Original Contract Proposal</td>
<td>$ 2,516.80</td>
</tr>
<tr>
<td>Issuing date of the VO</td>
<td>11 March 2010</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Variation Orders: Background</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of VO before this</td>
<td>No</td>
</tr>
<tr>
<td>The number of this VO (Amendment no.)</td>
<td>1/2010</td>
</tr>
<tr>
<td>Amount of this VO</td>
<td>$ 1,500.00</td>
</tr>
<tr>
<td>Percentage of the VO to the original Contractual amount %</td>
<td>2.98%</td>
</tr>
</tbody>
</table>

In this case, the VO was issued as due to non existence of similar item in the original BOQ. In fact, if this item was existed, such work can be implemented and reflected in the interim and final payment. Financially, this VO was covered from the contingency as it is higher than the amount of this VO. The reason for this variation order was one of the external environmental factors which are weather conditions. This result is matched with Wu et al. [16] and Hsieh, et al. [13] who showed the impact of this factor at the probability of variation orders occurrence in construction projects. In addition, utilizing this VO from the contingency was suggested by many researchers such as Alnuaim, et al. [20] who explained that the conventional approach is to include a percentage of the project cost as a contingency in the contract budget for their occurrence.

CASE 3: Construction of Emergency Program Office Building at Gaza Field Office.

The original project was intended to construct a new office building in Gaza Field Office to accommodate the newly formed Emergency Team. The project consisted of three components which were: Bill No. 1 to construct new Offices building (ground, first and second floors), Bill NO.2 to construct a Mosque and Bill NO.3 for external
Works. The project started on 28 Jan 2007 and it was planned to complete this project within 22 weeks.

Due to the imposed closure (siege) at Gaza Strip in the period 2007 till now, the contractor was not able to complete this work as it was planned in 2010, the Israeli side gave the green light to coordinate entering construction raw materials to UNRWA projects which gave a chance to revive all suspended contracts. At this project, nine variation orders were recorded due to many causes some of it related to the external environmental factors such as the imposed siege others related to design modifications, client’s requirements and other causes.

Until the mid of September 2010, approximately 70% of the works was completed as per the original contract and variation orders. Between 3 May 2007 and 5 Nov 2008 there were 8 variation orders issued some of which were partially completed. Due to the closure imposed on the Gaza Strip the work stopped and a suspension agreement was signed between UNRWA and the contractor on 09 Jun 2008. Variation Order No. "9" was raised to complete the remaining works and to add construction of an additional floor (3rd floor) for the office building as requested by the client. This variation order No 9 also cancels and supersedes Variation order No 2 which was not executed due to the closure. The summary of these V.O and the causes for each one is shown in Table 3 which introduces the chronological order of the V.O's issued during the life cycle stages of this project.

From Table 3, it can be observed that the occurrences of the variations in this project were mainly related to client (UNRWA) requirements and needs for some changes and modifications. The huge number of V.O’s in this project that reached nine could be a useful example to show the non stability of the construction industry in the Gaza strip as many factors are in dynamic status. The client requirements, the siege impact and the design errors or non perfectness were observed as main causes of these V.O’s in this project. Around 60% of these factors are related to the clients (Top management decisions and middle management levels). Besides, around 25% of this V.O’s related to design causes while around 15% of these causes were related to the external environmental factors such as siege and closure.
Table 3: Chronological order of the V.O’s issued during the life cycle stages of this project

<table>
<thead>
<tr>
<th>Variation Order (V.O) No</th>
<th>Net Amount of this V.O $</th>
<th>Justification</th>
<th>% of of executed V.O till Sep. 2010</th>
<th>Remarks</th>
<th>Reason for the V.O</th>
</tr>
</thead>
</table>
| V. Order No. 1 3 May 2007 | 3,136.00 | • Due to modification for the dome to change its height from 121cm as contracted to 190cm, it was necessary to change its price.  
• Due to existing of high difference between the F.F. of the offices building and the west road, it was necessary to implement drop manholes.  
• Due to shortage of galv. rain water pipes at local market, it has been necessary to change them to PVC pipes. | 25% | 25% of the work was completed and the last %75 was added to variation order no. “9” | • Design related factors  
• Instability of construction raw materials in the local markets. |
| V. Order No. 2 21 June 2007 | 38,382.35 | • For construction of additional floor (3rd floor) for the offices building at Gaza Field Office, the work in this V.O were not executed due to closure and will be covered by V.O no. “9”. | 0% | Suspension Agreement raised due to closure, the work in this V.O were not executed due to closure and will be covered by V.O no.9 | • Client requirement to add new floor (Top Management Decision). |
| V. Order No. 3 15 July 2007 | 3,068.70 | • Due to amendment of finishing’s of elevations and minaret for the mosque at Gaza Field Office from rendering and painting as specified in the original contract to marine finish.  
• Due to changing the specified aluminum profiles 1088 to profiles 7000 which is more durable and functional, the variation orders has been applied. | 17% | 17% of the work was completed and the last 83% was added to variation order no. “9” | • Design related factors (changing of specifications) |
<p>| V. Order No. 4 15 June 2008 | 33,537.35 | • Decision was taken to implement the absolute essential required works in order to operate the three floors (Ground floor, First floor &amp; Second floor) at new field office building. Taking into consideration the current local market prices for construction materials and using some of the suitable surplus materials remaining out of another UNRWA completed projects. | 100% | All works were completed | • Client requirement to construct the three floors. |</p>
<table>
<thead>
<tr>
<th>V. Order No.</th>
<th>Date</th>
<th>Amount</th>
<th>Description</th>
<th>Completion</th>
<th>Client Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>18 July 2008</td>
<td>10,389.00</td>
<td>It was decided by the client to carry out internal painting &amp; Plumbing works, in order the toilet unit to be operated at the three floors.</td>
<td>100%</td>
<td>All works were completed</td>
</tr>
<tr>
<td>6</td>
<td>10 August 2008</td>
<td>27,612.00</td>
<td>UNRWA administration requested installing air conditioners, it was necessary to implement the electrical works.</td>
<td>100%</td>
<td>All works were completed</td>
</tr>
<tr>
<td>7</td>
<td>17 August 2008</td>
<td>2,216.20</td>
<td>This VO was issued to add partition at second floor and the Kitchen sink including the marble cupboards will be prepared</td>
<td>100%</td>
<td>All works were completed</td>
</tr>
<tr>
<td>8</td>
<td>10 August 2008</td>
<td>3,200.00</td>
<td>This VO was issued upon the request of the building users to fix a multi-look door at the corridor in order to isolate the eastern part of the second floor at new office</td>
<td>100%</td>
<td>All works were completed</td>
</tr>
<tr>
<td>9</td>
<td>05 Nov 2008</td>
<td>Remaining works in the non completed V.O</td>
<td>This V.O was issued to completed the remaining works in all of non completed V.O (from 1-8)</td>
<td>100%</td>
<td>New B.O.Q was issued with a new prices based on the local market to finish all remaining works</td>
</tr>
</tbody>
</table>

