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### VARIATION ORDERS CAUSES IN CONSTRUCTION BUILDINGS PROJECTS IN JORDAN

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#### ABSTRACT

Generally, by review causes and issues related to V.O in construction projects, the aim of this paper is to investigate the real cause of variation orders in its root stage. This paper investigates the most significant causes contribute to the variation orders in the construction of building projects in Jordan, data was collected from questionnaire survey which is based on the literature reviews.

The data were analyzed by using mean score method and rank to formulate the findings. The results from questionnaire survey revealed three most significant causes variation orders which are:

Errors and omission in design delay in completion and increase project cost Change in specification by owners  
The finding concluded that employer us the main originator of the variation orders and suggested that owner should have adequate planning and recourses before initiating a project in order to avoid variation order during the construction stage.

#### INTRODUCTION

In Jordan, as in many countries, contracting is one of the imperative fields of economic growth and developments. Therefore, contracting has taken places that are directed towards enhancing the performance of projects quality.

The Construction Industry in Jordan According to the minister of public works and housing (JCCA 2012), the construction industry in Jordan is a major contributor to the Jordanian Gross Domestic Product (it contributes to about 15% of the Jordanian economy).

The industry is considered one of the key drivers in building a strong local economy. A high level of professionalism and organization characterizes the sector, and it includes 1716 Jordanian contractors graded by expertise and capabilities (OBG, 2011). Assistance is available for specialized and highly qualified staff of engineers and technicians. Materials and expensive equipment/resources, and specifications highlight the scale of the financial investment put into the construction industry. The development of this sector is evident both institutionally and technically, as is the development in other sector of the economy. The construction industry is valued at hundreds of millions of Jordanian dinars per year, consisting of more than a thousand construction companies along with engineering consultancy businesses with over ten thousand engineer's working for them. (Al Awad, 2015)

According to oxford business group, The construction sector saw renewed growth in 2013 with forecasts for continued expansion in 2014. Loans extended in 2013 reached \$5.76billions, accounting for 21.5% of credit to all industries. While housing accounted for the bulk of construction activity, several major real estate and tourism development projects are driving opportunities for large contractors, particularly in the Red Sea port of Aqaba. Meanwhile in the capital, Amman, the downtown area of Abdali has been the focus of major redevelopment projects, including commercial space, retail facilities and residential units at a total investment cost of \$5billions.



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The maximum project performance would be achieved if the work invariably flows smoothly within time limits and anticipated budget. Variation orders result in time delay, cost overrun, quality defects, and other negative impacts. This is common in construction projects. (Enshassi, Arain, & Al-Raei, 2010)

Although construction industry is a major player in the economy, generating both, employment and wealth. However many projects experience extensive delays and thereby exceed initial time and cost estimates. (Sweis, Sweis, Hammad, & Shboul, 2008)

These different types of delays affecting Construction Projects. Delays and cost overruns have significant implications from economic as well as political point of view. Due to delays in project implementation, the people and the economy have to wait for the provisions of public goods and services longer than is necessary. (Sharma, Rahul, & Rao, 2012) in construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. To the owner, delay means loss of revenue through lack of production facilities and rent-able space or a dependence on present facilities. In some cases, to the contractor, delay means higher overhead costs because of longer work period, higher material costs through inflation, and due to labor cost increases. (Assaf & Al-Hejji, 2006) Variation has become so prevalent in construction that it is hardly possible to complete a project without changes to the plans or the construction process itself (Ssegawa et al., 2002). Thus, according to Revay (2002), there will be changes to scope, time, cost and/or quality on most, if not all, construction projects.

Various studies have identified variation orders among the causes of project cost and time overruns, which (according to Sterman, 1992), are endemic problems in international construction. However, the existing literature gives little indication of their contributions to project cost and time overruns. (Jawad, Abdulkader, & Ali, 2009; Oladapo, 2007).

Given this background, the aim of this study is to identify issues on which variation order occur in building projects, factors causing variation order and how variation orders are managed. The study intends also to explore the existing variation order management approaches, and examine their applicability in building projects in Jordan.

The specific objectives are:

1. To identify internal variation orders and their causes that is, variation order among the project participants within the project team
2. To investigate causes and issues related to V.O in construction projects

### Variation order:

variation means any change to the works which is instructed or approved as a variation under clause 13. Most construction projects vary from its original design, many construction projects have inevitably depart from its original tender design, specifications and drawings prepared by the designers. This can be because of technological advancement, statutory changes or enforcement, change in conditions, geological anomalies, non-availability of specified materials, or simply because of the continued development of the design after the contract has been awarded. In large civil engineering projects variations can be very significant, whereas on small building contracts they may be relatively minor.

One of most important studies talked about majoring causes and effects of variation in construction projects of Malaysia

The scope of the study included the projects administrated by Public Work Department,. Average index analysis of the gathered data through survey revealed that: • In Malaysian construction projects, variations are often experienced in Public Work Department projects. , the study concluded that Five most significant causes are unavailability of equipment, poor workmanship, design complexity, change of schedule and impediment to prompt decision making process. • Logistic delays, delay in completion and increase project cost are significant



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effects of variations faced in construction projects. • With Principle Component Analysis (PCA) technique, four components are extracted as Financial and Decision Management; Design and Drawing Issues; Human and Equipment Resource; Client Related Issues. Based on above findings, for minimizing the occurrence of variations in Public Work Department projects, and it recommended that professionals should participate from design phase to assist in clarifying the project objectives and in identifying the noncompliance with their requirements at early stages. Further, consultant must focus on controlling the recurrent change in design; avoid inadequate working drawing details through systematic detailing of the design. (Memon, Rahman, & Hasan, 2014)

*Table 1 variation orders causes according to the authors*

Variation order cause	Author
1) poor workmanship,	(Memon et al., 2014)
2) design complexity,	(Memon et al., 2014)
3) change of schedule and impediment to prompt decision making process.	(Memon et al., 2014)
4) Logistic delays,	(Memon et al., 2014)
5) delay in completion and increase project cost	(Memon et al., 2014)
6) Financial and Decision Management;	(Memon et al., 2014)
7) Design and Drawing Issues;	(Memon et al., 2014) , (Alnuaimi, Taha, Al Mohsin, & Al-Harathi, 2009), (Enshassi et al., 2010)
8) Human and Equipment Resource;	(Memon et al., 2014)
9) Client Related Issues	(Memon et al., 2014)
10. Lack of materials and equipment spare parts due to closure,	(Enshassi et al., 2010), (Memon et al., 2014)

### RESEARCH METHODOLOGY

A research design is the program that guides the investigator in the process of collecting, analyzing, and interpreting observations (Nachmias and Nachmias, 1993:97).

In other words Yin (2003:20-21), considers it as an action plan for getting from here to there. Where here, is regarded as the initial set of questions to be answered, and there, is some set of conclusion about the questions. This research focuses on the understanding of V.O situation in building projects in Jordan. It was aimed to establish a critical issues of V.O and their causes in building projects in Jordan. This part involved three stages:

- i. Problem definition,
- ii. Literature review,
- iii. Questionnaire survey.

in the first stage the causes of excusable and compensable delays were established through existing

Literature on variation orders.

These causes of variation orders were used as a basis of questionnaire.



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In the second stage, a questionnaire set was developed.

The questionnaire was divided into two sections.

Section A is obtain demographic information of the respondent.

Section B was focused on the identified causes of variation orders based on the existing literature on variation orders.

The respondent were asked to rank the significant causes of variation orders based on their working experiences in the construction industry for completed project between year 2010 to 2015 .

The author adopted five points scale of 1-5 for ranking purposes.