From these results it can be concluded that the clients play the main role towards the observance of the V.O’s in the construction projects. These results are matched with Hsieh, et al. [13] who explained that planning and design such as defects, errors and omissions in design and planning, mistaken quantity estimates, planning mistakes, inadequate arrangement of contract interfaces, inconsistency between drawings and site conditions, citation of inadequate specifications are common factors cause V.O in construction projects. Also these results are matched with Hsieh, et al. [13] who illustrated that the user party, during the course of commissioning, may raise requests to modify its requirements for the built facility. If the modification is imperative in terms of safety, functionality and maintainability, a change order will be inevitable and this is the case here. Moreover the results are matched with Wu et al. [16] who showed many factors cause V.O in construction projects such as; project related causes Client-related causes include requirement changes, design related causes include design changes in respond to site conditions, erroneous or incomplete design, information, Insufficient site investigation, prior to design, and Changes in construction method, Contractor related causes include Poor workmanship, and Poor scheduling and External related causes include Legislative or policy changes, Political pressure, natural disaster, expected geological conditions, Local residents, and Other organizations.
7. CONCLUSIONS AND RECOMMENDATIONS

Changes in the construction process are seen as almost impossible to be eliminated. Many researchers used change order, variation order, and amendment to work in the same meaning. The variation order was observed with a negative impact on construction productivity, leading to a decline in labor efficiency and, in some cases, sizeable loss of man hours [2]. The study showed that many factors play a major role to create variation orders in construction projects that related to client, contractors, designers/consultants, external environmental factors such as weather conditions, political situations (siege and closures) and others. Finally, it can be concluded that UNRWA tries to manage the appearance of variation orders in construction projects by different means such as a concise and precise contract clauses (Article 7- Variations) that set out the procedural steps to manage these V.O which means that more attentions and methods should be used to control the V.O in UNRWA projects. Many methodologies and approaches were used to mitigate and minimize the negative impact of variation orders in construction projects such as coordination between, detailed and periodical review for tender documents before issuing it, considering margin of contingencies in order to cover any unforeseen costs, keeping the owner involved during all stages of project life cycle and other methods.

It is concluded that the variation order in the construction projects can be occurred as a result of the following: Increasing the quantities of an existed item that consequently increase the contract value by more than 25%, a need to issue new item that is not existed in the original contract, change of the specifications in the existed item in the contract due to unforeseen conditions or a need to change the scope of work.

It can be concluded that, in general the variation orders in UNRWA project are related to the top management requirements (client’s needs) during or immediately after starting the implementation of the works. Also, it is concluded that many work amendments and changes are requested although no similar or equivalent items are existed in the Original BOQ of the contract. For example, during the construction of school, new retaining wall was needed to protect adjacent buildings. If no similar or equivalent items existed in the original BOQ, the VO is required if the work is still within the same site/location and within the same type/scope of works. Moreover, if the new required works increase or decrease the original contract amount by plus or minus 25%. Under this case a variation order is required in addition to the right of negotiating the new unit prices with contractor (either to keep it or to increase or decrease).

As the design stage plays essential role to controls occurrence variation orders, it is recommended that the professionals should concentrate more on defining the scope of projects, allocating sufficient time for design development and improving design detailing and compliance by adding more risk factors during the itemization process. Because of inadequate communication before design, omissions or misrepresentations in the design, and specifications for defining and dividing job responsibilities among multiple contractors involved in the project, variation orders are often necessary to overcome the appeared communication problems. Coordination and direct communication will not only abolish 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 conflicts in contract documents.
It is recommended to hold training programmers in construction variation management that include all concerned parties such as engineering, procurement and Finance department’s staff in order to increase their awareness regarding the negative impact of variation order occurrence.

UNRWA Engineering and Procurement departments are recommended to identify and analyze the potential cause of the previous variations that were recorded in the construction project. This will enhance and improve lessons learned in managing any future variations in the projects. Learning from these variations is imperative because the professionals can improve and apply their experience in the future.

References


[37] UNRWA building contract (2008), Article 7 in UNRWA General Conditions-Variations- Page (BC/6)