To facilitate the analysis the following numerical values were assigned to the respondents ranking:

5 : extremely significant

4: very significant

3: moderately significant

2: slightly significant

1: no significant

The questionnaire were sent to one hundred and fifty construction projects all around the country , random sample was chosen from a listing approximately 436 contracting companies from data registration selected based on information from MOHW , and through personal networking contacts.

### Method of data analyzed

The data was analyzed by using score method that had been adopted from assaf et al (1995) in this method weighting scale of 1 to 5 was adopted in the view of its simplicity and suitability for evaluating each factor , significant based on the respondent own judgment and working experience in the construction industry .

This five point scale is used to calculate the mean score for each factor and element , which is then used to determine the relative ranking of each factor by assigning ranking to mean score , with low mean score assigned low ranks and high scores allocated high ranks .

The mean score (MS) for each factor is computed by n using the following formulas  $MS = \sum((f*s))/N$  .where s is the score given to each factor by respondents and ranges from 1 to 5 in which 1 is not significant and 5 is extremely significant , f is frequency of responses concerning that factor .

### Analyze of survey result

One hundred questionnaires were distributed to the contracting companies, consultants architect, civil / structural engineering, and mechanical and electrical, quantity surveyors.

The organization that has returned the survey questionnaire form was 105.

This gives response rate of 70%

*Table 2 shows the respondent response rate.*

number of questionnaires sent	150
number of questionnaires replied	105
response rate %	70%

Respondent experience has to be taken into account in analyzing the data as this information is the root source of the reliability of the data.



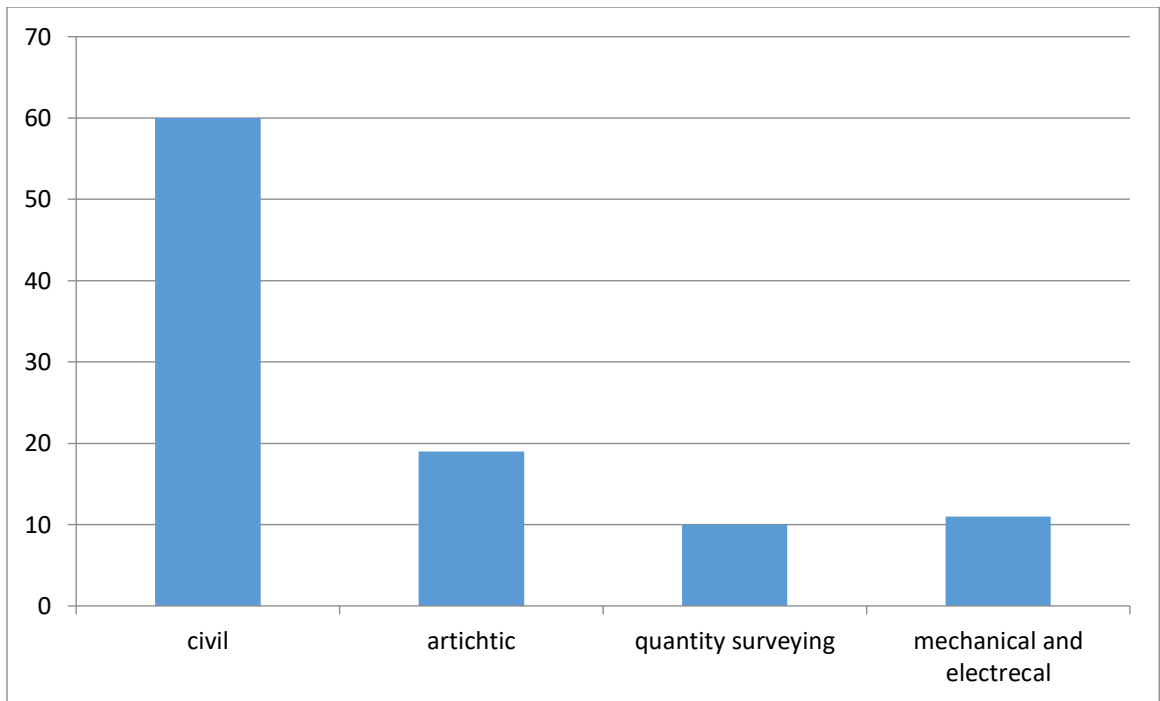
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The profile of the respondents working experience in the construction industry is illustrated in figure 4.

From the data collected it was found that the average experience of respondents was more than 11 years and has been experience working for the project cost more than one million J.D. therefore the information regarding the causes of variation orders is reasonably reliable and falls within the scope of this research .

Respondents profession were also been taken into account in analyzing the data.

From the survey result 60% of the respondents are civil followed by architects engineers (19%) quantity surveyors (10%) and mechanical and electrical engineers (11%) . figure 1 shows the distribution of the respondent various job variation orders .



*Figure 1: the distribution of the respondent various job variation orders..*

### Discussion of the results

Depends on The mean score (MS) it was observed that most of the causes of variation orders were Errors and omission in design This followed by delay in completion and increase project cost in which the respondents ranked this factor as the second most significant factor of the causes of variation order .

Meanwhile Change in specification by owners were ranked the third most significant causes of variation orders and the third rank was Design and Drawing Issues followed by Design and Drawing Issues as the fourth cause of the variation order .

The following is a brief discussion of the causes of variation orders as deducted from table 3.

**Table 3 : Result for significant causes of variation order**

Variation order factors	5	4	3	2	1	mean	rank
Errors and omission in design	28	36	28	7	6	3.70	1
delay in completion and increase project cost	35	36	13	0	21	3.61	2



Change in specification by owners	36	13	28	14	14	3.41	3
Design and Drawing Issues	0	41	64	0	0	3.39	4
Change of plans or scope by owner	28	11	45	14	7	3.37	5
Substitution of material or procedures	7	49	28	15	6	3.34	6
Lack of coordination among project	28	21	28	11	17	3.30	7
Differing site conditions	28	28	10	18	21	3.23	8
Conflicts between contract documents	21	21	25	31	7	3.17	9
Design change originated by owner	28	14	15	41	7	3.14	10
Change in design by engineer or consultant	0	63	7	20	15	3.12	11
Financial and Decision Management	30	5	28	28	14	3.09	12
Demolition and re-work	15	34	14	21	21	3.01	13
Lack of consultant's knowledge of available materials	0	21	70	6	8	2.99	14
Logistic delays	7	34	15	42	7	2.92	15
Human and Equipment Resource	14	29	27	0	35	2.88	16
Contractor desire to improve his financial conditions	14	15	41	14	21	2.88	17

### Errors and omission in design

Errors and omission in design were ranked the most significant causes of variation. This changes result maybe because of insufficient planning and also lack of involvement of consultant during design stage. the example of these changes is the increase of building area , additional fittings , changes in in building façade design and also omission of part of the works.

### Delay in completion and increase project cost

Delay in completion and increase project cost was ranked the second most significant causes of variation order in which 65% of the respondents ranked this as the most significant factor .delay in completion and increase project cost could be due to several factors such as inability of client to make decision on the selection the appropriate type of materials to be used for construction, wether condition and sometimes adding new items to the construction.

The common type of delay in completion and increase project cost is change of wall and flooring finishes, ironmongery, and also painting works.

This type of changes normally results I additional time and claims by the contractor.

### Change in specification by owners

This factor was ranked the third most significant factor causing variation to the contract.

## CONCLUSION

Based on results carried out within the scope stated , several conclusions can be drawn , which may help to improve the time performance and provide a better understanding on the actual causes of variation order in construction building projects in Jordan .

Based on the survey results it was noted that the client related changes is the most significant causes of the variation orders in the construction of building projects in Jordan. generally this finding is similar to several finding from developing countries which have confirm that most of the project abroad face similar problems as the common problems as the changes initiated by the client as the most significant causes of variation orders in the construction of building projects .

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